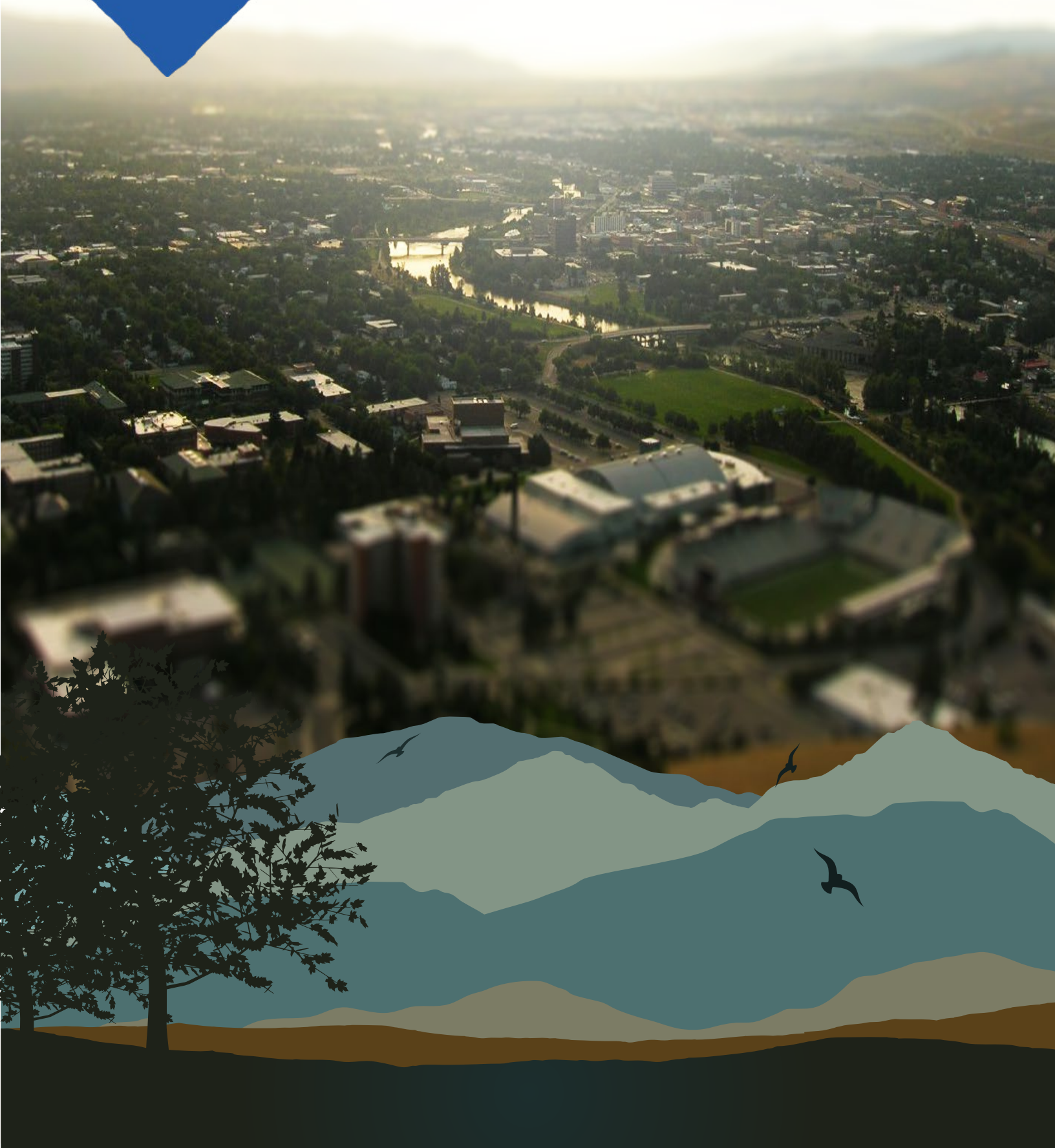
CITY OF MISSOULA

# 2018 Water System Master Plan



# WATER MASTER PLAN PURPOSE

The purpose of the Water System Master Plan (WSMP) is to describe the existing system, define planning criteria and projected water demands, evaluate the existing facilities and infrastructure to identify capacity and operations related needs, identify system deficiencies (including fire flow, storage, and pressure), assess the reliability of the system, prepare a pipeline renewal plan, develop prioritized recommendations for improvement projects and prepare and document a comprehensive Capital Improvement Plan (CIP)

- Provide a description of the Missoula water system, including ownership history, water rights, and infrastructure
- Update and calibrate the hydraulic model of the system
- Prepare a 5-year capital improvement plan
- Identify system deficiencies (fire flow, storage, pressure, etc.) under existing, 5-year, and 20-year growth scenarios
- Complete a feasibility study of the Rattlesnake Wilderness dams

Image credit: Ken Eckert

## GOALS

**Development and Growth**: Implement growth and development strategies and policies that are consistent with other city utilities and provide water infrastructure to support continued sustainable growth in the community.

**Long-term Water Supply and Water Rights**: Evaluate the reliability and resiliency of the water supply, and provide recommendations for long-term water rights and water conservation strategies in alignment with the city's efforts toward sustainability.

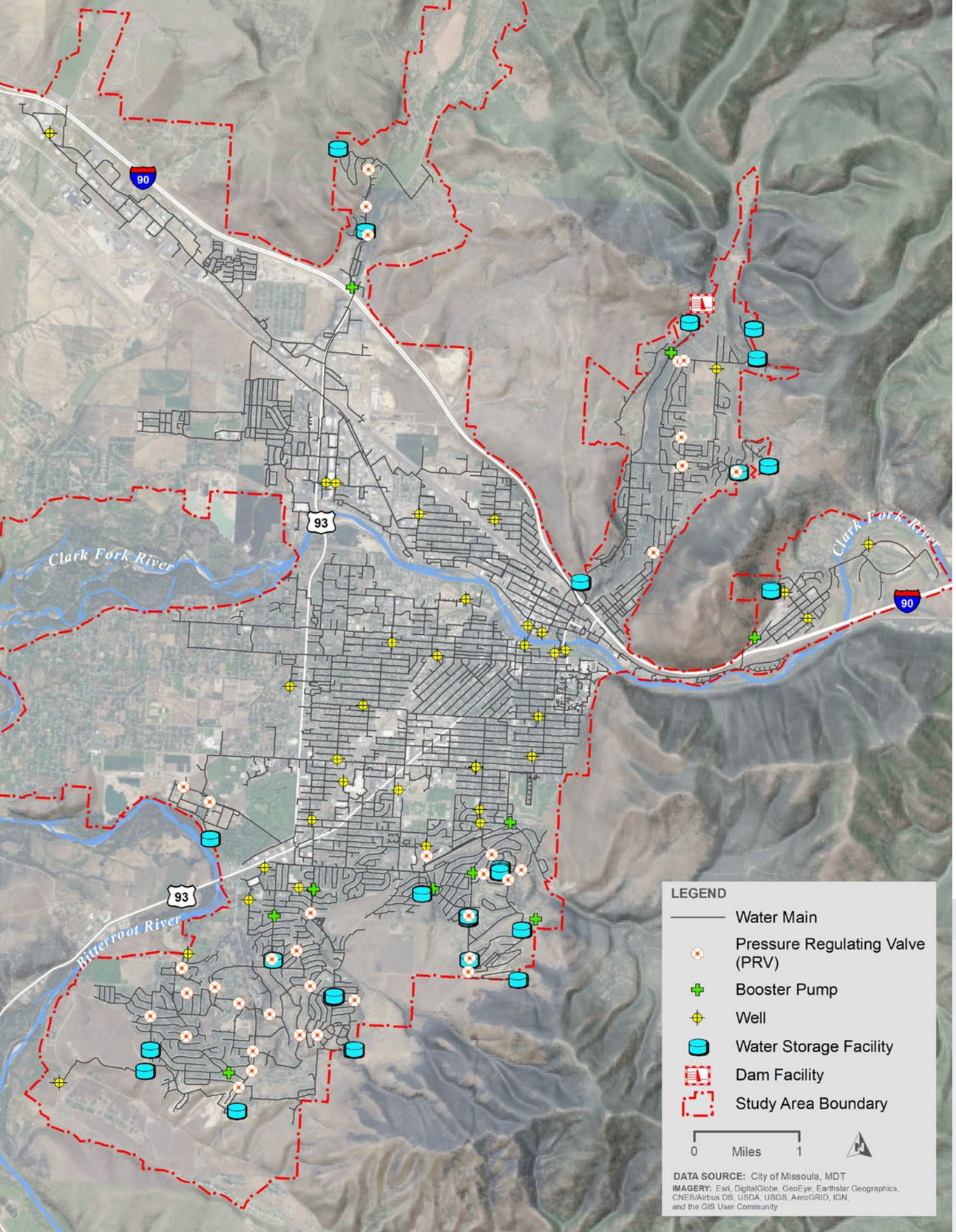
**Water System Leakage Reduction**: Implement industry best practices to evaluate and report on system leakage over time. Implement strategies and policies that will reduce real water loss over time.

**Key Water System Management and Operational Goals**: Maintain or improve the level of service provided to customers, including enhancing city council and customer's knowledge of the water system and programs moving forward.

**Water Quality:** Ensure water quality criteria are met in the short and long-term, and provide adequate protection for the aquifer.

# MISSOULA WATER SYSTEM HISTORY & TIMELINE

| | |
|---|---|
| 1860s | Early Missoula settlers use water from Rattlesnake Creek |
| 1860s | Rattlesnake Creek Water Rights filing |
| 1870s | |
| 1885 | Worden and Co. started constructing a water system |
| 1895 | Worden and Co. sold to Missoula Water Works and Milling Co. |
| 1906 | |
| 1911-1923 | Missoula Mercantile bought and renamed: Missoula Water Company |
| 1930 | W.A. Clark bought and renamed: Missoula Light and Water Company |
| 1935 | Rattlesnake Wilderness Dams constructed |
| 1979 | System was purchased by Montana Power Company |
| 1983 | Wells were drilled to augment Rattlesnake Creek supply |
| 1991 | Park Water Company purchased the utility |
| 1999 | Rattlesnake Creek discontinued as water source |
| 2000 | Park Water Company (PWC) acquired Clark Fork Water Company |
| 2001 | PWC acquired Fort Missoula system |
| 2010 | PWC acquired Linda Vista Water Company |
| 2016 | PWC acquired Missoula Water Works system |
| 2017 | Carlyle Group purchased PWC |
| 2018 | Algonquin Power and Utilities Corp. purchased PWC |
| | City of Missoula took ownership of the water utility |
| | Water master planning process completed |




# EXISTING WATER SYSTEM

**101 million gallons per day** of water rights at groundwater locations

**40** Groundwater Wells

**74M** Gallons Per Day Pumped Capacity

**25** Water Storage Facilities

**10.4M** Gallons of Total Storage

**46** Pressure Zones

**36** Pressure Reducer Stations

**22** Booster Stations

**331** Miles of Water Mains

**24,000** Service Connections

**1,450** Fire Hydrants

**73,000** People Served

## METERED WATER USE IN SURROUNDING AREAS gallons per capita per day

| Bozeman MT | Missoula MT | Rapid City SD | Miles City MT | Helena MT | Billings MT |
|---|---|---|---|---|---|
| **113** 2015 | **140** 2017 | **147** 2017 | **150** 2010 | **170** 2010 | **181** 2018 |

# EVALUATING THE WATER SYSTEM

### STORAGE
Are water storage requirements being met? What new storage will be required in the future?

### PRESSURE
Are there areas of the system where pressure is too low or too high?

### FIRE FLOW
What are the required fire flows and are they being met?

### SUPPLY
When and where does the system start to run short on water supply?

### WATER RIGHTS
What changes should be made to existing water rights? Will new rights be needed in the future? What about mitigation?

### WATER LOSS
What factors are present that lead to water loss in the system? And what can we do to reduce water loss?

### WATER QUALITY
What are the risks to water quality? What are the implications of current and future regulations?

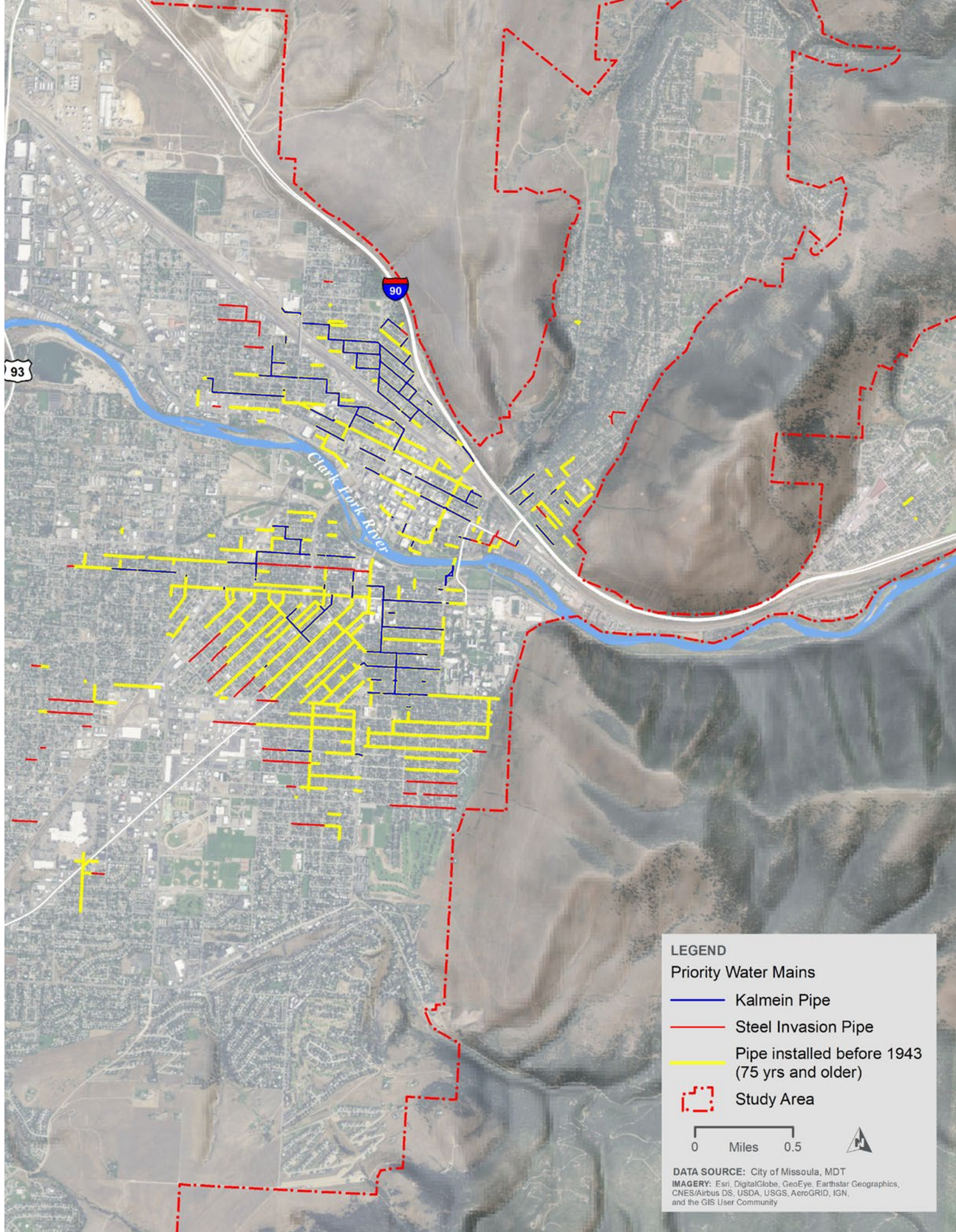
### RISK & RELIABILITY
Is there sufficient back up power? How do we increase system reliability and resilience?

## WATER MAIN REHABILITATION AND REPLACEMENT

Image Credit: Gordon McLean (CC-NC-BY-2.0)

Water mains are ranked based on a number of criteria that represent the likelihood and consequence of failure including number and location of leaks, pipe type, pipe age, pipe size, soil conditions, and community impacts.

The map to the right shows the water mains targeted for rehabilitation or replacement including steel invasion, kalamein, and pipes that are 75 years or older.



# RATTLESNAKE WILDERNESS DAMS

## TIMELINE

**1911-1923**

**10 dams built on 8 lakes in present-day Rattlesnake Wilderness Area to augment water supply for City of Missoula**

**1983**

**City discontinued use of Rattlesnake Creek for water supply, maintained for emergency backup supply**

**2017**

**City acquired dams and water rights from Mountain Water Company**

Originally built to augment water supply for the City of Missoula, these approximately 100-year old structures are approaching the end of their useful life. While it's difficult to predict when serious symptoms related to dam safety may appear, they would be inevitable in the future. Therefore, several options were evaluated for the dams including taking no action, rehabilitation, increasing storage, and decommissioning.

Those options were examined in terms of capital costs, life cycle costs, water rights, climate change, long-term community needs, regulatory agency requirements and goals, and environmental impacts.

## CONSIDERATIONS

**Preserve the Water Supply for Emergency Backup:** The Rattlesnake Creek water source has been maintained as an emergency backup supply. It has limited value as a backup drinking water source because there is currently no means for water treatment, so any use of the source would require appropriate precautions.

**Store Water for Late Season Flows in Rattlesnake Creek:** Rattlesnake Creek is critical habitat for Bull Trout, which are a threatened species. Rattlesnake Creek flows are influenced by the snow pack and runoff from the watershed, and the flows diminish in late summer and early fall, often to less than 10 cfs. The dams provide a means to store spring runoff for release later in the season. This may help keep temperatures low as well.

**Wilderness Area Considerations:** As described in this report, the Wilderness Act of 1964 puts very strict limitations on wilderness areas in order to preserve the pristine, quiet, contemplative, and natural settings. Any alternative needs to closely examine the impacts of work and continued operation in a wilderness area.

**Water Rights Seniority:** The City currently holds some of the most senior water rights in the basin at the Rattlesnake Dams. These rights have considerable value to the community and if the dams were decommissioned, those water right may be lost.

## RECOMMENDATIONS

In order to maintain senior water rights, maximize the ability to release late season flows in Rattlesnake Creek for the benefit of fish habitat (specifically bull trout) and recreation, and optimize the cost/benefit of the considerable work required to either decommission or rehabilitate the dams, the following preliminary recommendations have been made.

- A water rights change application process should be started to preserve and move the senior water rights.
- Additional data collection efforts should be started (temperature, flow, survey, etc.), and further engineering work completed to prepare for rehabilitation and decommissioning.
- Continue discussions and coordination with stakeholders engage the public in the process.
- Big Lake Dam, Sanders Lake Dam, and Glacier Lake Dam should be rehabilitated.
- All other dams should be decommissioned.

# PLANNING FOR THE FUTURE

## UPDATING THE MODEL

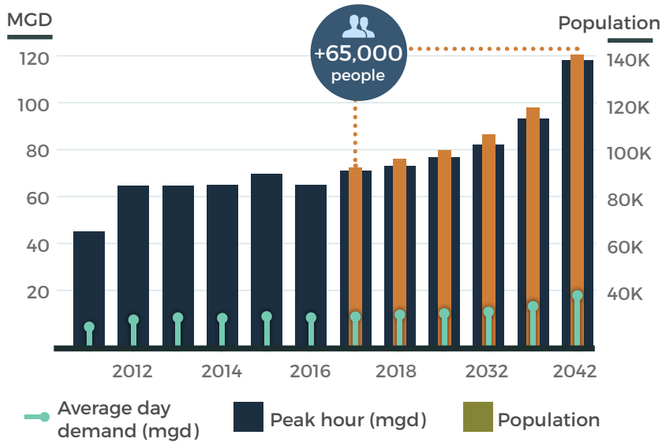
### THE CITY'S HYDRAULIC MODEL

Robust, calibrated, and highly accurate, including all infrastructure and actual customer meter data

### CALIBRATION PROCESS:

Comparing pressures in the model and the field and adjusting pipe roughness.

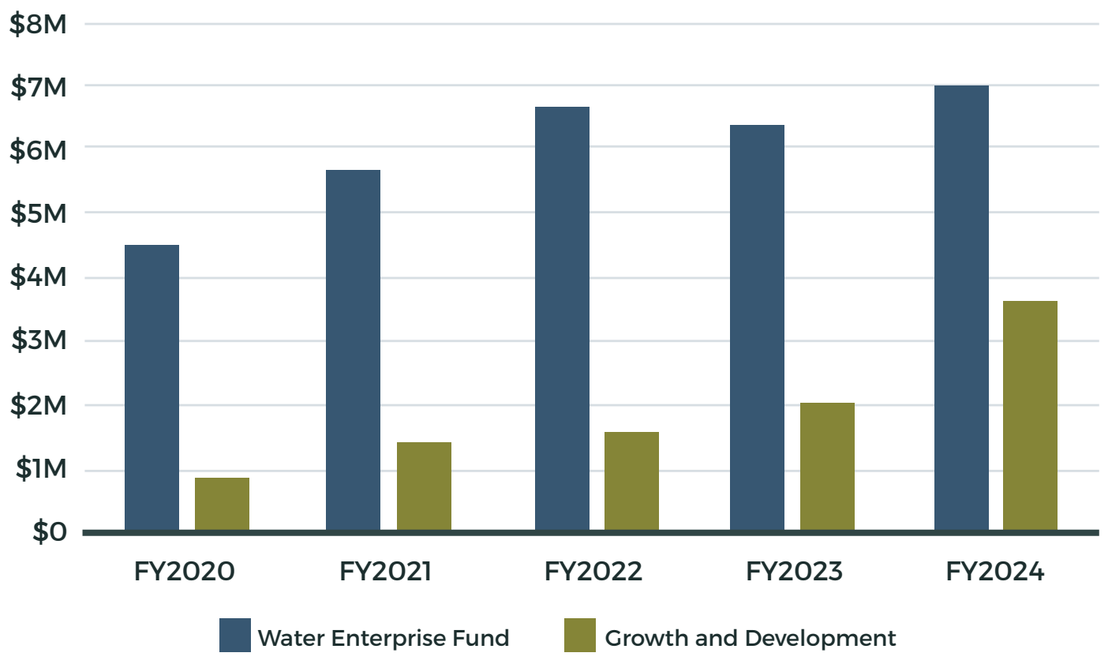
## POPULATION VS. WATER DEMAND




### RESULTING MODEL:

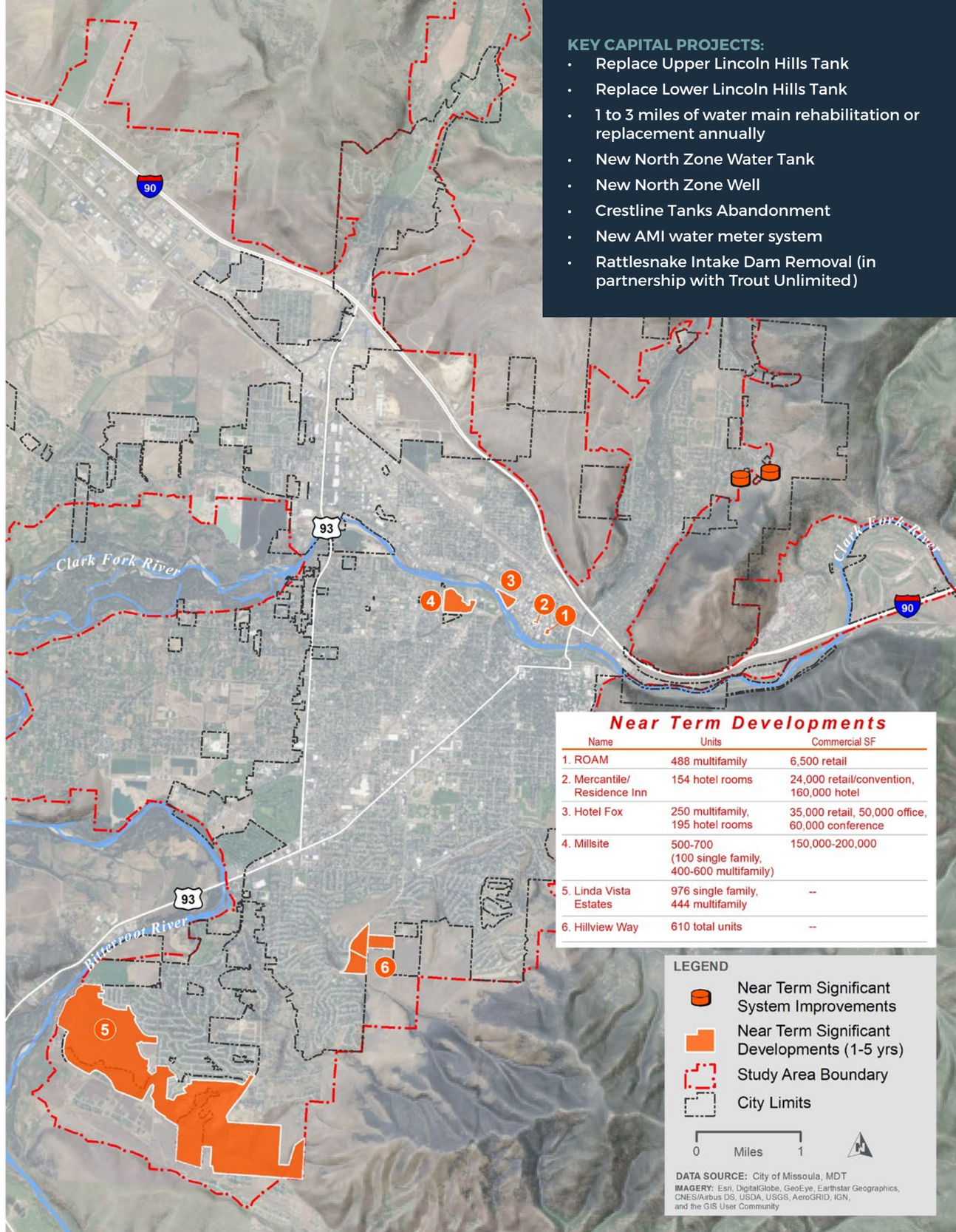
Allows the City to perform simulations to evaluate system storage, fire flows, pressures, and velocities; and model what-if scenarios for new development or capital improvement

## CAPITAL IMPROVEMENT PLAN




### KEY CAPITAL PROJECTS:

- Replace Upper Lincoln Hills Tank
- Replace Lower Lincoln Hills Tank
- 1 to 3 miles of water main rehabilitation or replacement annually
- New North Zone Water Tank
- New North Zone Well
- Crestline Tanks Abandonment
- New AMI water meter system
- Rattlesnake Intake Dam Removal (in partnership with Trout Unlimited)




**Near Term Developments**

| Name | Units | Commercial SF |
|---|---|---|
| 1. ROAM | 488 multifamily | 6,500 retail |
| 2. Mercantile/ Residence Inn | 154 hotel rooms | 24,000 retail/convention, 160,000 hotel |
| 3. Hotel Fox | 250 multifamily, 195 hotel rooms | 35,000 retail, 50,000 office, 60,000 conference |
| 4. Millsite | 500-700 (100 single family, 400-600 multifamily) | 150,000-200,000 |
| 5. Linda Vista Estates | 976 single family, 444 multifamily | -- |
| 6. Hillview Way | 610 total units | -- |

LEGEND

- Near Term Significant System Improvements
- Near Term Significant Developments (1-5 yrs)
- Study Area Boundary
- City Limits

0 Miles 1

DATA SOURCE: City of Missoula, MDT

IMAGERY: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

MISSOULA
City of WATER

Cover image credit: Justin Brockie

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# Chapter 1
# Introduction

2018 Water System Master Plan

*Missoula, MT*

## 1.1 Introduction

The purpose of the Water System Master Plan (WSMP) is to describe the existing system, define planning criteria and projected water demands, evaluate the existing facilities and infrastructure to identify capacity and operations related needs, identify system deficiencies (including fire flow, storage, and pressure), assess the reliability of the system, prepare a pipeline renewal plan, develop prioritized recommendations for improvement projects and prepare and document a comprehensive Capital Improvement Plan (CIP).

In 2017, the City of Missoula took ownership of the water system serving the Missoula area. The system had previously been under private ownership for almost 140 years. In 2018, the City began the development of this Water System Master Plan to lay the groundwork for operational strategies, policies, and specific projects and improvements necessary to provide reliable water utility services in the future.

## 1.2 Project Goals and Objectives

Project goals and objectives were developed through meetings with city staff, city leadership, and key stakeholders. It is important that this master plan align with the City of Missoula Strategic Plan, which includes the overarching goal of remaining financially stable while providing service to the City of Missoula citizens. The City's goal is to make Missoula a sustainable city by succeeding in three areas:

- Fiscal sustainability;
- Harmonious natural and built environment; and
- Quality of life for all people in all places.

These goals have been applied to City of Missoula Public Works Department in the following ways:

- Maintain or improve the level of service provided to the community;
- Engage and encourage staff to develop creative solutions to service delivery and productivity goals and implement selected solutions;
- Establish alternative funding sources for essential Public Works services and research potential new sources annually;
- Structure a method of more effective communications with Council, and subsequently citizens, to improve Council's and citizens' understanding of public works; and
- Continue to research and apply for all grant programs supporting clean air and water and energy conservation supporting the natural environment.

Specific project objectives for this WSMP include the following:

- Growth and Development: Implement growth and development strategies and policies that are consistent with other city utilities and provide water infrastructure and policies (such as water conservation) to support continued sustainable growth in the community;
- Long-term Water Supply and Water Rights: Evaluate the reliability and resiliency of the water supply, including water rights and provide recommendations for long-term water supply and water rights strategies;
- Water System Leakage Reduction: Implement industry best practices to evaluate and report on system leakage over time. Implement strategies and policies that will reduce real water loss over time;
- Key Water System Management and Operational Goals: Maintain or improve the level of service provided to customers, including enhancing city council and customer's knowledge of the water system and programs moving forward; and
- Water Quality: Ensure water quality criteria are met in the short and long-term, and provide adequate protection for the aquifer.

## 1.3 Document Organization

This document is divided into the following chapters:

- Chapter 1 – Introduction
- Chapter 2 – Missoula Water System Overview
- Chapter 3 – Water Demand Forecasting
- Chapter 4 – Water Rights and Regulatory Issues
- Chapter 5 – Water Quality and Regulatory Issues
- Chapter 6 – System Analysis
- Chapter 7 – Condition Assessment
- Chapter 8 – Risk and Reliability Assessment
- Chapter 9 – Rattlesnake Dams Feasibility Study
- Chapter 10 – Capital Improvements Plan

Additional supporting information is provided in the form of Technical Appendices as appropriate.

# Chapter 2
# Water System Overview

2018 Water System Master Plan

*Missoula, Montana*

## 2.1 Introduction

This chapter provides an overview of the existing Missoula water system, including the history and ownership of the system, customers served, and existing infrastructure. In addition, this chapter provides a discussion of management and operations considerations including water service line ownership, water loss, and water conservation.

## 2.2 History of the Water System

The first “water system” in Missoula began with a Native American named “One-Eyed Riley” and his friend hauling water out of Rattlesnake Creek in a donkey cart in the 1860s. In the early 1870s, Worden and Company began construction of a water system that diverted water from Rattlesnake Creek through a system of wooden pipes to a small, covered reservoir on Water Works Hill. From the reservoir to town, the system consisted of pine logs 12 feet long and one foot in diameter through which 2-inch holes were bored lengthwise with an auger operated by power from a treadmill driven by two horses. In 1901, the Rattlesnake Intake Dam was built along with a 3-million-gallon settling basin.

**Figure 2-1. Drilling South Ave. Well 1935**

Between 1911 and 1923, 10 dams were built on eight high mountain lakes in the present-day Rattlesnake Wilderness Area to augment water supply for the city of Missoula.

Rattlesnake Creek provided water to the entire customer base until 1935 when five wells were added to augment summer and fall demands. The Rattlesnake watershed via Rattlesnake Creek was used until 1983, when a *Giardia* problem arose and its use was discontinued.

### 2.2.1 Ownership

In 1885, Worden and Company sold the water system to Missoula Water Works and Milling Company. In 1895, the Missoula Mercantile bought the system and renamed it the Missoula Water Company. In 1906, W.A. Clark purchased the Missoula Water Company, which he combined with other holdings. In that same year, he legally changed the name to the Missoula Light and Water Company, which was subsequently purchased by the Montana Power Company in 1930.

In 1979, Montana Power Company sold the utility to Park Water Company (PWC) and with the approval of the Montana Public Service Commission (PSC); PWC set up Mountain Water Company (MWC) as a wholly owned subsidiary in Missoula, Montana. Over the years, MWC purchased several private water companies in the community as shown on Figure 2-2 including the Clark Fork Water Company in 1991, the Fort Missoula system in 1999, the Linda Vista Water Company in 2000, and the Missoula Water Works system in 2001.

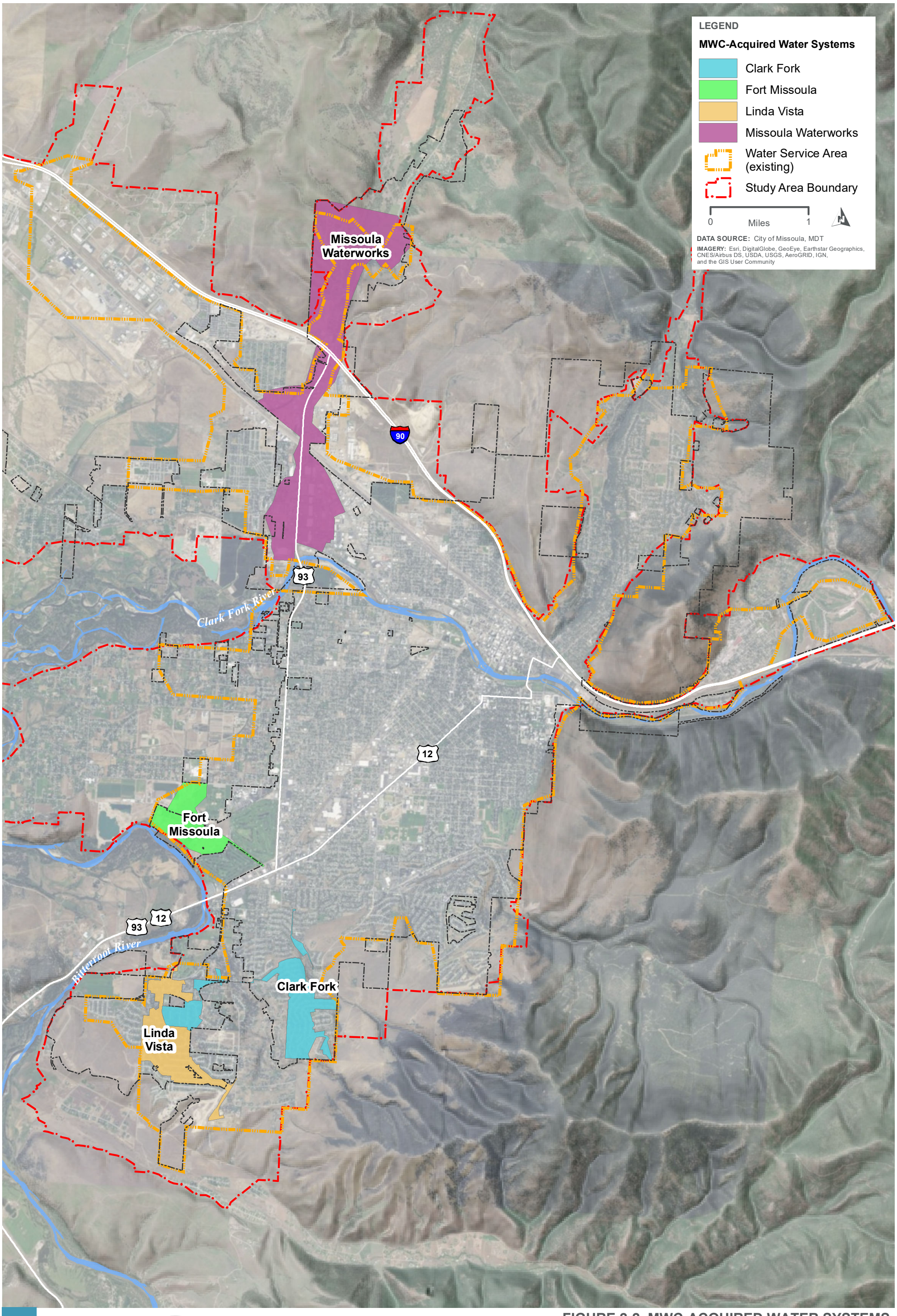
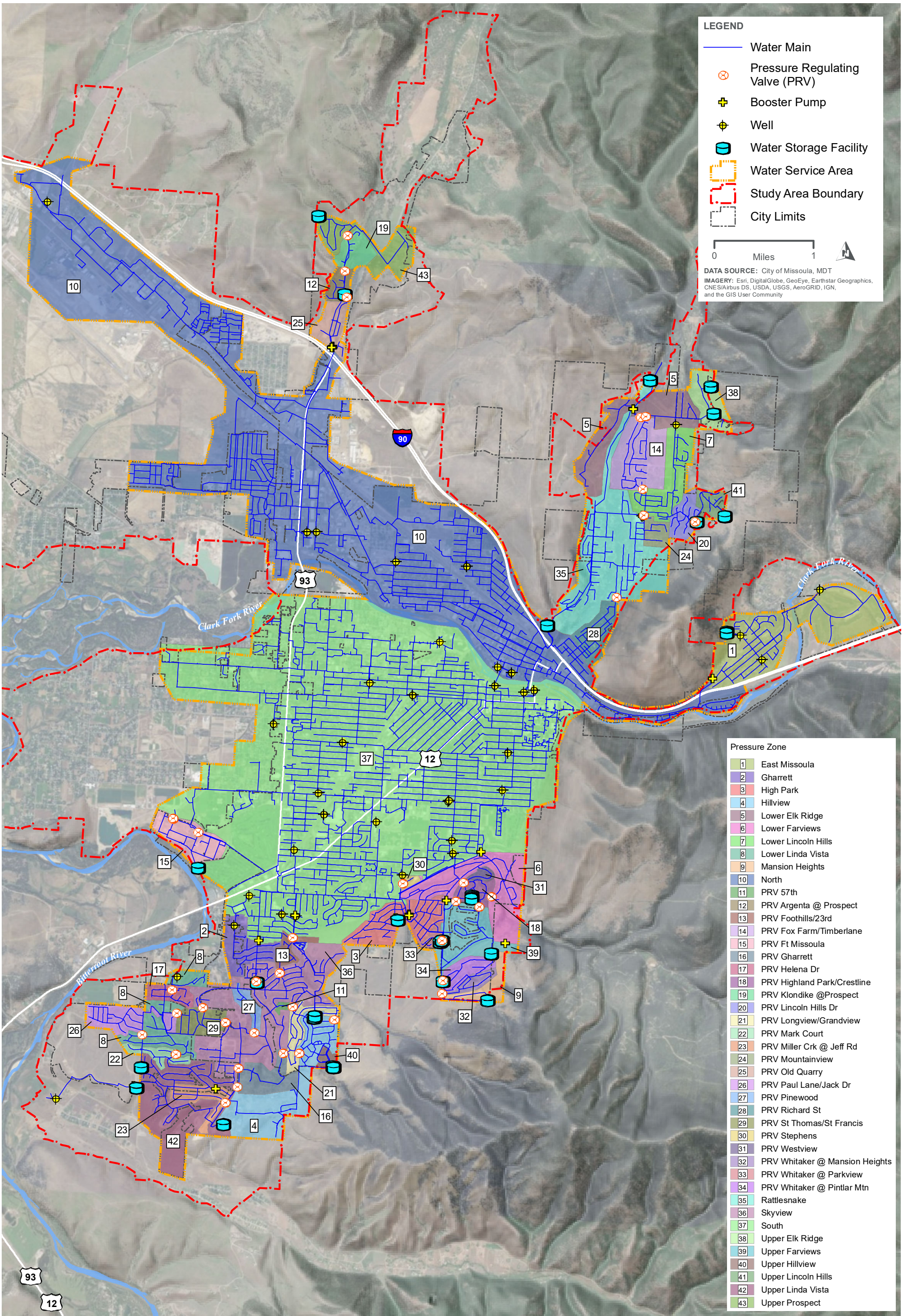



FIGURE 2-2 MWC-ACQUIRED WATER SYSTEMS

In 2010, the Carlyle Group purchased PWC and in 2016, it sold PWC to Algonquin Power and Utilities Corporation. In 2014, the City of Missoula filed a condemnation lawsuit exercising its powers of eminent domain to take over ownership of the water utility, and in June 2017, the City took possession of the water system. The major components of the water system include the following and are shown on Figure 2-3:

- 40 active groundwater wells
- 25 storage tanks or reservoirs
- 22 booster stations
- 36 pressure reducing valve stations
- 337 miles of water mains
- Approximately 20,000 metered and 3,500 unmetered customers
- 10 dams in the Rattlesnake Wilderness Area
- Supervisory control and data acquisition (SCADA) system
- 46 pressure zones
- 1,451 city owned fire hydrants




# FIGURE 2-3 WATER INFRASTRUCTURE OVERVIEW

# 2.3 Water System Description

## 2.3.1 Service Area and Customer Connections

### Service Area

The Missoula water system serves a population of about 73,000 via almost 24,000 service connections. This includes most of the City of Missoula and East Missoula. The overall capacity of the water system is about 74 million gallons per day (mgd), or 56 mgd with the largest well out of service in each storage zone.

There are two main service areas in the city, the north zone and the south zone, which are separated by the Clark Fork River (original river crossing shown in Figure 2-4). Customers on the north side of the river are served by wells in the north service area, and customers on the south side of the river are served by wells in the south service area. Customers in East Missoula (a small, single-zone service area on the north side of the river), are served by two wells in East Missoula and through a main and booster station connection to the north service area during periods of high demand. The north and south service areas are connected through three large water mains that cross the Clark Fork River.

**Figure 2-4. River Crossing, Original Construction Photo, 1923**

### Customer Connections

The active service connections in the Missoula water system serve residential, business, public authority and irrigation (Table 2-1). As shown, approximately 85% of these customers are served through metered connections. The unmetered or flat rate connections decrease annually as customers switch to meters, as shown in Figure 2-5.

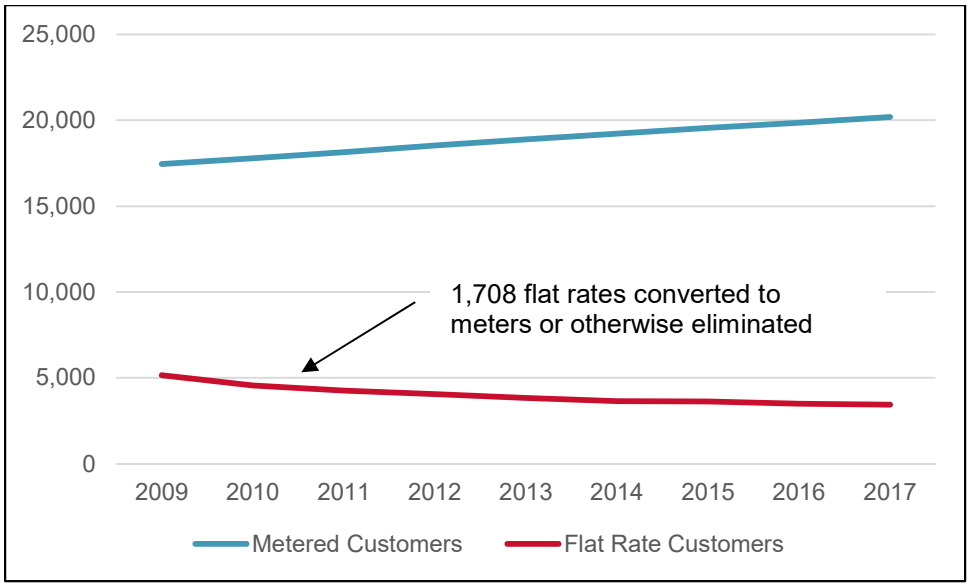



**Figure 2-5. Metered and Flat Rate Customers**

## 2.3.2 Supply

### Missoula Aquifer

The Missoula aquifer is the primary drinking water source in Missoula and the U.S. Environmental Protection Agency (EPA) designated it as a sole-source aquifer in 1988.

The Missoula aquifer is composed primarily of a 100 to 150 foot thick sequence of sand, gravel, and cobbles that were deposited as a result of the glacial Lake Missoula flooding about 12,000 to 20,000 years ago. Groundwater generally flows from east to west and the Clark Fork River leaks water to the aquifer in the eastern portion of the valley and gains water from the aquifer in the west. Groundwater models indicate that about 232,000 acre-feet per year of water flow into and out of the aquifer with hydraulic conductivities ranging from 6,150 to 18,000 feet per day[1].

Although the aquifer is extremely prolific, it is susceptible to contamination from the surface because it is unconfined and lacks a continuous overlying protective geologic unit.[1] However, the overall risk of contamination, particularly to the entire water supply, is low.

The aquifer is a reliable source of water since groundwater is not as susceptible to dry periods or prolonged drought, as is surface water. The City has static water level data from various wells in the system dating back to 1975, and the data shows that static levels have not decreased over time. Water withdrawal (e.g., groundwater pumping) from the aquifer is regulated by the State through the issuance of water rights to water purveyors and land owners in the watershed to protect against over-pumping the groundwater source.

[1] Ross D. Miller, "Numerical flow model of the Missoula aquifer: interpretation of aquifer properties and river interaction." (1991). *Theses, Dissertations, Professional Papers*. Paper 7639.

Table 2-1. Number and Classification of Customer Connections in the Missoula Water System

| Classification | Number of Customer Connections | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| **Metered** | | | | | | | | | |
| Residential | 13,501 | 13,772 | 14,074 | 14,357 | 14,627 | 14,894 | 15,129 | 15,389 | 15,683 |
| Business | 3,319 | 3,375 | 3,420 | 3,494 | 3,546 | 3,587 | 3,667 | 3,693 | 3,735 |
| Public authority | 64 | 65 | 62 | 61 | 61 | 61 | 61 | 61 | 60 |
| Irrigation | 560 | 574 | 590 | 610 | 652 | 673 | 690 | 702 | 705 |
| Total metered | 17,444 | 17,786 | 18,146 | 18,522 | 18,886 | 19,215 | 19,547 | 19,845 | 20,183 |
| **Unmetered** | | | | | | | | | |
| Residential | 5,030 | 4,423 | 4,133 | 3,921 | 3,734 | 3,554 | 3,298 | 3,180 | 3,367 |
| Business | 130 | 119 | 114 | 108 | 102 | 95 | 86 | 84 | 84 |
| Public authority | | 29 | 23 | 22 | 3 | 3 | 1 | 1 | 1 |
| Irrigation | | | | | | | 242 | 232 | |
| Total unmetered | 5,160 | 4,571 | 4,270 | 4,051 | 3,839 | 3,652 | 3,627 | 3,497 | 3,452 |
| **Total connections** | **22,604** | **22,357** | **22,416** | **22,573** | **22,725** | **22,867** | **23,174** | **23,342** | **23,635** |

Source: City of Missoula billing data by calendar year.

## Existing Water Rights

The City holds water rights from the Montana Department of Natural Resources and Conservation (DNRC) for surface and groundwater sources for municipal use. These water rights are within sub-basin 76M, the Lower Clark Fork Basin, and sub-basin 76H of the Bitterroot Basin, as summarized in Table 2-2. These water rights are all for a municipal purpose of use. These rights include existing groundwater rights and surface water rights transferred to groundwater diversion points.

In 1903, the water system owners obtained rights to a full 55.8 cubic feet per second (cfs) of flow from Rattlesnake Creek for municipal supply. The surface water supply was managed under storage rights to operate eight lakes in the Rattlesnake Wilderness Area upstream of the diversion point to maintain the flow of 55-cfs flow rights and 40,352 acre-feet storage rights.

MWC completed a change authorization with Montana DNRC to transfer the senior surface water rights in Rattlesnake Creek as indirect use from eight production wells, but the ability to use them as surface water rights was also maintained.

The City holds water rights for over 70,186 gallons per minute (gpm). This is equivalent to 156 cubic feet per second (cfs) or 101 million gallons per day (mgd) at groundwater well locations.

**Table 2-2. Water Rights Summary**

| Water Right | Water Right Type | Priority Date | Source Name | Claimed Flow Rate | Claimed Volume (AF) |
|---|---|---|---|---|---|
| 76H 10179 00 | STATEMENT OF CLAIM | 6/1/1877 | MILLER CREEK | 364.65 GPM | |
| 76H 10180 00 | STATEMENT OF CLAIM | 9/1/1878 | MILLER CREEK | 1.25 CFS | |
| 76H 10181 00 | STATEMENT OF CLAIM | 10/20/1883 | MILLER CREEK | 1.23 CFS | |
| 76H 10182 00 | STATEMENT OF CLAIM | 6/7/1878 M | MILLER CREEK | 1.06 CFS | |
| 76H 105162 00 | STATEMENT OF CLAIM | 6/1/1877 | MILLER CREEK | 4.19 CFS | |
| 76H 105163 00 | STATEMENT OF CLAIM | 6/7/1878 | MILLER CREEK | 5.19 CFS | |
| 76H 105164 00 | STATEMENT OF CLAIM | 9/1/1878 | MILLER CREEK | 6.25 CFS | |
| 76H 105165 00 | STATEMENT OF CLAIM | 5/1/1889 | MILLER CREEK | 1.25 CFS | |
| 76H 107536 00 | STATEMENT OF CLAIM | 12/18/1973 | GROUNDWATER | 3,998 GPM | 6449.2 |
| 76H 14489 00 | PROVISIONAL PERMIT | 8/5/1977 | GROUNDWATER | 2,500 GPM | 4032 |
| 76H 214431 00 | STATEMENT OF CLAIM | 6/30/1973 | MILLER CREEK | 13.2 CFS | |
| 76H 22285 00 | GROUNDWATER CERTIFICATE | 4/6/1979 | GROUNDWATER | 90 GPM | 13.2 |
| 76H 26360 00 | STATEMENT OF CLAIM | 8/5/1981 | GROUNDWATER | 1,000 GPM | 1613 |
| 76H 30063539 | PROVISIONAL PERMIT | 6/28/2012 | GROUNDWATER | 2,000 GPM | 622.9 |
| 76H 35167 00 | 62-73 GW RECORD | 8/5/1981 | GROUNDWATER | 1,200 GPM | |
| 76H 40149 00 | STATEMENT OF CLAIM | 5/31/1955 | GROUNDWATER | 1,000 GPM | 1613 |
| 76H 40155 00 | STATEMENT OF CLAIM | 3/10/1967 | GROUNDWATER | 1,000 GPM | 1613 |
| 76H 40156 00 | STATEMENT OF CLAIM | 8/28/1968 | GROUNDWATER | 1,000 GPM | 1613 |

| Water Right | Water Right Type | Priority Date | Source Name | Claimed Flow Rate | Claimed Volume (AF) |
|---|---|---|---|---|---|
| 76H 40164 00 | STATEMENT OF CLAIM | 9/27/1972 | GROUNDWATER | 1,000 GPM | 1613 |
| 76H 40166 00 | STATEMENT OF CLAIM | 9/24/1973 | GROUNDWATER | 1,000 GPM | 1613 |
| 76H 67585 00 | PROVISIONAL PERMIT | 1/25/1988 | GROUNDWATER | 500 GPM | 350 |
| 76H 70436 00 | PROVISIONAL PERMIT | 4/5/1989 | GROUNDWATER | 3,800 GPM | 500 |
| 76H 77270 00 | PROVISIONAL PERMIT | 3/29/1991 | GROUNDWATER | 455 GPM | 341.32 |
| 76H 96947 00 | PROVISIONAL PERMIT | 1/26/1996 | GROUNDWATER | 175 GPM | 120 |
| 76M 10378 00 | PROVISIONAL PERMIT | 11/12/1976 | GROUNDWATER | 6.68 CFS | 4839 |
| 76M 108816 00 | STATEMENT OF CLAIM | 1/16/1963 | GROUNDWATER | 2,440 GPM | 296 |
| 76M 23029 00 | PROVISIONAL PERMIT | 6/6/1979 | GROUNDWATER | 1,200 GPM | 1936 |
| 76M 26357 00 | STATEMENT OF CLAIM | 9/24/1973 | GROUNDWATER | 120.00 GPM | 194 |
| 76M 26358 00 | STATEMENT OF CLAIM | 8/30/1919 | RATTLESNAKE CREEK | 2.50 CFS | 300 |
| 76M 26359 00 | STATEMENT OF CLAIM | 12/28/1972 | GROUNDWATER | 33 GPM | 53.37 |
| 76M 26361 00 | STATEMENT OF CLAIM | 8/30/1919 | RATTLESNAKE CREEK | 7.54 CFS | 905 |
| 76M 26362 00 | STATEMENT OF CLAIM | 8/30/1919 | RATTLESNAKE CREEK | 1.76 CFS | 212 |
| 76M 26363 00 | STATEMENT OF CLAIM | 8/30/1919 | RATTLESNAKE CREEK | 431.00 GPM | 115 |
| 76M 26364 00 | STATEMENT OF CLAIM | 8/30/1919 | RATTLESNAKE CREEK | 5.22 CFS | 623 |
| 76M 26365 00 | STATEMENT OF CLAIM | 11/6/1923 | RATTLESNAKE CREEK | 1.43 CFS | 170 |
| 76M 26366 00 | STATEMENT OF CLAIM | 9/8/1923 | RATTLESNAKE CREEK | 398 GPM | 104 |
| 76M 26367 00 | STATEMENT OF CLAIM | 8/13/1923 | RATTLESNAKE CREEK | 1.64 CFS | 195 |
| 76M 26368 00 | STATEMENT OF CLAIM | 11/21/1968 | GROUNDWATER | 1,000 GPM | 1617.15 |
| 76M 31907 00 | PROVISIONAL PERMIT | 1/22/1981 | GROUNDWATER | 2,440 GPM | 296 |
| 76M 35166 00 | 62-73 GW RECORD | 8/5/1981 | GROUNDWATER | 1,468 GPM | |
| 76M 40143 00 | STATEMENT OF CLAIM | 5/31/1935 | GROUNDWATER | 2.67 CFS | 1937.83 |
| 76M 40144 00 | STATEMENT OF CLAIM | 5/31/1935 | GROUNDWATER | 2.67 CFS | 1937.83 |
| 76M 40145 00 | STATEMENT OF CLAIM | 5/31/1935 | GROUNDWATER | 2.67 CFS | 1937.83 |
| 76M 40146 00 | STATEMENT OF CLAIM | 12/31/1937 | GROUNDWATER | 1.78 CFS | 1291.88 |
| 76M 40147 00 | STATEMENT OF CLAIM | 5/31/1958 | GROUNDWATER | 2.67 CFS | 1937.83 |
| 76M 40148 00 | STATEMENT OF CLAIM | 8/31/1954 | GROUNDWATER | 2.67 CFS | 1937.83 |
| 76M 40150 00 | STATEMENT OF CLAIM | 6/30/1957 | GROUNDWATER | 2.67 CFS | 1937.83 |
| 76M 40151 00 | STATEMENT OF CLAIM | 7/31/1957 | GROUNDWATER | 2.67 CFS | 1937.83 |
| 76M 40152 00 | STATEMENT OF CLAIM | 9/28/1964 | GROUNDWATER | 2.67 CFS | 1937.83 |
| 76M 40153 00 | STATEMENT OF CLAIM | 9/28/1964 | GROUNDWATER | 1.78 CFS | 1291.88 |
| 76M 40154 00 | STATEMENT OF CLAIM | 3/10/1967 | GROUNDWATER | 148 GPM | 239.51 |
| 76M 40157 00 | STATEMENT OF CLAIM | 5/13/1969 | GROUNDWATER | 2.67 CFS | 1937.83 |
| 76M 40158 00 | STATEMENT OF CLAIM | 6/2/1969 G | ROUNDWATER | 2.67 CFS | 1937.83 |

| Water Right | Water Right Type | Priority Date | Source Name | Claimed Flow Rate | Claimed Volume (AF) |
|---|---|---|---|---|---|
| 76M 40159 00 | STATEMENT OF CLAIM | 7/7/1969 G | ROUNDWATER | 2.67 CFS | 1937.83 |
| 76M 40160 00 | STATEMENT OF CLAIM | 12/31/1949 | GROUNDWATER | 2.67 CFS | 1937.83 |
| 76M 40161 00 | STATEMENT OF CLAIM | 7/31/1948 | GROUNDWATER | 305 GPM | 486.67 |
| 76M 40162 00 | STATEMENT OF CLAIM | 3/30/1955 | GROUNDWATER | 1.00 CFS | 725.78 |
| 76M 40163 00 | STATEMENT OF CLAIM | 11/18/1970 | GROUNDWATER | 2.22 CFS | 1611.23 |
| 76M 40165 00 | STATEMENT OF CLAIM | 8/5/1981 | GROUNDWATER | 3.28 CFS | 2380.55 |
| 76M 40170 00 | STATEMENT OF CLAIM | 4/1/1866 | RATTLESNAKE CREEK | 24 CFS | 17164.65 |
| 76M 40171 00 | STATEMENT OF CLAIM | 11/16/1868 | RATTLESNAKE CREEK | 4.00 CFS | 2903.11 |
| 76M 40172 00 | STATEMENT OF CLAIM | 4/1/1871 | RATTLESNAKE CREEK | 153 GPM | 246.38 |
| 76M 40173 00 | STATEMENT OF CLAIM | 5/1/1871 | RATTLESNAKE CREEK | 1.62 CFS | 1175.76 |
| 76M 40174 00 | STATEMENT OF CLAIM | 4/1/1881 | RATTLESNAKE CREEK | 1.16 CFS | 841.9 |
| 76M 40175 00 | STATEMENT OF CLAIM | 5/1/1881 | RATTLESNAKE CREEK | 8.70 CFS | 6314.27 |
| 76M 40176 00 | STATEMENT OF CLAIM | 6/1/1877 | RATTLESNAKE CREEK | 16 CFS | 11706.8 |
| 76M 53867 00 | PROVISIONAL PERMIT | 8/22/1983 | GROUNDWATER | 3,000 GPM | 4838.29 |
| 76M 53868 00 | PROVISIONAL PERMIT | 8/22/1983 | GROUNDWATER | 2,500 GPM | 4031 |
| 76M 53872 00 | PROVISIONAL PERMIT | 8/22/1983 | GROUNDWATER | 3,000 GPM | 4838.29 |
| 76M 5452 00 P | PROVISIONAL PERMIT | 5/7/1975 | GROUNDWATER | 6.68 CFS | 4839 |
| 76M 5604 00 P | PROVISIONAL PERMIT | 6/3/1975 | GROUNDWATER | 6.68 CFS | 4839 |
| 76M 6616 00 | PROVISIONAL PERMIT | 10/7/1975 | GROUNDWATER | 2,989 GPM | 4821.29 |
| 76M 706 00 | PROVISIONAL PERMIT | 10/15/1973 | GROUNDWATER | 2,000 GPM | 3186 |
| 76M 91259 00 | PROVISIONAL PERMIT | 9/4/1994 | GROUNDWATER | 2,440 GPM | 504 |

## Rattlesnake Lakes

Between 1911 and 1923, ten dams were constructed on eight high mountain lakes in order to augment the city's water supply, which dwindled in late summer and early fall. In the 1930s, Montana Power Company purchased most of the privately held land in the drainage on the west side of Rattlesnake Creek in order to protect the watershed. In 1980, the land was designated as the Rattlesnake Wilderness and National Recreation Area. The Rattlesnake Wilderness dams are listed in Table 2-3.

**Table 2-3. Rattlesnake Wilderness Dams**

| Name of Lake | Permit or Easement [a, b] | Maximum Storage Volume (acre-feet) | Drainage |
|---|---|---|---|
| Big Lake | Easement | 621 | Lake Creek |
| Carter Lake | Permit | 161 | Lake Creek |
| Glacier Lake | Easement | 240 | Wrangle Creek |

Table 2-3. Rattlesnake Wilderness Dams

| Name of Lake | Permit or Easement [a, b] | Maximum Storage Volume (acre-feet) | Drainage |
|---|---|---|---|
| Little Lake | Easement | 298 | Wrangle Creek |
| McKinley Lake | Easement | 168 | Lake Creek |
| Sanders South Lake | Permit | 897 | Wrangle Creek |
| Sanders North Lake | Easement | 897 | Wrangle Creek |
| Sheridan East Lake | Permit | 130 | Lake Creek |
| Sheridan West Lake | Permit | 130 | Lake Creek |
| Worden Lake | Permit | 70 | Lake Creek |

[a] *Permit* refers to a special-use permit from the U.S. Forest Service, which authorizes specific use of the land for a period of time. The current special-use permit expires in 2036.
[b] *Easement* refers to an easement that was granted from the U.S. Forest Service.

Due to the high elevation and remoteness of the Rattlesnake lakes, construction and maintenance have always presented particular challenges. Over the years, crews and equipment have been brought in via helicopter, airplane, pack animal, snowmobile, snowshoes, skis, and off-road motorcycle. One account from 1956 describes a Ford trimotor airplane dropping 10-foot sections (70 feet total) of 12-inch water main with a parachute attached.

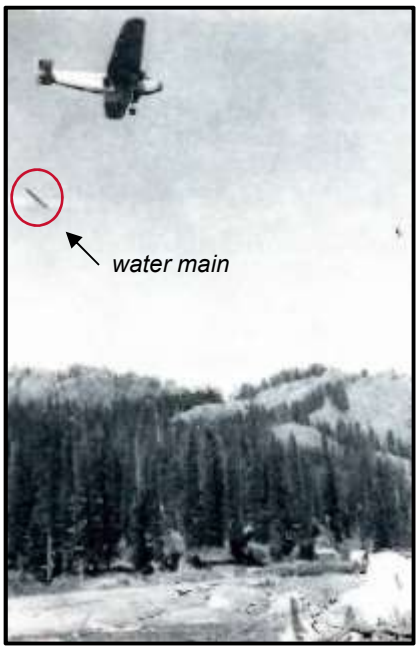



**Figure 2-6. Photo from *Mueller Record*, October 1956.**

In the 1950s, the water superintendent described an April trip that "turned south" when a snowstorm descended and three employees took shelter in one of the cabins near the lakes. They were stranded in the cabin for three days with nothing but black coffee until the weather broke and they were able to hike out.[2] In the late 1970s, a helicopter crash-landed into McKinley Lake; luckily, all those involved were relatively unharmed.

The Rattlesnake Creek portion of the water system was discontinued for daily use after a 1983 *Giardia* outbreak. From 1983 to present, the intake dam, caretaker's house (which has since been demolished), the present-day log cabin, and the Rattlesnake dams have been maintained as an emergency backup water supply. The Rattlesnake Creek water is separated from the present-day distribution system via an above-ground air gap. The City estimates that water from Rattlesnake Creek could be connected to the distribution system in about 30 minutes if necessary; however, because there is no mechanism for treating the water, appropriate precautions would need to be taken, including placing the system under an order to boil the water. There is an ongoing project to remove the

[2] *Mueller Record*, October 1956, Walter Dyer, editor.

Rattlesnake intake dam and reservoir, once this project is complete, the city will not have the ability to connect Rattlesnake Creek water to the system.

### 2.3.3 Production

#### Wells

The Missoula water system has 40 active wells (Table 2-4), which range in depth from 86 feet to 360 feet below ground and with capacities ranging from less than 200 gpm to 5,700 gpm. The overall capacity of the water system is 74 mgd, or 56 mgd with the largest well in each pressure zone out of service. The wells are relatively well-distributed throughout the service area. The high-producing wells are close to the Clark Fork River, including the highest-producing well, Maurice, which can pump 5,700 gpm.

**Table 2-4. Wells in the Missoula Water System**

| System ID | Well Facility Name[a] | Pressure Zone | Year Installed | Horsepower | Rated Flow (gpm) |
|---|---|---|---|---|---|
| W1 | 6th Street Well | South | 1935 | 100 | 1,125 |
| W2 | 14th Street Well | South | 1935 | 100 | 1,000 |
| W3A | South Avenue Wells | South | 1935 | 100 | 1,250 |
| W3B | South Avenue Wells | South | 1984 | 200 | 2,450 |
| W4 | Sommers Street Well | East Missoula | 1937 | 50 | 500 |
| W8 | Schilling Street Well | South | 1955 | 100 | 1,000 |
| W9 | Dixon Well | South | 1955 | 100 | 1,000 |
| W10 | Hilda Well | South | 1957 | 100 | 950 |
| W11 | Agnes Well | South | 1957 | 100 | 1,350 |
| W12 | Judi Drive Well | East Missoula | 1964 | 50 | 525 |
| W13 | Mountainview Well | Rattlesnake | 1964 | 60 | 900 |
| W17 | Momont Well | North | 2014 | 100 | 1,000 |
| W18 | Willowwood Well | South | 1968 | 100 | 850 |
| W19 | North Russell Well | North | 1969 | 100 | 1,100 |
| W20 | Catlin Well | South | 1969 | 100 | 1,100 |
| W21 | East Central Well | South | 1969 | 100 | 1,250 |
| W22 | Intermountain Well | South | 1970 | 100 | 1,075 |
| W23 | Pattee Creek (25-hp) Well | Lower Farviews | 1973 | 25 | 185 |
| W24 | Pattee Creek (50-hp) Well | Lower Farviews | 1973 | 50 | 320 |
| W25 | Stephens Well | South | 1973 | 100 | 825 |
| W26 | Benton Well | South | 1972 | 100 | 950 |
| W27 | 26th Avenue Well | South | 1972 | 50 | 525 |
| W29 | Orchard Well | Gharrett | 1973 | 100 | 950 |
| W30 | Bank Street Well | North | 2014 | 300 | 3,600 |

Table 2-4. Wells in the Missoula Water System

| System ID | Well Facility Name[a] | Pressure Zone | Year Installed | Horsepower | Rated Flow (gpm) |
|---|---|---|---|---|---|
| W31 | Kiwanis Well | North | 1976 | 300 | 3,400 |
| W32 | Arthur Well | North | 1976 | 300 | 3,800 |
| W33 | Gerald Well | South | 1977 | 300 | 3,800 |
| W34 | Maurice Well | South | 1978 | 500 | 5,700 |
| W35 | Southgate Well | South | 1978 | 300 | 2,425 |
| W38 | 23rd Street Well East | Skyview | 1971 | 300 | 1,775 |
| W39 | 23rd Street Well West | Skyview | 1971 | 300 | 1,750 |
| W40A | Linda Vista Well 1(East) | Lower Linda Vista | 1990 | 30 | 220 |
| W40B | Linda Vista Well 2 (North) | Lower Linda Vista | 1990 | 40 | 220 |
| W40C | Linda Vista Well 3 (West) | Lower Linda Vista | 1990 | 40 | 250 |
| W41 | Great Northern Well | North | 2001 | 100 | 1,200 |
| W42 | Palmer Street Well | North | 2001 | 100 | 1,140 |
| W43 | Canyon River Well | East Missoula | 2013 | 60 | 555 |
| W45A | Haugan Drive Well (North) | Sophie | 2015 | 100 | 1,000 |
| W45B | Haugan Drive Well (South) | Sophie | 2015 | 125 | 770 |
| W45C | Haugan Drive Well (West) | Sophie | 2015 | 150 | 1,000 |

[a] hp = horsepower

## Booster Stations

The Missoula water system has 22 booster stations (Table 2-5) including 54 booster pumps that generally pump water from the valley floor to storage facilities on the hillside, and some that pump water from those storage facilities to storage sites even higher on the hillside. There also exists one small booster pump station that increases the pressure for a small pressure zone near one of the storage tanks where higher pressure water is not available. The pumps range in size from 3 horsepower (hp) to 150 hp and can pump 40 to 1,920 gpm.

Table 2-5. Booster Stations in the Missoula Water System

| System ID | Booster Name | Pressure Zone | Year Installed | Horsepower | Rated Flow (gpm) |
|---|---|---|---|---|---|
| B1 | Gharrett | Gharrett | 1965 | 15 | 470 |
| B2 | Lower Elk Ridge | Lower Elk Ridge | 1975 | 60, 60, 40 | 690, 560, 410 |
| B4 | High Park | High Park | 1991 | 30, 60 | 275, 380 |
| B5 | High Park Tank | Upper Farviews | 1991 | 30, 100, 100 | 370, 1210, 1090 |
| B6 | Upper Elk Ridge | Upper Elk Ridge | 1975 | 10, 10 | 95, 45 |
| B7 | Upper Lincoln Hills | Upper Lincoln Hills | 1975 | 60, 60, 40 | 430, 440, 250 |

Table 2-5. Booster Stations in the Missoula Water System

| System ID | Booster Name | Pressure Zone | Year Installed | Horsepower | Rated Flow (gpm) |
|---|---|---|---|---|---|
| B8 | Whitaker | Upper Farviews | 1978 | 60 | 350 |
| B9 | Gharrett Tank | Skyview | 1978 | 50, 40 | 470, 300 |
| B13 | North Reservoir | Rattlesnake | 2006 | 100, 100, 100 | 1790, 1920, 930 |
| B14 | Mountain View | Lower Lincoln Hills | 2011 | 60,60 | 980, 1020 |
| B15 | South Reservoir | High Park | 2008 | 50,150, 150 | 530, 1740, 1775 |
| B16 | Lower Farviews | Lower Farviews | 2008 | 40 | 550 |
| B17 | Skyview Tank | Hillview | 1979 | 75, 75, 150 | 790, 760, 1340 |
| B18 | Hillview Tank | Upper Hillview | 2011 | 10, 20, 20, 3 | 100, 250, 250, 30 |
| B20 | East Missoula | East Missoula | 1992 | 20, 20 | 540, 520 |
| B21 | Mark Court | Upper Linda Vista | 1999 | 15, 15 | 125, 125 |
| B23 | Upper Prospect | Upper Prospect | 2011 | 60, 75, 60 | 355, 380, 345 |
| B24 | Grant Creek | PRV Old Quarry | 2002 | 10, 20, 20 | 210, 350, 350 |
| B25 | Miller Creek | Hillview | 2002 | 50, 50 | 440, 440 |
| B26 | Mansion Heights | Mansion Heights | 2002 | 10, 50, 50 | 115, 245, 255 |
| B27 | 23rd Street | Skyview | 2006 | 100, 100 | 1000, 990 |
| B28 | Sophie Drive | Upper Linda Vista | 2015 | 50, 50, 50 | 622, 622, 622 |

## 2.3.4 Water Storage and Distribution

### Water Storage

The Missoula water system has 25 tanks and reservoirs (Table 2-6), with a total available storage volume of 10.2 million gallons. Two of these tanks are currently inactive.

**Table 2-6. Tanks and Reservoirs in the Missoula Water System**

| System ID | Facility Name | Pressure Zones Served | Year Installed | Capacity (gallons) |
|---|---|---|---|---|
| R1 | North Reservoir | North | 1902 | 1,000,000 |
| R2 | Rattlesnake Reservoir | Rattlesnake, PRV Richard St | 1978 | 1,000,000 |
| R3 | South Reservoir | South, PRV Fort Missoula | 1979 | 3,000,000 |
| R4 | Lower Linda Vista Reservoir | Lower Linda ,Vista, PRV Helena Dr., PRV Paul Lake / Jack Dr* | 1998 | 85,000 |
| R5 | Upper Linda Vista Reservoir | Upper Linda Vista, PRV Mark Court | 1998 | 500,000 |
| R6 | Lower Prospect Reservoir | North | 2001 | 550,000 |
| R10 | Skyview Reservoir | Skyview, PRV Pinewood, PRV Foothills / 23rd, PRV St. Thomas / St. Francis | 2000 | 1,000,000 |
| R11 | Upper Prospect Reservoir | Upper Prospect, PRV Klondike at Prospect, PRV Argenta at Prospect, PRV Old Quarry | 2001 | 150,000 |
| R12 | East Missoula Reservoir | East Missoula | 2004 | 250,000 |
| R13 | High Park Reservoir | High Park | 2007 | 600,000 |
| R14 | Hillview Reservoir | Hillview, PRV Gharrett, Upper Hillview, PRV Longview / Grandview, PRV 57th, PRV Miller Creek at Jeff Dr. | 2013 | 300,000 |
| R15 | Sophie Reservoir | Sophie | 2015 | 300,000 |
| T1 | East Missoula Tank | East Missoula | 1964 | 50,000 |
| T2 | Lower Elk Ridge Tank | Lower Elk Ridge | 1988 | 404,000 |
| T4 | Gharrett Tank | Gharrett | 2007 | 152,350 |
| T6 | Lower Lincoln Hills Tank | Lower Lincoln Hills Dr., PRV Mountainvew | 1967 | 35,000 |
| T8 | Upper Elk Ridge Tank | Upper Elk Ridge | 1989 | 22,000 |
| T9 | Lower Farviews Tank (north) | Lower Farviews, PRV Stephens | 1973 | 50,000 |
| T13 | Lower Farviews Tank (middle) | Lower Farviews | 1977 | 35,000 |
| T14 | Lower Farviews Tank (south) | Lower Farviews | 1977 | 35,000 |
| T15 | High Park Tank | High Park | 1979 | 85,000 |
| T16 | Upper Lincoln Hills Tank | Upper Lincoln Hills | 1977 | 41,000 |
| T18 | Hillview Tank | Hillview | 1985 | 200,000 |

Table 2-6. Tanks and Reservoirs in the Missoula Water System

| System ID | Facility Name | Pressure Zones Served | Year Installed | Capacity (gallons) |
|---|---|---|---|---|
| T19 | Upper Farviews Tank | Upper Farviews | 1993 | 400,000 |
| T20 | Mansion Heights Tank | Mansion Heights, PRV Whitaker at Mansion Heights, PRV Whitaker at Pintlar Mtn | 1998 | 210,000 |
| | | | TOTAL | 10,454,350 |

*Notes: PRV Paul Lane/Jack Dr. can be fed from Skyview Reservoir or from the Lower Linda Vista Reservoir

## Pressure Reducing Valve Stations

The Missoula water system has 36 pressure reducing valve (PRV) stations that regulate the water pressure delivered from higher to lower pressure zones to help control water system pressures. A PRV station can be housed above or below ground and consists of a section of the water main, two isolation valves, and the PRV. Most stations have pressure reading instrumentation that is connected to the supervisory control and data acquisition (SCADA) system and is monitored at the City's Operations Center.

## Water Distribution

The Missoula water system has about 337 miles of water mains, ranging in size from 2-inch to 30-inch in diameter, and several pipe material types. Figure 2-7 provides a summary of the length of pipe installed by year for each material type. Approximately 70 percent of the water mains are ductile iron, PVC, or steel, the remaining 30 percent includes asbestos concrete, cast iron, cured in place pipe liner, HDPE, steel invasion and kalamein.

Steel invasion pipe refers to light weight, thin walled steel pipe originally manufactured during World War II for the purpose of carrying gas over the ground. Surplus pipe was available after WWII and almost 10 miles of 6-inch steel invasion pipe was installed between 1946 and 1950. This pipe has had a tendency to develop small pin hole sized leaks and has been targeted for replacement. Approximately 4.9 miles still remain in the system.

Kalamein pipe refers to standard steel pipe that was immersed in a molten alloy made primarily of zinc, but also tin and nickel. While the kalamein pipe itself has held up relatively well, the joints have a tendency to lose their lead filler and leak. Of the 12 miles originally installed, 11.7 remain in service today.

Figure 2-7 shows water mains by install year and pipe material. Figure 2-8 and 2-9 show the material types and ages of water mains.

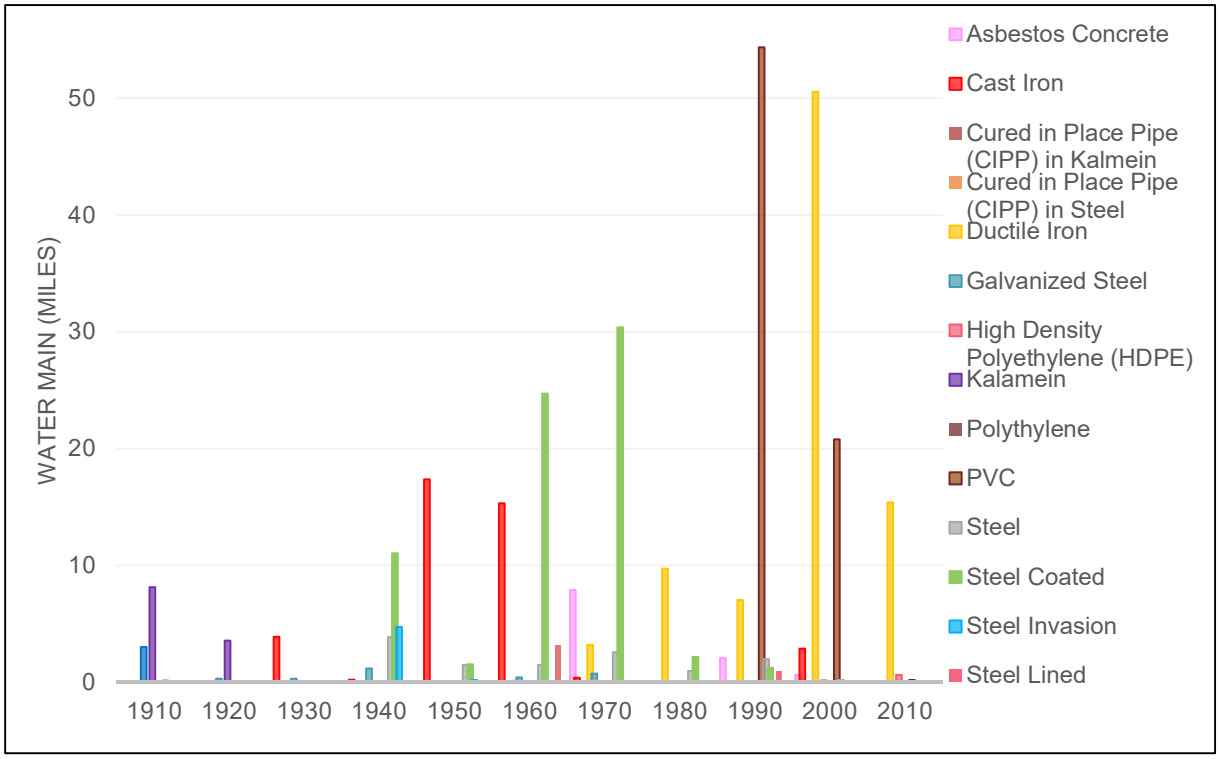



**Figure 2-7. Water Main by Pipe Type and Year Installed**

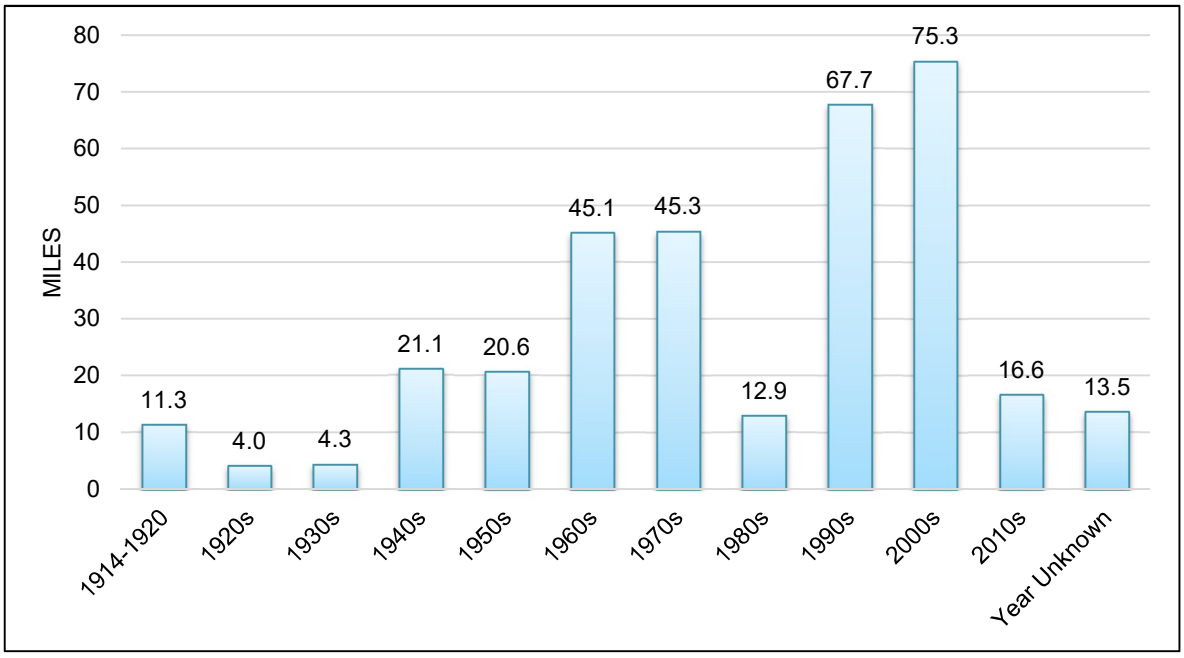



**Figure 2-8. Miles of Water Main by Decade Installed**

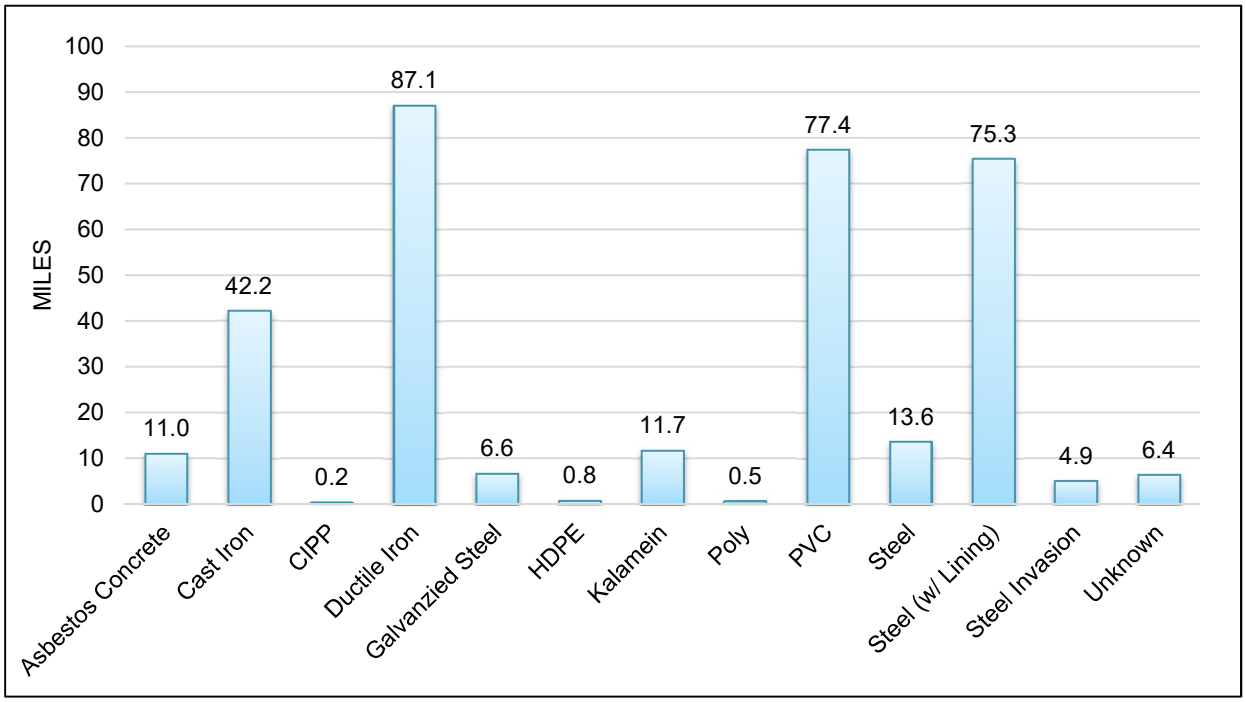



**Figure 2-9. Water Main Type by Miles**

Note: Asbestos concrete (AC) pipe contains cement and asbestos; asbestos containing material is not generally considered to be harmful unless it is releasing dust or fibers into the air where they can be inhaled or ingested. When AC pipe is removed, special precautions are taken.

## 2.3.5 SCADA, Controls and Emergency Power

### SCADA and Controls

The Missoula water system is monitored and controlled through a computerized Supervisory Control and Data Acquisition (SCADA) system that is located in the Operations Center. The human–machine interface (HMI) or SCADA computer located in the Operations Center uses GE iFIX operating software to monitor and provide remote-control access to the individual facilities. Tank settings, pump start/stop set points, lead/lag, pressure settings, and other operational set points can be adjusted and set in the HMI at the Operations Center.

Additionally, operational trend data such as tank levels, well flow rates, pump station flows, chlorine residual levels, and other data, are recorded and maintained in historical data files by the HMI. These data are backed up daily. The SCADA system is not connected to the rest of the internal information technology (IT) system, computer systems, or the internet because it is isolated from remote access for security purposes.

Each remote water system facility is equipped with a programmable logic controller (PLC) that provides local operational control logic that operates the facility. The water system uses Allen-Bradley SLC 500 PLCs for all of its facilities. The PLCs are connected to the HMI at the Operations Center via radio communication that sends operational data back to the HMI when polled, and operational control set points that are changed at the central HMI and communicated to individual facilities.

In the event of a communication failure between the facility PLC and HMI, the PLC retains the last control set points and parameters it received from the HMI, and uses those until

communication is restored. Additionally, control set points and control logic can be changed at the facility directly to the PLC, and these are then updated to the HMI through the remote radio communication.

If a power outage occurs, the water system has emergency generators to power many of the facilities. However, if the facility does not have emergency backup power, the facility PLCs have battery backup to maintain operational control and monitoring of the facility. The Operations Center is also equipped with an emergency generator so that, in case of a widespread power outage, the SCADA system will remain operational.

All local operational measuring devices, transmitters, and other instrumentation and controls (I&C) monitoring equipment are connected via hard wire to the PLC.

### Emergency and Backup Power

The Missoula water system has 20 portable emergency generators that can be used at wells or booster pump stations, and two stationary generators at the utility office. There is also an emergency generator at the Rattlesnake Dam.

## 2.4 Management and Operations

### 2.4.1 Water Service Line Ownership Policy

Prior to June 2017, the Missoula Water System was under private ownership and according to the Administrative Rules of Montana, the customer owns the water service line from the water main to the building for privately owned utilities. Now that the utility is under municipal ownership, the City is developing strategies to assist the customer with maintenance of their service lines. The City recently proposed an ordinance that would clarify that the property owner is responsible for maintenance and repairs on their water service line, but the City would offer a loan program so those repairs could be completed, then paid off over a 5 to 7 year period of time.

### Service Line Age and Type

Water service line records, called ditch cards, are kept as a hard copy and have been cataloged in a searchable Microsoft Access database. The database includes 27,028 records and the age, pipe type, and size information available is shown in Tables 2-7 and 2-8. Many communities are dealing with the replacement of lead water service lines. However, there are no records of lead service lines in Missoula[3].

*The majority of water service line (of known type) are galvanized, installed between 30 and 60 years ago. The useful life of these pipes is typically about 40 years.*

[3] Historically, some lead swing joints have been found in the field. A swing joint is between 1 and 2 feet long and connects the service line to the water main. When these lead swing joints are encountered, they are replaced.

Table 2-7. Water Service by Size

| 3/4" | 1" | 2" | 3" | 4" | 6" | No Size Listed |
|---|---|---|---|---|---|---|
| 9,728 | 6,564 | 510 | 43 | 309 | 119 | 9,756 |
| 36% | 24% | 2% | 0.16% | 1% | 0.4% | 36% |

Table 2-8. Water Service by Material Type

| Galvanized | PVC | Copper | Plastic | Ductile | No Type Listed |
|---|---|---|---|---|---|
| 7,937 | 5,767 | 287 | 815 | 4 | 12,219 |
| 29% | 21% | 1% | 3% | 0% | 45% |

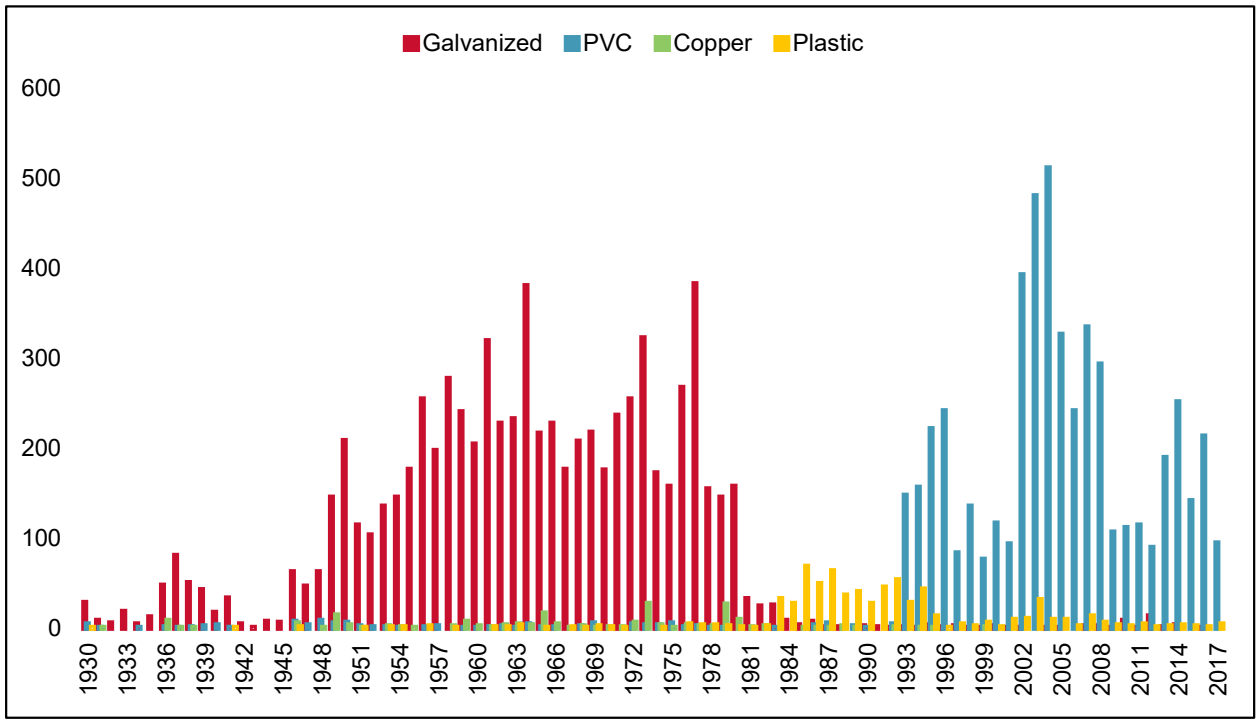



Figure 2-10. Water Service Line by Type and Year Installed

## 2.4.2 Non-Revenue Water

Non-revenue water is water that has been "lost" before it reaches the customer. Losses can be real losses (through leaks, sometimes also referred to as physical losses) or apparent losses (for example through theft or metering inaccuracies). Non-revenue water has been an important issue in the Missoula water system for decades. Non-revenue water has been estimated using a variety of methods, and has been found to be between 45 and 55% of the total water

produced or between 7,500 – 9,000 gpm. Further discussions of non-revenue water are included in Chapter 3.

## Past Efforts to Quantify and Locate Water Loss

### RESERVOIR FALL STUDIES

Since 2007, the water system operators have conducted reservoir fall studies in the spring and fall. The studies consistent of filling all the tanks and reservoirs in the late evening, then turning off all pumping facilities and measuring the amount of water leaving the tanks over the course of a few hours through the night. The total amount of water leaving the tanks, minus the estimated customer usage, provides an estimate of the overall system leakage. Drawbacks of this method include the need to estimate water use; however, the procedures used have been consistent over time.

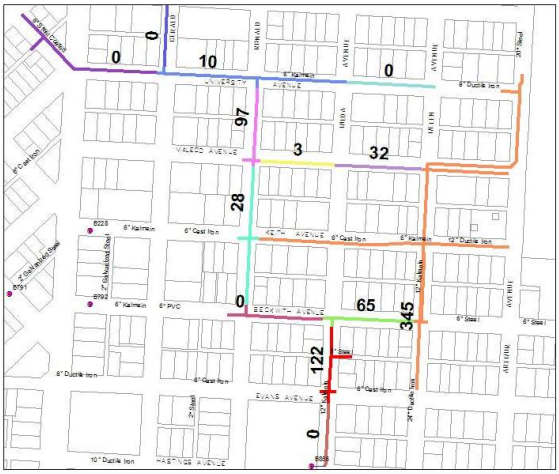



**Figure 2-11.**
**Example Valve to Valve Leak Test Results**

### DISTRICT METERED AREAS

In 2014, water operators began setting up district metered areas to conduct 'valve to valve' leak investigations, as shown in Figures 2-11 and 2-12. Using valves to isolate a particular segment of pipe, water flowing into the area was measured with a meter until the flow rate stabilized. Because the pipe segments were relatively small, the operators were able to determine when water was being used by a customer by watching the meter. When flow stabilized and there was no detectable customer usage, the water loss was documented. To date, staff has tested over 54 miles of water mains or about 17% of the total system. These tests have identified some large leaks which were subsequently repaired.

## Education and Awareness

### RESOURCES FOR HOME OWNERS

Home owners are provided with free home leak detection kits.

### ECONOMIC ANALYSIS

EPA's document *Best Practices to Consider When Evaluating Water Conservation and Efficiency as an Alternative for Water Supply Expansion*, December 2016 EPA-810-B-16-005, states that water loss minimization and leak management is a best practice to assist utilities in using water efficiency as an alternative to developing new supplies.

**Figure 2-12. Above Ground Meter Installed for a Valve To Valve Leak Test**

The American Water Works Association (AWWA) has developed a spreadsheet based water audit tool, founded on the principles of the M36 Water Audit methodology that is designed to help quantify and track water losses. The Missoula water system operators have utilized this tool since 2014 as a method to quantify water loss. Worksheets from the AWWA water audit performed for the City of Missoula for 2017 are included as Appendix A. A couple of definitions that may be helpful include:

- Apparent Losses: = Unauthorized Consumption + Customer Metering Inaccuracies + Systematic Data Handling Errors. Apparent Losses include all types of inaccuracies associated with customer metering (worn meters as well as improperly sized meters or wrong type of meter for the water usage profile) as well as systematic data handling errors (meter reading, billing, archiving and reporting), plus unauthorized consumption (theft or illegal use).
- Non-Revenue Water: Apparent Losses + Real Losses + Unbilled Metered Consumption + Unbilled Unmetered Consumption. This is water which does not provide revenue potential to the utility. In the City of Missoula this includes water used for street sweeping, firefighting, hydrant flow testing, and construction water.
- Real Losses: Physical water losses from the pressurized system (water mains and customer service connections) and the utility's storage tanks, up to the point of customer consumption. In metered systems this is the customer meter, in unmetered situations this is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks and overflows.

There are no standard specific water loss percentage guidelines since every water utility has unique challenges. In fact, AWWA guidance suggests that using percentage indicators to assess water loss often provides misleading and unreliable measures of utility performance because:

- This type of performance indicator is mathematically skewed.
- It is impossible to reliably represent multiple types of non-revenue water typically occurring in a water utility with a single simplistic percentage.
- A simple percentage reveals nothing about water volumes and costs, the two most important factors in water loss assessments of water utilities[4].

There are a variety of factors affecting leakage and the need to repair leaks including economics, soil percolation rates and whether or not leaks surface, and the cost / benefit of locating and repairing leaks.

### 2.4.3 Water Conservation

The City of Missoula's Conservation and Climate Action Plan (CCAP) is a planning document that describes work on conservation and climate related initiatives including strategies and goals for emission reductions. As shown in Figure 2-13, the City of Missoula has targeted 2025 for carbon neutrality. The water utility is one contributer to the City's green house gas

[4] AWWA Water Loss Control Terms Defined, http://www.awwa.org/portals/0/files/resources/water%20knowledge/water%20loss%20control/water-loss-control-terms-defined-awwa-updated.pdf

emissions. While the high leakage rate has a relatively small monetary cost to the City, excessive leakage does have an emissions cost since any water that is pumped and then leaked is an unnecessary energy output.

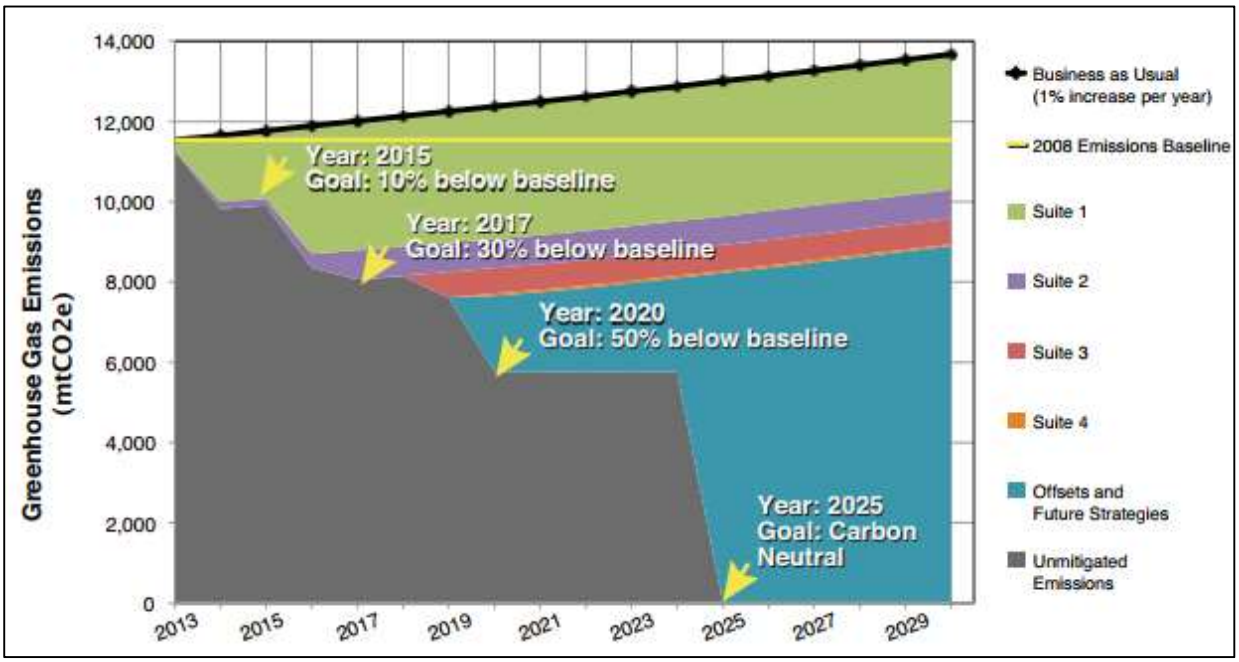



**Figure 2-13. Goal for Carbon Neutrality,**
**City of Missoula Conservation and Climate Action Plan**

The City currenlty encourages water conservation by providing guidelines for irrigation and lawn watering only during the cooler parts of the day, and encouraging flat rate customers to convert to meters. Should the City chose to expand its water conservation measures, the following section provides an overview of potential water conservation program elements.

## Elements of a Water Conservation Program

A water conservation program can be implemented in stages over time in a progressive manner; starting with a survey to establish a baseline, moving to public education and awareness, then to implementation of incentives, and ultimately to enforcement measures of non-efficient water use if necessary. This section gives some best practices that have been effective in other parts of Montana and around the country, as well as strategies specific to the City of Missoula.

### COMMUNICATIONS

Public education and awareness is essential to a successful program and should be achieved through a comprehensive and strategic communications plan that includes well defined objectives and metrics for measuring its effectiveness.

#### PUBLIC SURVEY

The City of Missoula has a clean, plentiful water source in the Missoula aquifer and historically water conservation has not been a high priority. By conducting a survey, the City can achieve the following;

- Establish a baseline in order to evaluate the effectiveness of the proposed program.
- Gauge residents support for various conservation measures that the City may implement.
- Gain an understanding about outdoor watering practices including automatic sprinkler use and settings.

## Demonstration Project

The City of Missoula maintains a demonstration project called the Water Wise Garden along the banks of the Clark Fork River near downtown. This project creates awareness by highlighting drought resistant plants and watering techniques. The City may consider adding additional projects in other parks or partnering with a landscape company or home owners association. These projects can provide ideas and guidance for residents on choosing native drought resistant plants, water-wise irrigation techniques, and proper soil composition. Existing landscaping such as mature trees should remain in place, and educational signs regarding evapotranspiration or other topics could be added. Non-native species could also be replaced with drought resistant plants.

## Partner Organizations

The Missoula water system has maintained strategic partnerships over the years including providing funding and support to the Watershed Education Network, the Groundwater Academy, and various academic endeavors at the University of Montana and UC Berkeley.

These alliances can be an effective strategy to achieve effectiveness through synergy, and may allow the City of Missoula to reach a wide audience with its comprehensive communications strategy and leverage proxy people and organizations to deliver the message. Organizations identified as potential partners include the following:

- The Alliance for Water Efficiency: A non-profit organization dedicated to the efficient and sustainable use of water. They provide training, educational materials, and guidance on products, practices, and programs.
- Clark Fork Coalition: A non-profit organization that educates community members about the Clark Fork River to ensure the river remains clean & healthy.
- Local schools: Provides an opportunity to educate the next generation about good conservation practices. City staff members have shown interest in potentially forming a task force to give monthly presentations or hands on workshops in local schools.

## Water Rates and Rate Structure

Water rates can be a valuable economic and public policy tool to communicate water use efficiency and water wasting to its customers. In many cases, utility customers may experience very little connection between their water use decisions and their total bill.

## Inclined Block Tier Rate Structure

In general, an increasing block tier structure, where the cost per unit of water increases as the consumer uses more water, is considered the most effective conservation rate structure.

An important aspect of conservation rates is designing the rate structure so a large portion (two-thirds or more) of the charges are based on the quantity of water the customer consumes. It is important to balance this strategy with the needs of the utility to recover fixed costs regardless of actual water usage.

The best examples of this residential rate design include the following features: the first tier provides minimal water usage for a typical household at the minimum reasonable price; the subsequent tiers are priced significantly higher (greater than 50%) than the prior tier.[5]

## Price Elasticity in Water Rates

Price elasticity of demand is a measure used in economics to show the responsiveness, or elasticity, of the quantity demanded of a good or service to a change in its price. In other words, as the cost of water goes up, demand may go down. In a white paper entitled Water Rates and Conservation[6], the authors describe price elasticity of water rates.

The majority of empirical studies have found the long-term residential price elasticity to range between 0.2 and 0.6. After reviewing the evidence, Griffin (2006)[7] concluded that price elasticity for annual residential water use is likely to lie in the range of 0.35 to 0.45, meaning a 10% rate increase may produce a 3.5% to 4.5% reduction in demand over time.

In addition, residential customer demand for water is more responsive to price over the long-term than over the short-term; it takes time for price changes to fully influence the demand for water. Right after a price increase, consumers are mostly locked into their water using appliances and landscaping. Thus, long term demand tends to be less inelastic than short term demand.

Outdoor residential demand is more elastic than indoor residential demand. All things equal, residential water users will reduce outdoor consumption more readily than indoor consumption. The corollary of this finding is that summer demand tends to be more elastic than winter demand, because most outdoor use occurs during the summer.

Understanding the basic principles of price elasticity in water rates will help the City of Missoula determine where to focus a water conservation program to achieve the most cost effective results.

## Budget Based Rate Structure

This section includes a brief discussion of budget based rate structures since they are incredibly effective at promoting water conservation, though more difficult to implement. Each residence has an inclining block rate structure designed according to its individual needs. The tiers are usually set based upon the quantity of occupants and the square footage of landscape

5 Alliance For Water Efficiency website. Accessed 3/7/2017. http://www.allianceforwaterefficiency.org/1Column.aspx?id=712

6 Alliance for Water Efficiency website. Accessed 3/7/2017. http://www.allianceforwaterefficiency.org/uploadedFiles/Resource_Center/Library/rates/White-Paper-Rate-Structures-and-Conservation-March-13-2009.pdf

7 Griffin, Ronald C. (2006). Water Resource Economics: The Analysis of Scarcity, Policies, and Projects. The MIT Press, Cambridge, MA.

known to be the two most significant factors in residential water use. The prices of the tiers increase significantly (greater than 50%) after the base usage tier is established.

This rate system requires a robust billing system to accommodate the quantity of individual rate structures (possibly equal to the quantity of customers) the system also requires a formal process to establish each homes' base water usage and responds to the many customers likely to appeal their base tier allotment. Water budget based rates are an effective water conservation strategy and the rate structure is the most equitable means to base rates on the needs of each individual household. A 2013 study of residential water budgets in Southern California found an 18% reduction in use over three years. This rate structure can also be adapted for non-residential customers.

In addition, a few water purveyors have implemented water budgets with punitive tiers when budgets are exceeded and have found this rate structure to be very effective in motivating customers to be water efficient. Often the revenue generated from punitive tiers is used to fund the conservation programs. This sets the tone for water wasters to help fund the efforts of customers participating in water utility conservation programs and measures.

## Demand Tracking and Alerts

Many utilities across the country are taking advantage of technology to communicate with their customers. There are many tools available that allow customers to track their water use in real time, which provides the following advantages;

- Customers can get alerts when they are nearing the next rate block.
- Customers gain knowledge about their typical water use patterns.
- Customers can be alerted in real time if they have a water leak.
- Customers can become aware of inefficient appliances or fixtures.

The City of Missoula is in the process of upgrading their water metering system that will allow these types of features.

## Water Bill Re-Design

The City of Missoula communicates monthly with its customers through the water bill. This is one opportunity to communicate the City's message regarding water conservation. The water bill could be re-designed to highlight excessive use, advertise incentive programs, provide information on leak detection, etc. For example, the City of Bozeman water utility bills include a graph of the individual customers water use compared with their neighbors and an 'efficient' water user as shown on Figure 2-14. This provides the customer with information regarding how their water use compares to others. In addition, Bozeman has changed the billing units from CCFs to gallons, which are a more commonly used and understood unit of measure. An example is included in Appendix B.

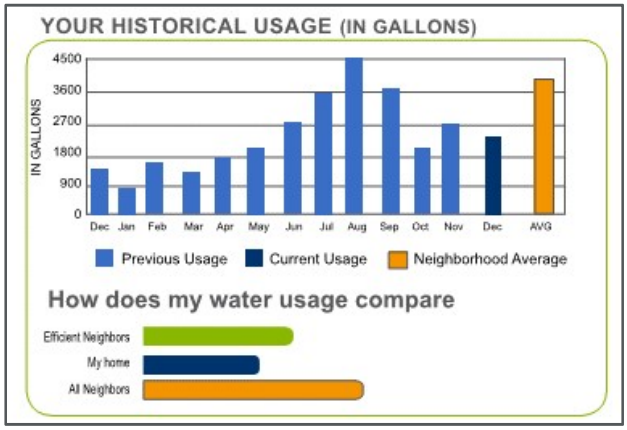



**Figure 2-14. Example Graph from City of Bozeman Re-Designed Utility Bill**

## Landscape Professionals Certification

Water consumption is closely associated with area weather conditions including but not limited to precipitation and evapotranspiration, which is the sum of evaporation and plant transpiration. The evapotranspiration rate indicates the amount of water used by landscapes or lost to the atmosphere and requiring replacement in order to maintain healthy vegetation. Evapotranspiration is a good indicator of water use. The water conservation plan should have a strong focus on summertime peak use, and it is important to include landscape professionals in outdoor water conservation efforts that focus on data collection (temperature, precipitation, etc.) and efficient watering practices.

By involving landscape professionals in a water conservation program, the City may see farther reaching impacts than by educating home owners alone. Landscape professionals assist home owners in installing, evaluating, and adjusting watering systems.

The Irrigation Association offers a variety of certifications, including the Certified Landscape Irrigation Auditor (CLIA) program. CLIAs are certified to perform an audit including collecting site data, making maintenance recommendations, performing minor repairs, taking field measurements and observations, determining irrigation uniformity and efficiency, and working with the property owner to manage overall irrigation water use. These audits can lead to water saving landscape retrofits.

## Incentives

Many water utilities use incentives such as cash rebates for the purchase of water saving fixtures to encourage water conservation. For example, the City of Bozeman has developed their own rebate program. During the 2014-2015 year they invested $67,000 in rebates and they've estimated the associated water savings at 20 acre feet per year (6.5 billion gallons per year or 17.8 MGD), which is over one million dollars in retail water costs.[8] Some indoor and outdoor rebates include the following:

### INDOOR

- Rebate programs for high efficiency fixtures including washing machines, showerheads, urinals, and toilets. Figure 2-15 below shows indoor per capital water use by type; this data can help the City target an indoor incentive program[9].

### OUTDOOR

- Rebates for high efficiency sprinklers, rain barrel purchases and implementation, weather sensing irrigation controllers, drip irrigation equipment, and drought tolerant plants.

[8] 2014-2015 City of Bozeman Water Conservation Program Update, Annual Report to the City Commission.

[9] Alliance for Water Efficiency website, accessed June, 2016. http://www.allianceforwaterefficiency.org/residential-end-uses-of-water-study-1999.aspx

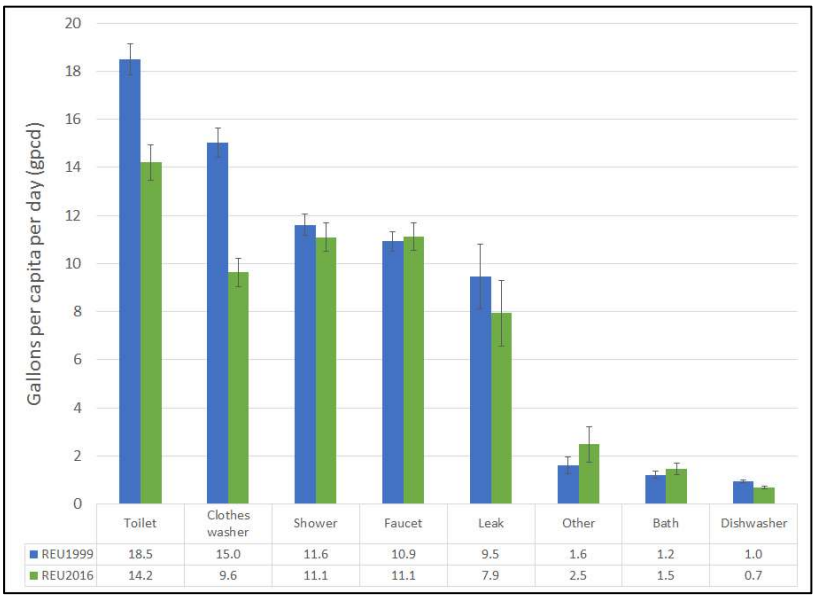
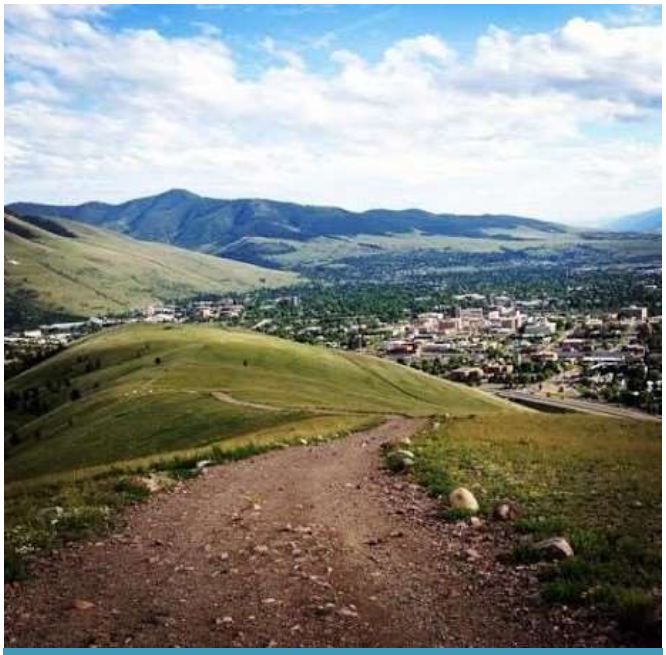



**Figure 2-15. Indoor Per Capita Water Use from the Alliance for Water Efficiency**

## Software Tools and Technology

Software tools and technology can provide water operators and consumers with valuable data allowing them to make decisions. Some of these tools are described below:

- Omni Earth (www.omniearth.net): This company provides user-friendly software tools that give specific parcel by parcel land classification and water use data that can help municipalities effectively and efficiently target water conservation measures.
- There are a number of companies with products that provide water operators and users with real-time water use data and alerts via apps, email, or websites; some offer utility billing integration as well. These include Fathom (www.gwfathom.com) and DropCountr (dropcountr.com).
- The Alliance for Water Efficiency *Peak Day Water Demand Management Study*, July 2017, details a pilot study conducted to evaluate the use of centralized remote irrigation controls. Technological advancements have resulted in the ability of property owners to remotely control their automated sprinkler systems. The results of the study show that interrupting, pausing, or otherwise adjusting residential sprinklers in order to reduce or shave peak demands can have a significant impact. This new technology could be very valuable for water utilities seeking to manage their peak day use, which dictates many costly infrastructure decisions. The City of Missoula could offer rebates to customers willing to adopt and use this or similar technology.
- Automatic meter infrastructure (AMI), often called fixed base, is a technology that automatically collects consumption data, and may assist in achieving the City's goals by providing near real-time consumption data to customers. As stated above, the City is in the process of acquiring new meters and a new AMI metering system.



# Chapter 3
# Water Demand Forecasting

2018 Water System Master Plan

*Missoula, Montana*

## 3.1 Basis of Planning

The purpose of this chapter is to present the data and assumptions used as the foundation for this water system master plan. This chapter includes the following sections:

- Study Area: meetings were held with planning staff and water utility staff to establish a study area boundary.
- Existing Land Use and Future Zoning: existing land use was used to characterize current water demand and create water duty factors; these factors were then applied to future zoning to estimate future water demands throughout the study area.
- Master Planning Time-steps: three time steps were established, (1) existing conditions, (2) Near Term, including developments and capital improvement projects that are ongoing or very likely to occur in the next 3-5 years, and (3) a 20-year projection to 2037.
- Analysis of Historical and Current Water Demand: data was gathered to help characterize current water customers and their water use including customer type (residential, commercial, etc.), average day, maximum day, and peak hour usage, seasonal water use variations, and daily water use patterns. These patterns are applied to future demands to evaluate system needs.
- Population Projections: traffic analysis zone (TAZ) data was used to evaluate population growth in terms of numbers of new customers (residential and non-residential), and establish where that growth is anticipated to occur in the study area.
- Future Water Demand Projections: future water demand in the study area is estimated using all the available data described in the sections above.

Additional information including links to specific neighborhood plans, and the development of design criteria is described in Appendix C Technical Memorandum: Demand Forecasting and Hydraulic Modeling Approach. Much of the information described in this chapter forms the basis for the hydraulic model, which is fully described in Chapter 6.

### 3.1.1 Study Area

The City established a study area boundary to be used for this Water System Master Plan. The boundary, which includes all existing customers and areas that could potentially be served by the water utility through the planning horizon year (2037), is shown in Figure 3-1 below. Note that this boundary doesn't indicate a future *service area* boundary but rather the *potential* future service areas to be studied in this plan.

This study area boundary is consistent with the study area boundary used in the 2018/2019 Wastewater Facility Plan.

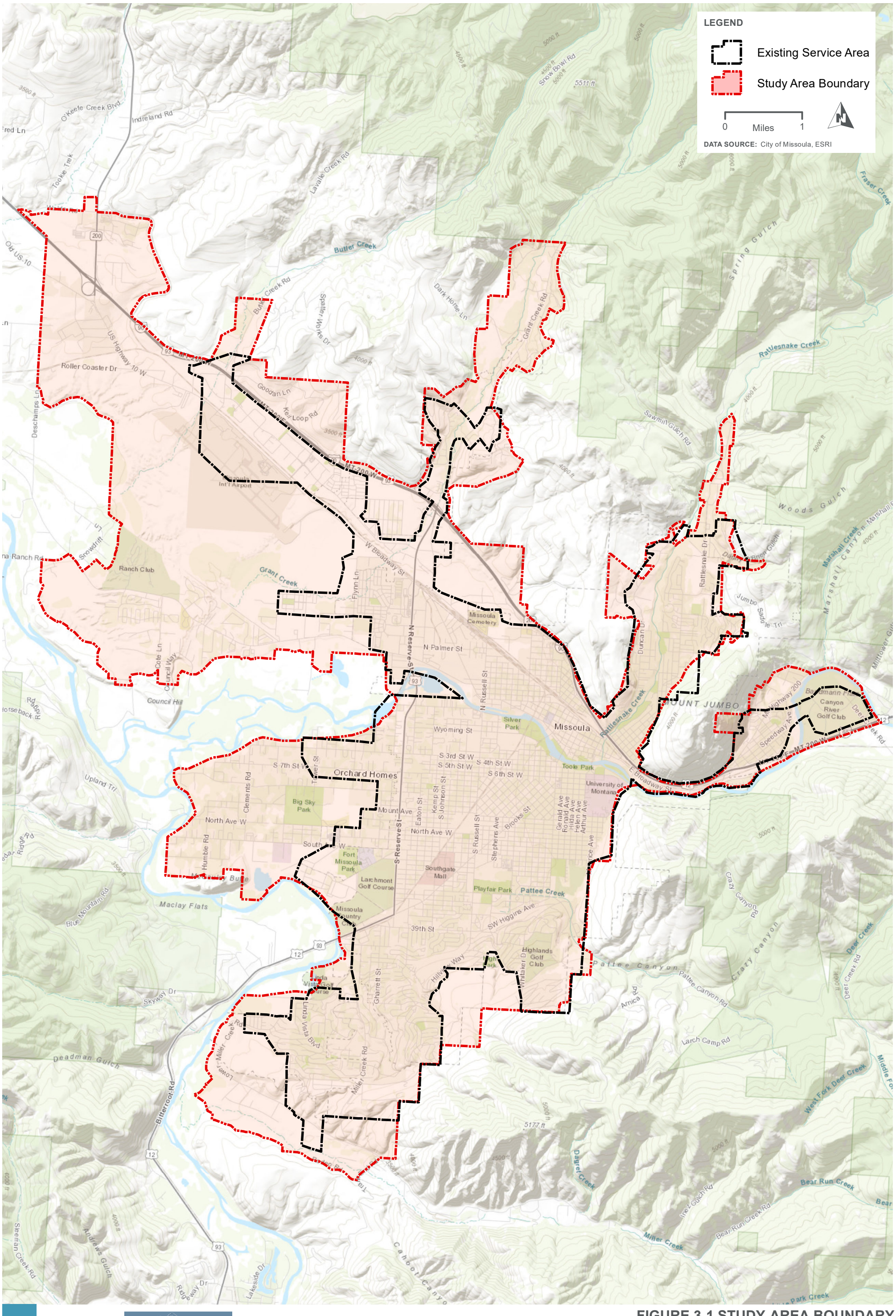



**FIGURE 3-1 STUDY AREA BOUNDARY**
**WATER FACILITIES MASTER PLAN**
**CITY OF MISSOULA, MT**

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### 3.1.2 Existing Land Use and Future Zoning

Missoula's development is guided by the City and County Growth Policy documents and neighborhood, transportation, and area plans. The City Growth Policy was adopted in 2015 and looks forward 20 years to 2035. These planning documents were reviewed to ensure this water facility master plan is in alignment with those plans.

Land use information is used to characterize existing water use patterns for different types of land use such as single-family residential, multi-family residential, commercial, and industrial. These water use patterns can be expressed in terms of unit water demands, also known as water duty factors, which represent the average daily water demands for each type of land use. These are usually expressed in units of gallons per day per acre (gpd/ac). Water duty factors are combined with land use data to generate future water demand estimates. With this information, the City can project future water demands that it will need to plan for.

Efficiently providing and extending municipal services, including water service, depends on a sound strategy for future use of land in both fringe areas and previously developed areas that offer redevelopment and infill opportunities. This section will describe the existing land use and future zoning, and how this information is used to project future water demands.

#### Existing Land Use

Current land uses in the City of Missoula service area are primarily residential with a mix of agricultural, light industrial, and commercial. For this study, the land use categories provided by the City were simplified into Agricultural, Residential, Commercial/Industrial, Private/Park/Open Space, Vacant, and Other/Blank, which incorporates blank parcels and smaller categories not relevant for planning.[1] This simplification allowed the City to more easily compare existing and future use and more closely relates land use to the water duty factors that were determined for residential and non-residential land uses (for more information, see the section in this chapter on water duty factors). Table 3-1 shows how the City's land use categories were simplified.

[1] These other categories include mining claims, centrally assessed non-valued property, gravel pit, tribal, lease, and utility property.

**Table 3-1. Simplified Categories for Existing Land Use**

| City Land Use Category | Simplified Land Use Category |
|---|---|
| Agricultural | Agricultural |
| Business Metered | Commercial/Industrial |
| Commercial/Industrial | Commercial/Industrial |
| Commercial/Industrial | Commercial/Industrial |
| Irrigation Flat Rate | Residential |
| Irrigation Metered | Residential |
| Other | Other/Blank |
| Private/Park/Open Space | Private/Park/Open Space |
| Public Authority Metered | Other/Blank |
| Residential Flat Rate | Residential |
| Residential High Density | Residential |
| Residential Low Density | Residential |
| Residential Metered | Residential |
| Vacant | Vacant |

Table 3-2 summarizes the existing land uses in the City of Missoula existing service area, which is about 17,000 acres. Parcel ownership data was used to evaluate the current land use.

The existing service area doesn't perfectly overlap with the parcel data (some parcels are partially in the existing service area and partially out of the existing service area), so the total acreage isn't identical. Blank parcels consisted mostly of right-of-way and were excluded from the analysis. The resulting subset of parcels provides a good characterization of the existing land use.

About 50% of the parcels by area are identified as improved in the existing land use category but without a specific land use provided. To categorize these parcels, meter billing code data was used to assign land uses to parcels. The Residential Flat Rate, Residential Metered, and Irrigation Flat Rate categories were incorporated into the Residential category. The Public Authority Metered category was incorporated into the Other/Blank category. Business Metered and Irrigation Metered[2] was incorporated into the Commercial/Industrial category.

About 14% of the total service area is currently undeveloped with agriculture/rural or vacant properties. The Agricultural, Vacant, and Other land use categories help classify existing land use, but the City expects that these parcels will be reclassified in the future with development.

[2] The majority of Irrigation Metered accounts are commercial. The City's commercial sewer rates are based on metered water usage, so having a separate irrigation meter is typical of commercial users.

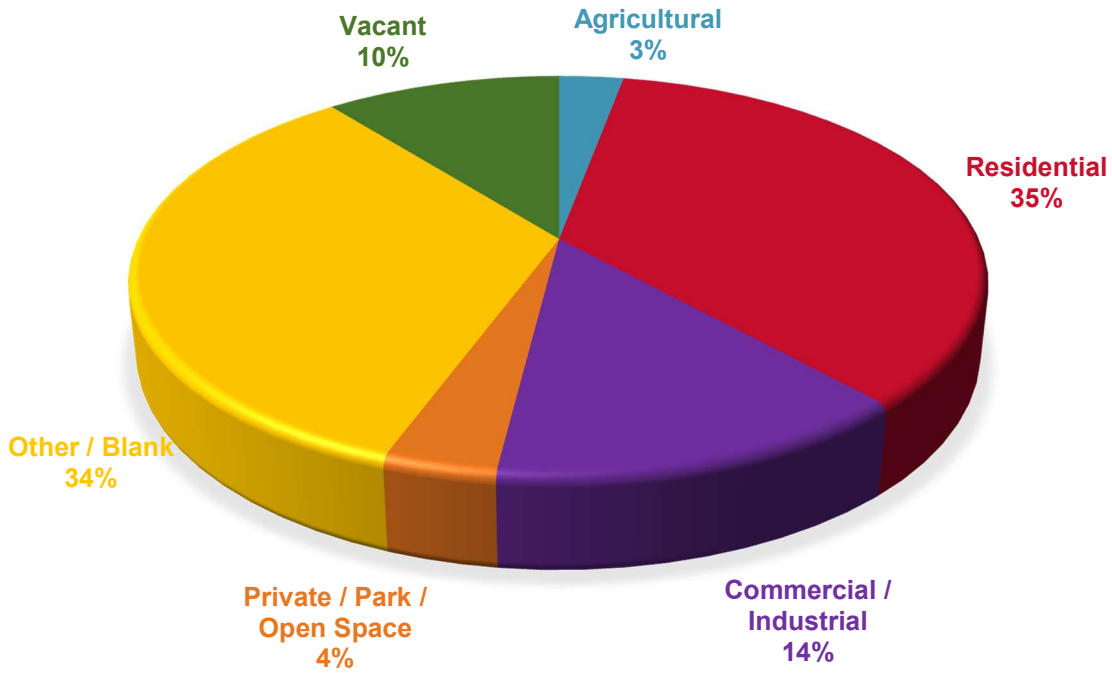
### Table 3-2. Existing Land Use in the Existing Service Area

| Land Use Category | Acres | Percentage of Total Area |
|---|---|---|
| Agricultural | 444 | 3% |
| Commercial/Industrial | 2,085 | 14% |
| Other/Blank | 5,153 | 34% |
| Private/Park/Open Space | 560 | 4% |
| Residential | 5,410 | 35% |
| Vacant | 1,627 | 11% |
| **Total[a]** | **15,278** | **100%** |

Source: Existing land use shapefile provided by the City

[a] Total area doesn't account for easements/right-of-way or portions of parcels that are predominantly outside the service area. As a result, the service area and parcel area differ.

Figure 3-2 shows the different land use categories as percentages of the total land use area in the existing service area. Figure 3-3 shows the locations of land use types throughout the existing service area.




### Figure 3-2. Percentages of Existing Land Use

Source: Existing land use shapefile provided by the City. Total area doesn't account for easements.

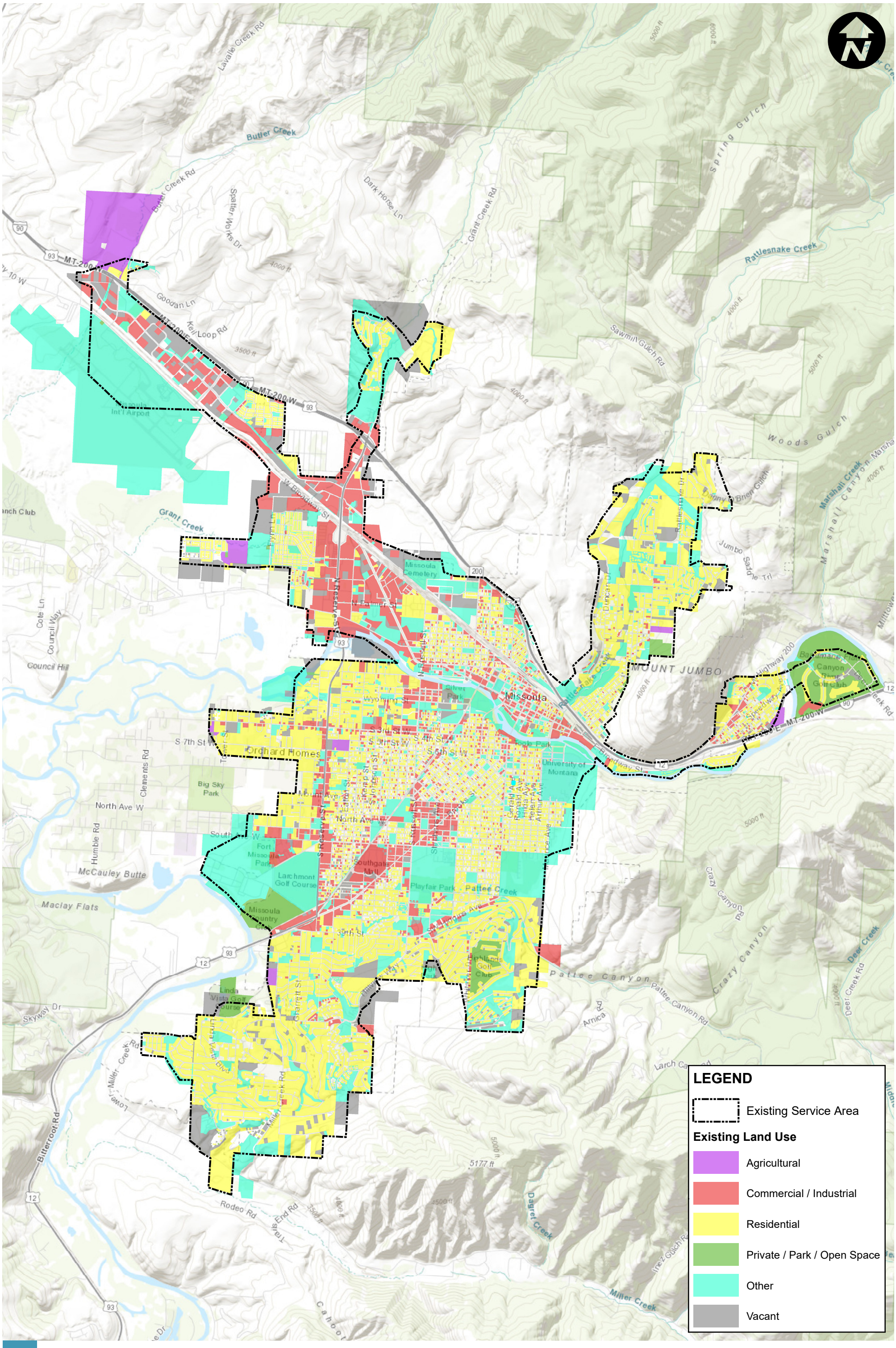



**FIGURE 3-3 CITY OF MISSOULA, MT**

**WATER FACILITIES MASTER PLAN**

**LOCATIONS OF EXISTING LAND USES IN THE SERVICE AREA**

## Future Zoning

The City of Missoula Development Services provides information regarding zoning. Zoning allows predictions to be made for future land use, and thus water requirements. For example, if a parcel is zoned industrial, it would be appropriate to assume a commercial water demand as opposed to a residential demand. In accordance with the City's zoning, the likely future land uses in the City's current study area boundary are listed in Table 3-3, with the different categories shown as a percentage of the total land use area.

The City provided traffic analysis zone (TAZ) data and land use planning shapefiles to characterize and project future zoning. TAZ data are commonly used in transportation planning models. The GIS based data includes incremental population and employment growth projections by TAZ. While each zone varies in size, the data was created on the parcel level. These data were used to estimate what type of growth is likely to occur across the study area. The land use planning shapefile boundary includes 40,245 acres and it exceeds that of the study area boundary (33,875 acres), but it was clipped to characterize the future land use in the study area. The study area is nearly twice the size of the existing service area, which is about 17,000 acres.

Future land use types were simplified into Commercial/Industrial, Residential, Public Agency/Other, Public/Parks/Open Space, and Unknown. These simplified categories provide easier comparison to the existing land use and are more consistent with the data available for demand analysis used to develop future projections. Table 3-3 lists the future land use and simplified land use categories.

**Table 3-3. Simplified Categories for Future Land Use**

| City Land Use Category | Simplified Land Use Category |
|---|---|
| Community Mixed Use | Commercial/Industrial |
| Industrial Heavy | Commercial/Industrial |
| Industrial Light | Commercial/Industrial |
| Neighborhood Mixed Use | Commercial/Industrial |
| Open and Resource | Private/Park/Open Space |
| Parks and Open Lands | Private/Park/Open Space |
| Public and Quasi-Public | Public Agency |
| Regional Commercial and Services | Commercial/Industrial |
| Residential High | Residential |
| Residential Low | Residential |
| Residential Medium | Residential |
| Residential Medium-High | Residential |
| Residential Rural | Residential |
| Unknown | Unknown |
| Urban Center | Commercial/Industrial |

Table 3-4 summarizes the future land use in the study area. The predominant land use types are projected to be Residential at 51% of the study area and Commercial/Industrial at 23% of the study area.

**Table 3-4. Future Zoning in the Study Area**

| Land Use Category | Acres | Percentage of Total Area |
|---|---|---|
| Residential | 17,431 | 51% |
| Commercial / Industrial | 7,909 | 23% |
| Private / Park / Open Space | 3,277 | 10% |
| Public Agency | 3,785 | 11% |
| Unknown / Not Designated | 1,472 | 4% |
| Total[a] | 33,875 | 100% |

Source: Zoning shapefile provided by the City

[a] Values reported in this table reflect land use within the study area boundary to provide a comparison to the City's existing land use. Total area includes easements/right-of-way which were not included in the existing land use summary shown in Table 3-2.

Figure 3-4 shows the future zoning categories as percentages within the study area boundary. Figure 3-5 shows the locations of future land use in the study area. These data provide a reference for future development, but all demand projections are based on TAZ.

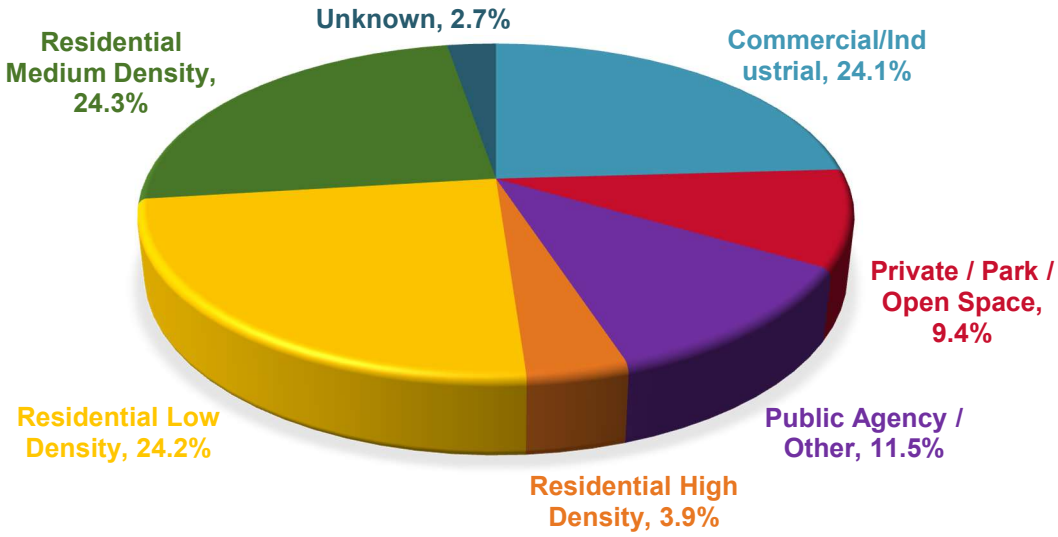



**Figure 3-4. Percentages of Future Zoning**

Source: Zoning shapefile provided by the City

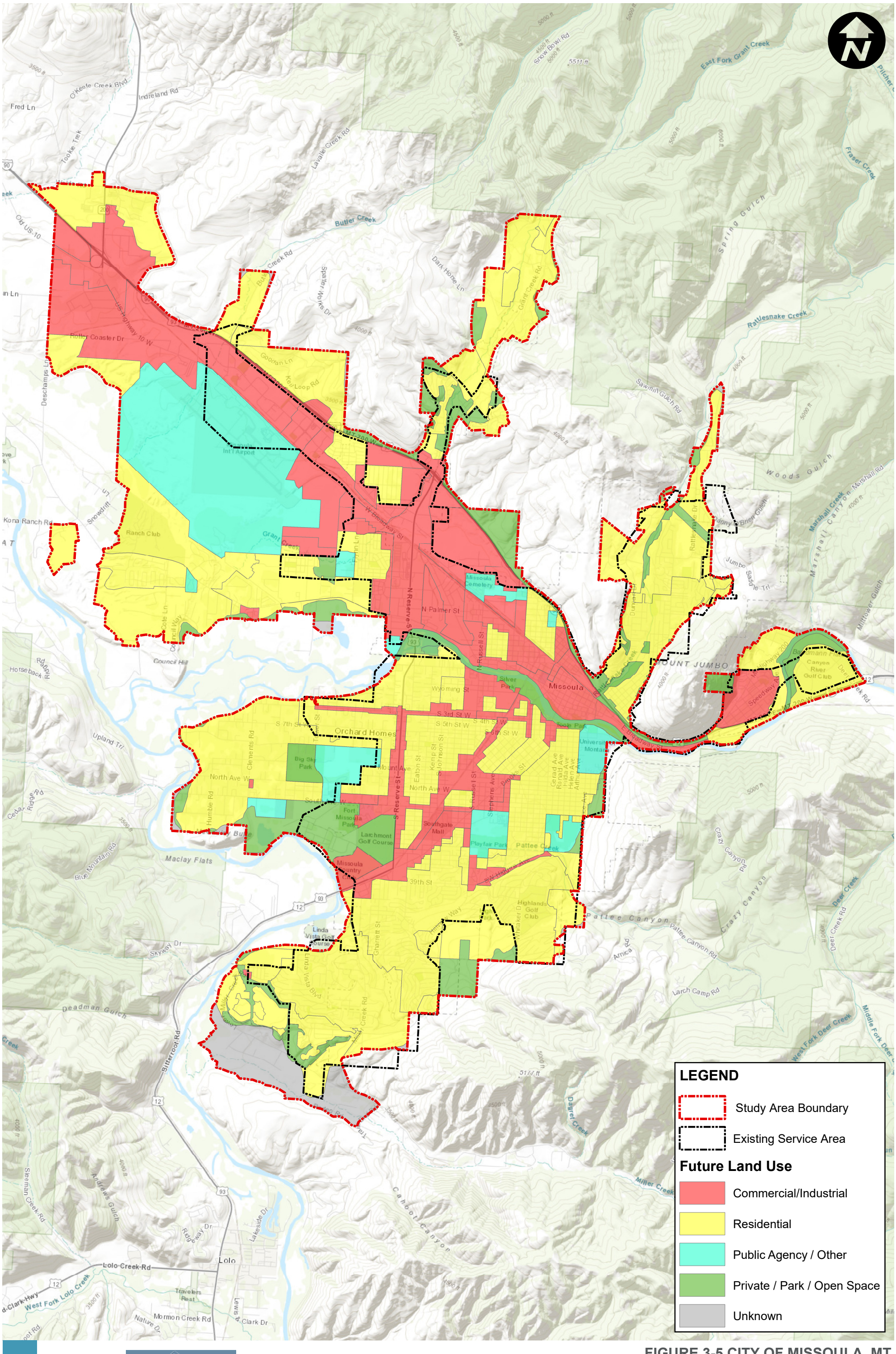



FIGURE 3-5 CITY OF MISSOULA, MT

WATER FACILITIES MASTER PLAN

LOCATIONS OF FUTURE LAND USE IN THE STUDY AREA

## 3.2 Master Planning Time-Steps

Through discussions with city water utility and planning staff, it was determined that three time-steps would be analyzed in terms of future growth and water demands, and these three scenarios were evaluated in the hydraulic model. These time-steps are described below:

- **Existing time-step (2017[3])** – Figure 3-4 above shows the existing service area and land use. This scenario looks at actual existing water demands for the year 2017, which is the most recent year of complete data.
- **Near-term (5-year) time-step (2022)** – Figure 3-24 shows graphically the near-term developments, water system improvements, and existing service area. Because there are projects and system improvements that are ongoing or upcoming, it will be important to understand the impacts of these projects.
- **Long-term planning horizon (2037)** – Figure 3-5 above shows the future land use in the study area boundary.

## 3.3 Analysis of Historical and Current Water Demand

This section breaks down historical and current water use to better understand water use by land use, customer type, time of year, and time of day.

### 3.3.1 Historical Customer Water Use

To address the adequacy of existing infrastructure and water supply, it's necessary to evaluate current water demands and projections of future demands. Table 3-5 presents an analysis of the historical quantity of water used by Missoula's metered water customers, as well as total annual production

Total metered water use will always be less than the amount of water produced. There are a number of reasons for this including water used for hydrant flushing and street sweeping, flat-rate customers, unaccounted-for water due to theft and meter inaccuracies, and water loss due to leaks in mains and service lines and water main breaks. As shown in Table 3-5, since 2011, metered water use has ranged from a low of 2,549 million gallons (MG) in 2011 to a high of 3,782 MG in 2015. Typically, these annual fluctuations are found to be associated primarily with changes in the number of accounts and various changes in response to weather conditions, the economy, unemployment, and water loss.

[3] 2017 is used instead of 2018 because meter demand data are available for all of 2017.

**Table 3-5. Annual Metered Water Use and Number of Accounts (2011–2017)**

| Year | Number of Metered Accounts | Total Metered Annual Water Use (MG) | Total Annual Production (MG) |
|---|---|---|---|
| 2011 | 18,147 | 2,549 | 8,471 |
| 2012 | 18,523 | 3,539 | 8,658 |
| 2013 | 18,888 | 3,551 | 8,747 |
| 2014 | 19,217 | 3,506 | 8,557 |
| 2015 | 19,540 | 3,782 | 8,807 |
| 2016 | 19,838 | 3,554 | 8,750 |
| 2017 | 20,115 | 3,231 | 8,658 |

Source: Missoula's water billing data and production data

Figure 3-6 shows the metered residential use in gallons per capita per day (assuming 2.38 people per account, which is consistent with the TAZ data) along with the total number of residential metered accounts. Figure 3-7 shows the metered irrigation usage in gallons per account per day, along with the total number of accounts, and Figure 3-8 shows the same data for metered business accounts. All three graphs show per person or per account metered water usage leveling off while the total number of accounts increases.

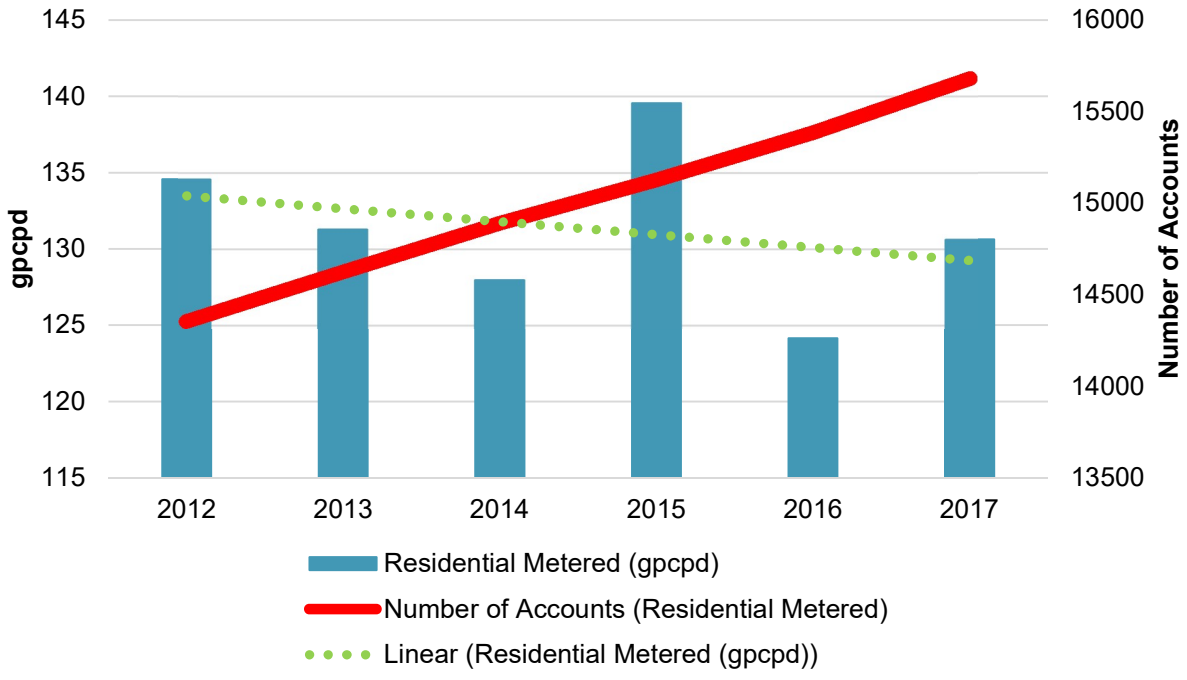



**Figure 3-6: Metered Residential Water Use and Number of Accounts**

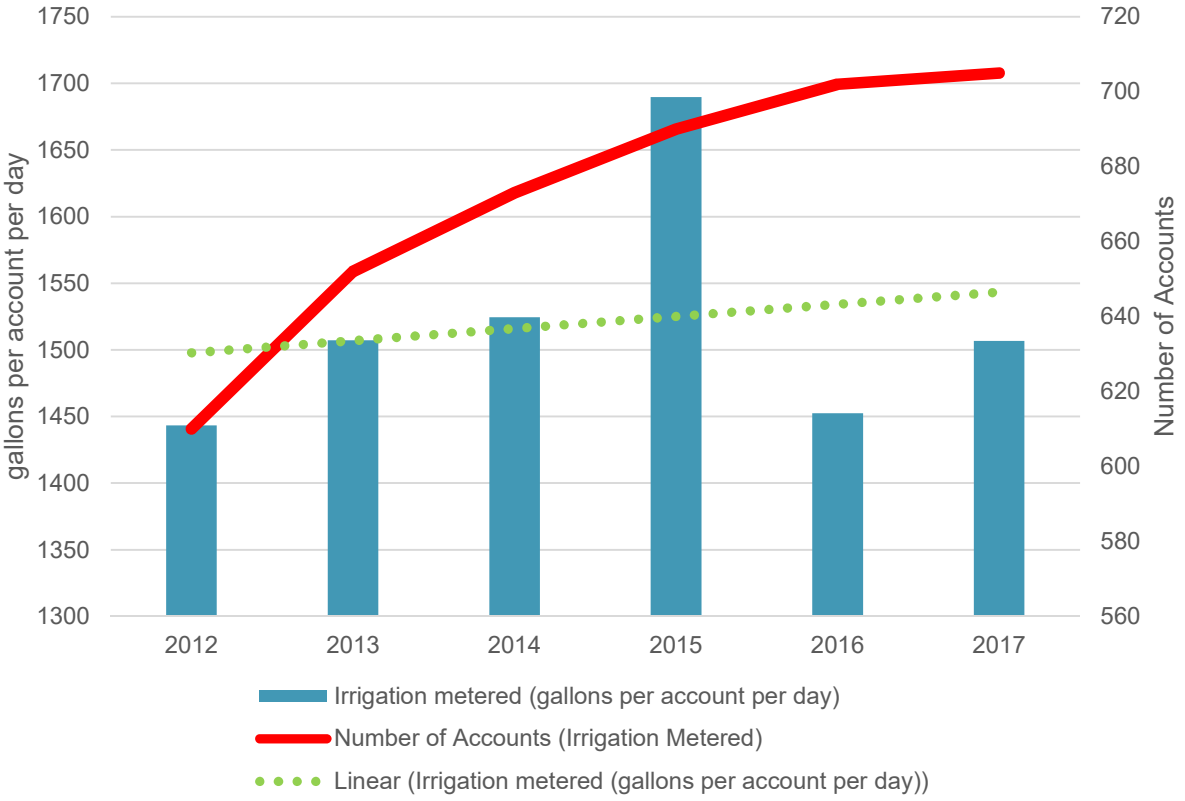



**Figure 3-7: Metered Irrigation Usage and Number of Accounts**

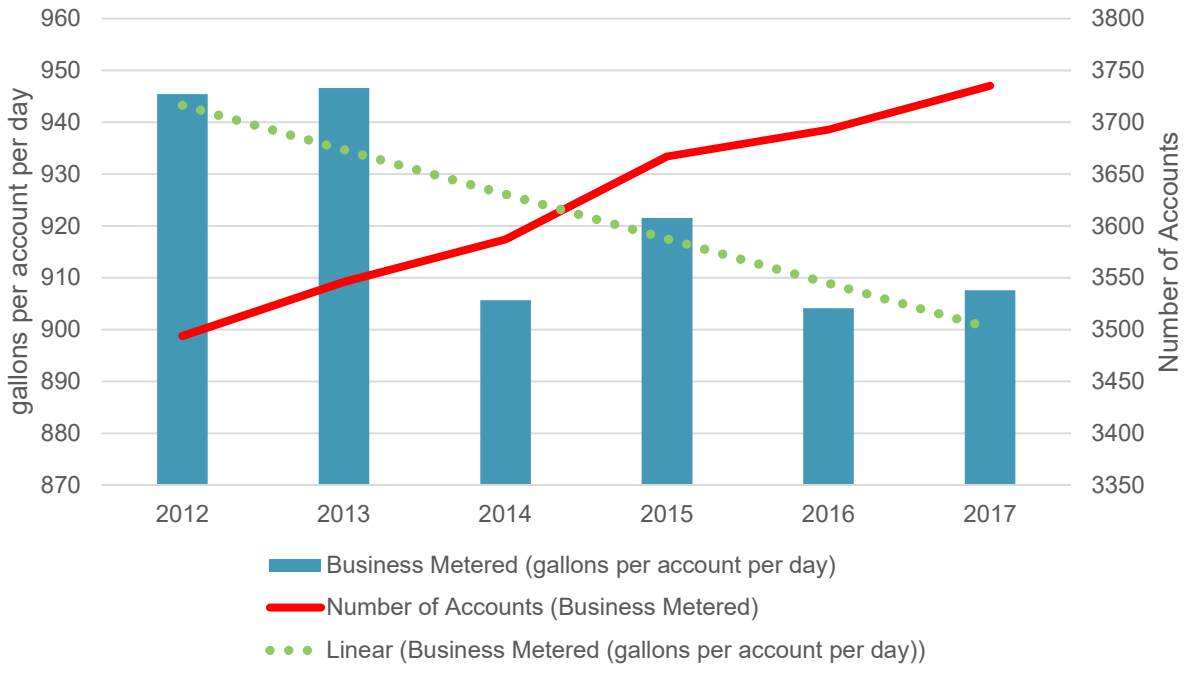



**Figure 3-8: Metered Business Usage and Number of Accounts**

Water use per capita has been decreasing across the country since its peak in 1980. This decrease has been attributed to a variety of factors including water conservation, water rates, water rate structures, water use efficiency (low-flow fixtures), changes in ambient temperature, changes in land use, a shift to more multifamily and mixed-use housing options, an awareness of water management, and economics. Figure 3-9 shows total water use leveling off nationwide from 1980 to 2010 as population has continued to increase across the country. Due to the number of flat rate customers and the amount of water loss in Missoula, it is difficult to determine if per capita water loss has been similarly decreasing in Missoula. However, Figures 3-6 and 3-8 show a slight decrease in per capita metered use and per business account use over the last six years as the number of accounts continues to increase. In Missoula, this could indicate a decrease in per capita water use and it could partially be attributed to flat-rate customers converting to meters in addition to the factors described above because metered customers tend to use less water than flat rate customers.

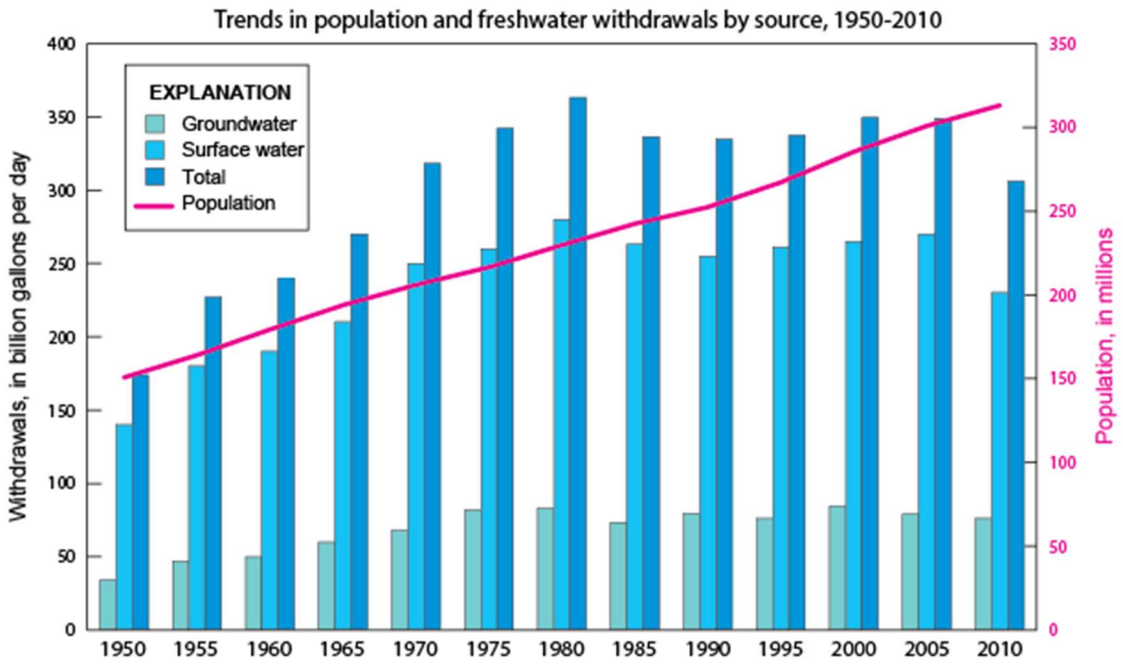



**Figure 3-9. Trends in Water Use Nationwide (1950–2010)**

Source: Estimated use of water in the United States in 2010: U.S. Geological Survey Circular 1405

## Water Demand Classification by Number of Connections

Missoula has about 20,000 active metered service connections; in 2017, 76% of these were residential and 18% were commercial/industrial accounts.

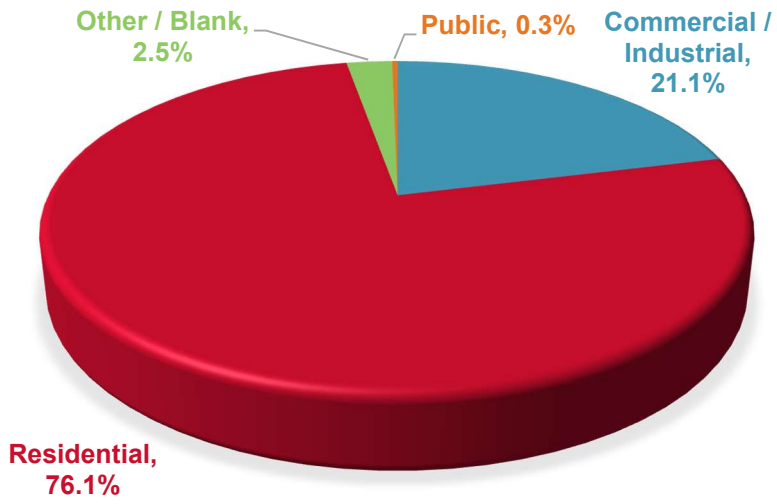



**Figure 3-10. Water Demand Classification by Number of Accounts**

## Water Demand Classification by Consumption

Water consumption data was analyzed to determine the percentage of metered consumption by land use. Customers were identified in the meter data as business, residential, irrigation, or public authority.[4] A 3-year average of the 2017, 2016, and 2015 consumption data was used as the existing conditions scenario in the hydraulic model of the system.

Figure 3-11 shows the annual consumption for the various land use categories as percentages. The land use category with the greatest water consumption is Residential, which accounts for 48% of the total water consumption, followed by Business (Commercial/Industrial) accounting for 31% of the total water consumption.

[4] 2.3% of the customers weren't classified.

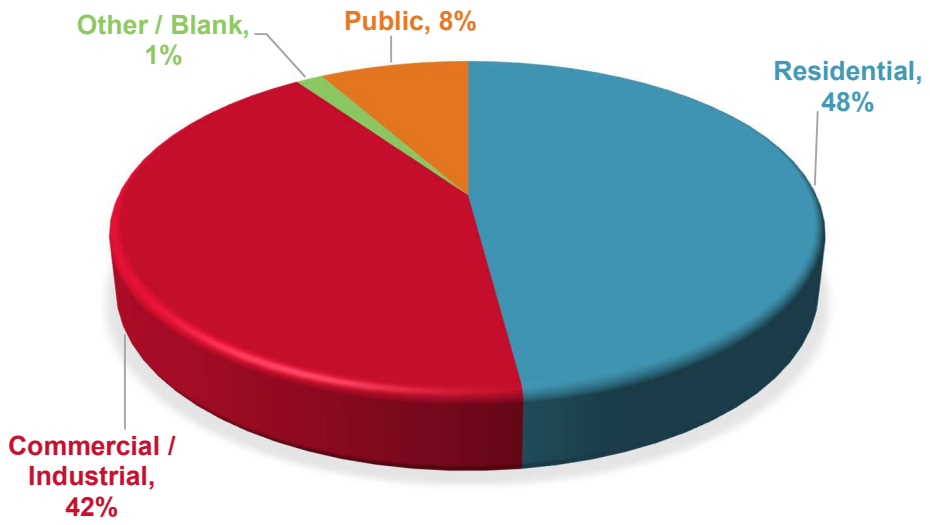



**Figure 3-11. Three-year Average Annual Water Consumption by Land Use (2015–2017)**

## Seasonal Customer Water Use

*Water demand in the summer can be 5 times higher than winter demands.*

Figure 3-12 shows the seasonal variation of water consumption based on the water billing data available from 2015 through 2017. Water consumption is highest in the summer due to the increase in irrigation demand, and it ranges from about 4 million gallons per day (MGD) in December to 21 MGD in July. Water production follows a similar trend observed in metered customers.

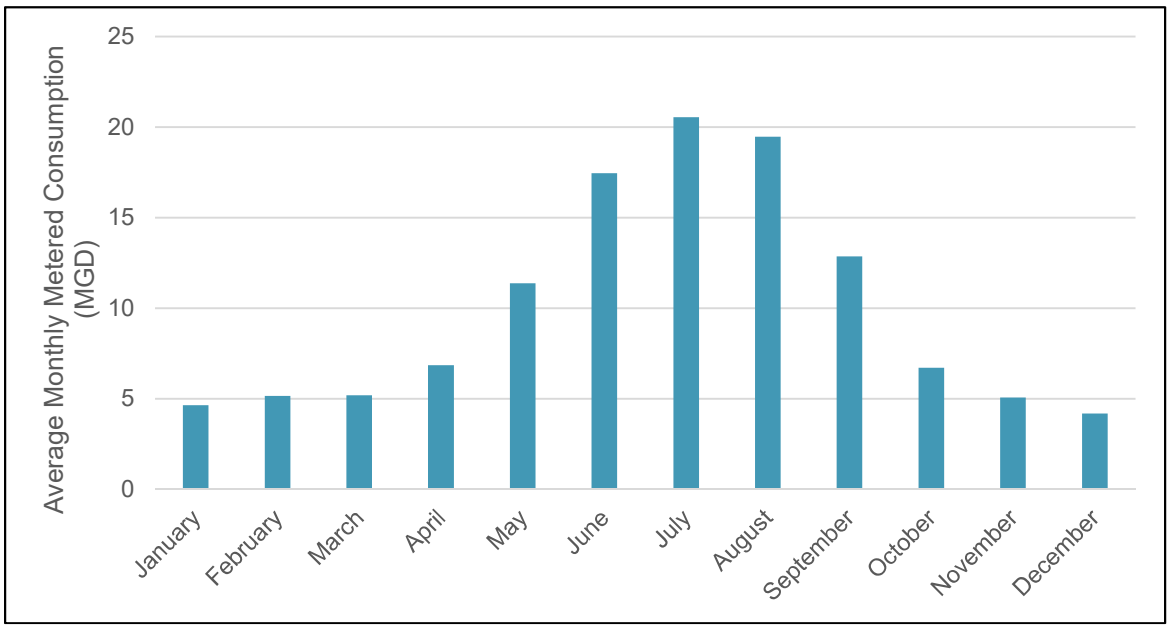



**Figure 3-12. Three-year Average Metered Customer Water Consumption by Month (2015–2017)**

## Average and Maximum Monthly Water Use

Figure 3-13 and Figure 3-14 show the annual average and maximum monthly water demand, respectively, for 2011 through 2017 based on water billing data. Water consumption increased from 2011 through 2013 and decreased slightly from 2013 to 2016.. Figure 3-12 above shows that water use is significantly lower in winter, which will result in a similar average demand as in previous years. A similar trend occurs in the maximum month water demand, with 2017 showing the highest maximum month demand.

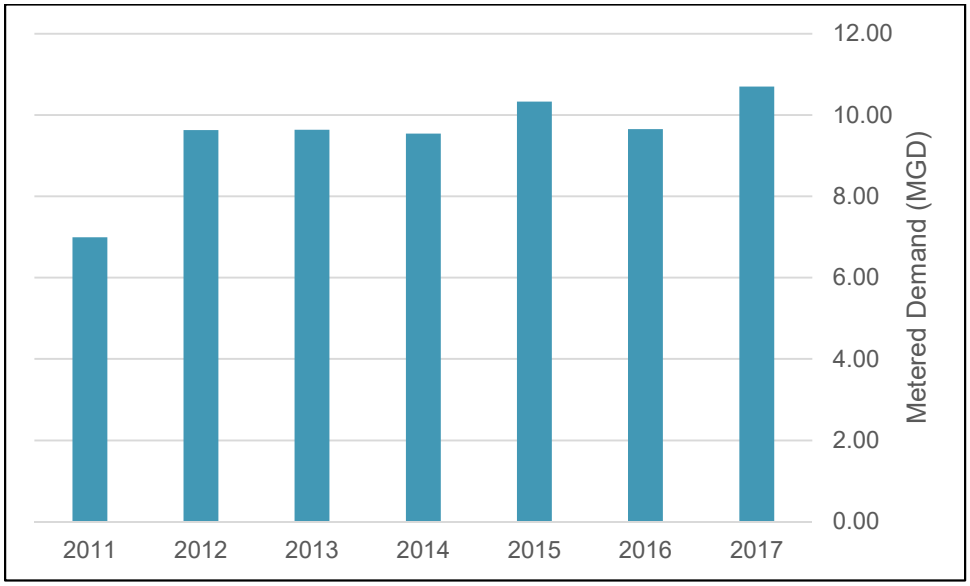



**Figure 3-13. Annual Average Metered Water Demand (2011–2017)**

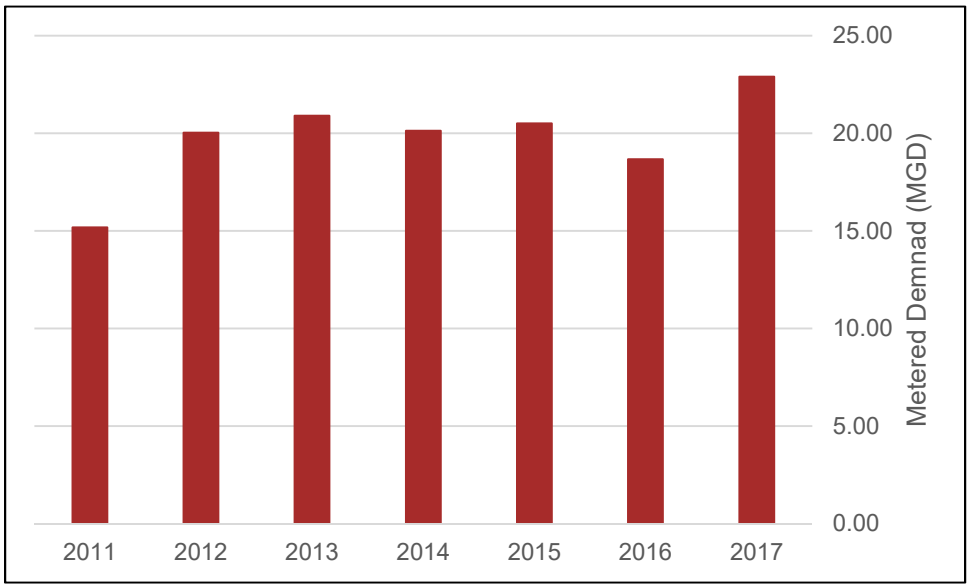



**Figure 3-14. Maximum Month Metered Water Demand (2011–2017)**

Table 3-6 summarizes the water demand data that were analyzed. The final maximum month peaking factor of 2.02 was obtained from an average of the past 3 years of data.

**Table 3-6. Total Annual Average and Maximum Month Metered Demand (2011–2017)**

| Year | Annual Average Day Demand (MGD) | Maximum Month Demand (MGD) | Maximum Month Peaking Factor |
|---|---|---|---|
| 2011 | 7.00 | 15.19 | 2.17 |
| 2012 | 9.63 | 20.03 | 2.08 |
| 2013 | 9.63 | 20.90 | 2.17 |
| 2014 | 9.55 | 20.14 | 2.11 |
| 2015 | 10.33 | 20.51 | 1.99 |
| 2016 | 9.65 | 18.69 | 1.94 |
| 2017 | 10.70 | 22.91 | 2.14 |
| **3-year average** | **10.22** | **20.70** | **2.02** |

Based on the historical water use analysis, the monthly peaking factors were developed using data from 2011 to 2017. The graph below shows the maximum monthly peaking factors over the last 7 years. Figure 3-15 shows maximum monthly peaking factors for the various years. Peaking factors help contrast high water demands between years and help refine diurnal patterns and peak demands for hydraulic model analysis.

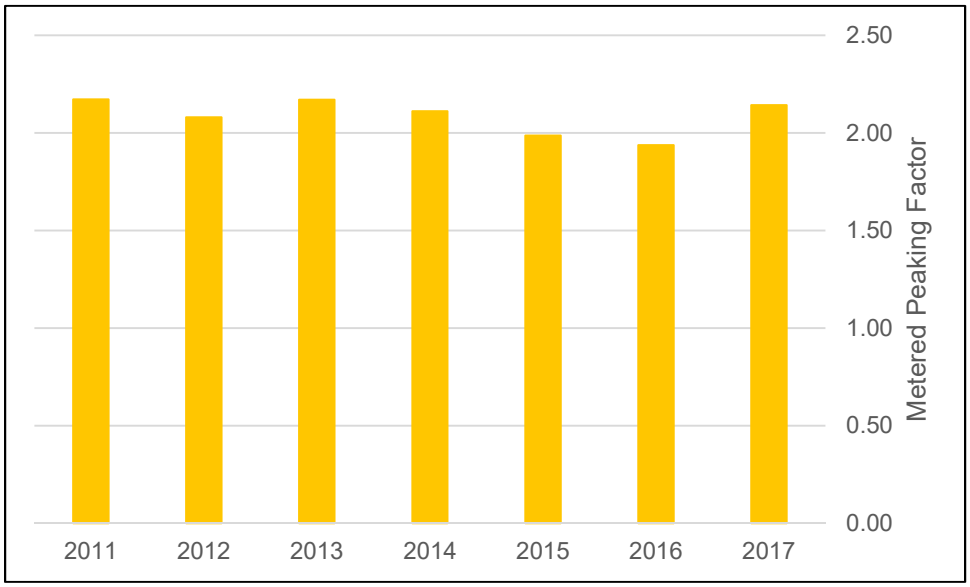



**Figure 3-15. Maximum Month Peaking Factor from Meter Data (2011–2017)**

## Maximum Day Production

The City performed a mass balance on water in the system using current production data to determine maximum-day and peak-hour demand. The maximum day demand is the largest volume of water delivered to the system in a single day. The maximum flow rate

delivered by the distribution system on any single hour during the year corresponds to the peak hour water demand. The 2017 maximum day occurred on July 25th. The maximum-day production was 43.6 MGD, and the peak-hour production was 60.7 MGD, which includes non-revenue water. These values differ from the values presented for the maximum month peaking factor because they were determined using the production data, which include flat-rate water demands and water loss, whereas the maximum-month peaking factor presented in the section above was determined directly from metered consumption data.

Table 3-7 summarizes the maximum-day and peak-hour demands based upon 2017 production data.

**Table 3-7. Maximum-Day and Peak-Hour Production (2017)**
**In millions of gallons per day (MGD)**

| Average Production | Maximum-Day | Peak-Hour |
|---|---|---|
| 21.5 | 43.6 | 60.7 |

Figure 3-16 shows the maximum-day diurnal demand pattern developed by the City. A diurnal curve describes the typical water use for a specific system (or area or pressure zone) over a 24-hour period. This diurnal pattern is used in the hydraulic model extended period simulation to better understand how the system operates over long periods of time. The maximum-day demand from this figure was used to determine the maximum-day and peak-hour peaking factors.

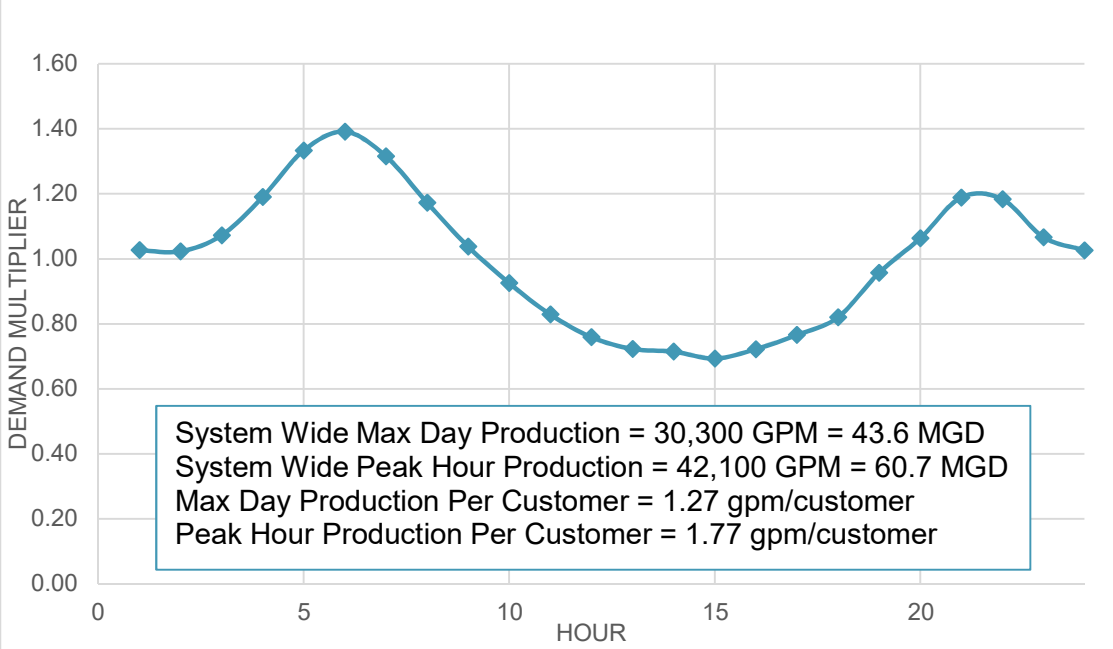



**Figure 3-16. Missoula Water Hourly Production Multipliers on Maximum Day (July 25, 2017)**

## Flat-Rate Customers

In Missoula, a portion of the total water demand comes from flat-rate customers. Flat-rate customers do not have a water meter, but instead are billed based on number of rooms and bathrooms in a home. Flat-rate customer water use and non-revenue water is difficult to determine accurately, since these are both unknown and un-metered values; however, several methods have been applied to best approximate flat rate customer usage and non-revenue water. The City completed American Water Works Association (AWWA) water audits from 2010-2013 which are included as Appendix A. The AWWA water audit provides a method for a water utility to input information including total water production, billed unmetered consumption such as water used for construction, unbilled unmetered consumption such as water used for firefighting, street cleaning, water main flushing, and fire flow tests, and meter inaccuracies, as well as other components.

In addition, the utility has completed reservoir fall studies since 1999. The reservoir fall studies provide an estimate of leakage in the system by storage zone. The tests consist of measuring the drop in reservoir levels during a several hour period in the middle of the night during a low usage time of the year (typically March and November). An assumption is made based on AWWA guidance that customers are using 0.25 times their average day water usage during the test.

In simple terms, the total water produced, minus the estimated leakage, should equal the flat rate water use. Then the total flat rate use can be divided by the number of flat rate customers; doing this predicts that flat rate customers likely use 1.7 times the typical metered residential customer.

The number of non-metered accounts identified in the wAccounts shapefile, or GIS data, provided by the City is consistent with information from previous water audits. Figure 3-17 shows the locations of the flat-rate customers reported in the wAccounts shapefile. Table 3-8 lists the number of flat-rate customers, the number of metered customers, and the ratio of flat-rate to metered customers.

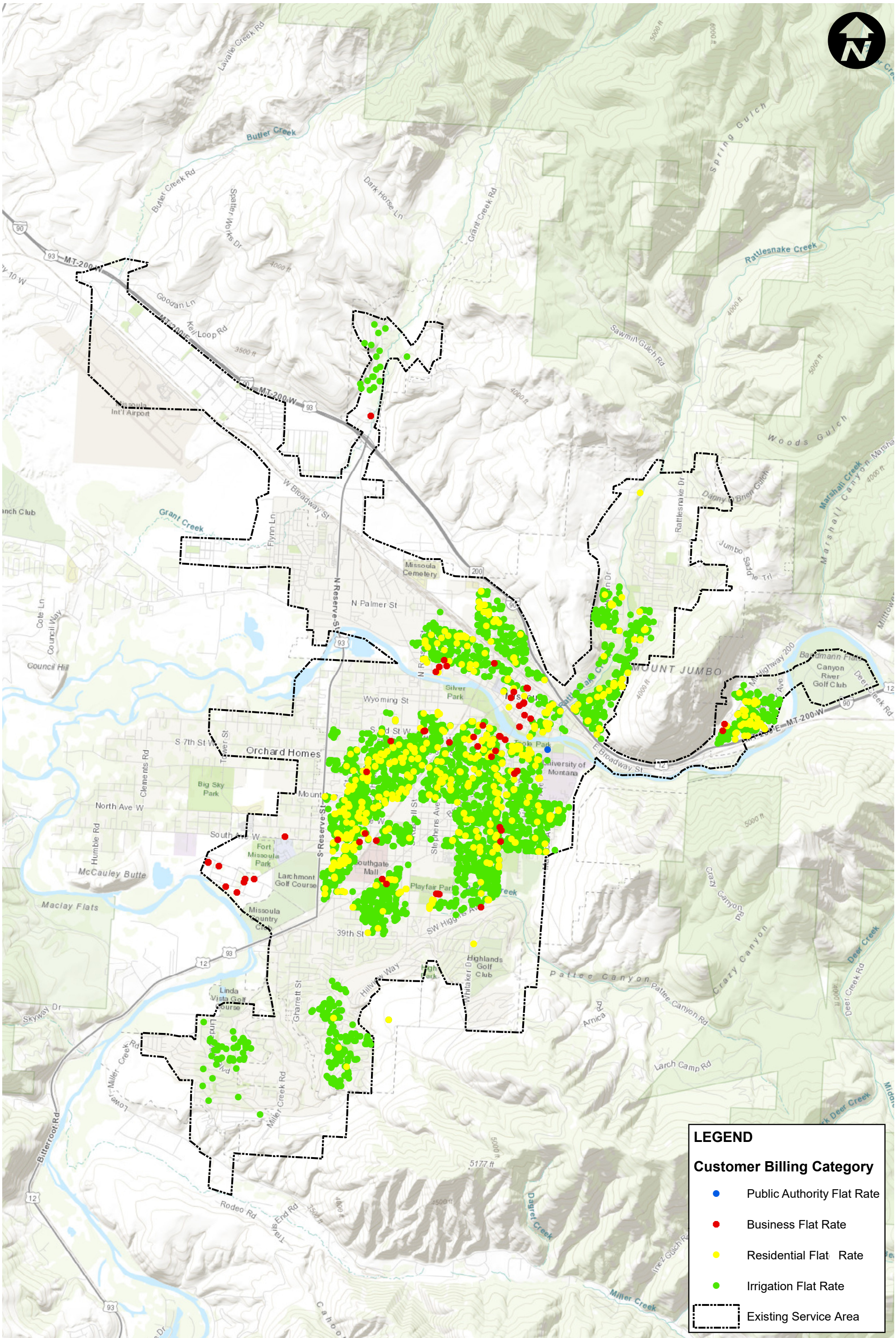



**FIGURE 3-17 CITY OF MISSOULA, MT**

**WATER FACILITIES MASTER PLAN**

**LOCATION OF FLAT RATE CUSTOMERS**

### Table 3-8. Flat-Rate Customers as a Percentage of Total Customers

| Year | Number of Flat-Rate Customers | Number of Metered Customers | Percentage of Flat-Rate Customers | Ratio of Flat-Rate to Metered Customers[a] |
|---|---|---|---|---|
| 2010 | 4,397 | 17,575 | 20% | 0.25 |
| 2011 | 4,094 | 18,147 | 18% | 0.23 |
| 2012 | 3,870 | 18,523 | 17% | 0.21 |
| 2013 | 3,674 | 18,888 | 16% | 0.19 |
| 2017 | 3,127 | 20,285 | 15% | 0.15 |

[a] Used to estimate flat-rate customer water demand based on metered customer water demand.

The 2017 ratio of flat-rate customers to metered customers (0.15) was used to determine the total flat-rate customer water demand for 2016 and 2017. The total demand from these years was multiplied by this ratio and the calculated water use rate relative to metered customers (1.7 times). Table 3-9 summarizes the total water consumption estimates for flat-rate customers.

### Table 3-9. Recent Flat-Rate Water Consumption Estimates from Meter Data

| Year | Total Metered Consumption (MG) | Estimated Flat-Rate Consumption (MG) |
|---|---|---|
| 2016 | 3,554 | 906 |
| 2017 | 3,231 | 824 |

## Significant Users

Major water users can have a significant effect on flows in the water system and on the hydraulic model calibration. Locating these large demands is important for developing an accurate model. Table 3-10 lists the top retail water customers as determined from the City's meter data, and Figure 3-18 shows their locations throughout the City's water system. The figure identifier (ID) from Table 3-10 identifies significant users.

**Table 3-10. Average Annual Water Use by the City's Largest Water Customers (year)**

| Figure ID | Customer Meter ID | Water Use Category | Average Demand (gpm) | Parcel Owner |
|---|---|---|---|---|
| 1 | A069448 | Public Authority Metered | 214.83 | University of Montana |
| 2 | A069447 | Public Authority Metered | 203.37 | University of Montana |
| 3 | A069570 | Public Authority Metered | 55.51 | UM Family Housing |
| 4 | A067930 | Business Metered | 47.44 | Community Medical Center |
| 5 | A069573 | Business Metered | 41.96 | Union Square Apts |
| 6 | A068301 | Business Metered | 37.67 | St Patricks Hospital |
| 7 | A069635 | Business Metered | 34.28 | American Eagle |
| 8 | A069455 | Public Authority Metered | 30.19 | Missoula County Airport |
| 9 | A068590 | Business Metered | 27.35 | Missoula County Detention |
| 10 | A066157 | Business Metered | 25.66 | Missoula County Fairgrounds |
| 12 | A068836 | Business Metered | 25.60 | Travois Village |
| 13 | A061133 | Irrigation Metered | 22.65 | Highland Golf |
| 14 | A063376 | Irrigation Metered | 21.02 | Wal-Mart |
| 15 | A081083 | Irrigation Metered | 19.26 | Gateway Partners |
| 16 | A081080 | Irrigation Metered | 19.19 | Cottonwood Condo Assoc |
| 17 | A069683 | Business Metered | 18.08 | Holiday Inn Downtown |
| 19 | A101935 | Irrigation Metered | 17.08 | City of Missoula Parks Dept |
| 20 | A068128 | Business Metered | 17.04 | Doubletree/Edgewater |
| 21 | A081085 | Irrigation Metered | 16.96 | Gateway Partners |
| 22 | A063370 | Irrigation Metered | 16.80 | Wal-Mart |
| 23 | A081105 | Irrigation Metered | 15.14 | Wal-Mart |
| 24 | A068202 | Irrigation Metered | 14.98 | Creekside Apts |
| 25 | A081086 | Irrigation Metered | 14.96 | Target |
| 26 | A101270 | Irrigation Metered | 14.91 | City of Missoula Parks Dept |
| 27 | A117630 | Irrigation Metered | 14.46 | City of Missoula Parks Dept |
| 28 | A080960 | Irrigation Metered | 14.35 | Copper Run Apts |
| 29 | A081139 | Irrigation Metered | 14.31 | Western States Equipment |
| 30 | A078321 | Irrigation Metered | 14.17 | City of Missoula Parks Dept |
| 31 | A069641 | Public Authority Metered | 13.96 | Aerial Fire Depot |

| Figure ID | Customer Meter ID | Water Use Category | Average Demand (gpm) | Parcel Owner |
|---|---|---|---|---|
| 32 | A069658 | Irrigation Metered | 13.92 | Lithia Motors |
| 33 | A069572 | Public Authority Metered | 13.70 | UM Family Housing |
| 34 | A069680 | Business Metered | 13.16 | Big Sky Brewing |
| 35 | A062576 | Irrigation Metered | 13.13 | Stone Mountain HOA |
| 36 | A090800 | Business Metered | 12.90 | Hilton Garden Inn |
| 37 | A109940 | Irrigation Metered | 12.84 | DirectTV AT&T Services |
| Un-joined | A083825 | Unknown | 12.45 | City of Missoula Parks Dept |
| 38 | A069054 | Business Metered | 12.32 | Trailer Park |
| 39 | A081084 | Irrigation Metered | 11.81 | Gateway Partners |
| 40 | A063687 | Irrigation Metered | 11.79 | City of Missoula Parks Dept |
| 41 | A081138 | Business Metered | 11.77 | Western States Equipment |
| 42 | A078316 | Irrigation Metered | 11.73 | City of Missoula Parks Dept |
| 43 | A078312 | Irrigation Metered | 11.70 | City of Missoula Parks Dept |
| 44 | A069919 | Irrigation Metered | 11.35 | Elk Hills HOA |

Apts = Apartments; Assoc = Association; Dept = Department; gpm = gallons per minute; HOA = Homeowners' Association; ID = identifier; UM = University of Montana

FIGURE 3-18 LOCATIONS OF MAJOR WATER USERS CITY OF MISSOULA, MT

WATER FACILITIES MASTER PLAN

MAJOR WATER USERS

### 3.3.2 Non-revenue Water Estimate

Non-revenue water, also referred to as unaccounted-for water, is the difference between the amount of water that enters Missoula's distribution system and the amount of water billed to Missoula's customers. Non-revenue water is water lost from the distribution system through a variety of ways, both authorized and unauthorized, including water for firefighting, street sweeping, pipe flushing, hydrant testing, leakage from pipelines, meter errors, main breaks, and theft.

**Table 3-11. Average Annual Water Production (2015–2017)**

| Year | Annual Average Production (MGD) |
|---|---|
| 2015 | 24.13 |
| 2016 | 23.97 |
| 2017 | 25.93 |
| **3-year average** | **24.68** |

Estimates for non-revenue water are directly related to the number of unmetered accounts. This relationship complicates the approximation of non-revenue water leaving the system. The City used water consumption data to estimate flat-rate customer water use by applying the assumptions discussed in the flat-rate customer section above. These estimates were used along with the consumption data to approximate non-revenue water.

The presence of flat-rate customers combined with water loss make it difficult to quantify water use, since assumptions must be used for both categories. The City helped develop assumptions that were used to estimate flat-rate water use and water loss. These assumptions are discussed in the following sections to clarify the water demand analysis.

Approximately 52% of annual water production is estimated to be non-revenue water. If assumptions are changed to assume equal water consumption for flat-rate and metered customers, non-revenue water is estimated to be approximately 56% of the City's water production in 2016 and 2017. The estimated non-revenue water percentages reflect approximations from previous AWWA water audits, which estimated non-revenue water at about 47% to 52% of total production using the same assumptions.

Expressing non-revenue water as a percentage is problematic for a variety of reasons, which is why the City has used AWWA water audits and the reservoir fall studies to attempt to *quantify* water losses. Having the use of several robust, detailed performance indicators instead of a single, simplistic indicator is a superior means by which to assess water loss. Table 3-12 shows the monthly water use trends for a 3-year average of 2015 through 2017 and identifies the portions of flat-rate, metered, and non-revenue water.

### Table 3-12. Estimate of Non-revenue Water (2015 - 2017)

In millions of gallons per day (MGD)

| Month | Average Production | Average Metered Consumption | Estimated Flat Rate[a] | Estimated Non-revenue | Percent Non-revenue |
|---|---|---|---|---|---|
| January | 18.50 | 4.65 | 1.07 | 12.78 | 69% |
| February | 18.60 | 5.16 | 1.19 | 12.25 | 66% |
| March | 19.62 | 5.20 | 1.32 | 13.1 | 67% |
| April | 23.33 | 6.85 | 1.33 | 15.15 | 65% |
| May | 30.52 | 11.37 | 1.75 | 17.4 | 57% |
| June | 37.50 | 17.46 | 2.90 | 17.14 | 46% |
| July | 37.10 | 20.54 | 4.45 | 12.11 | 33% |
| August | 30.16 | 19.46 | 5.24 | 5.46 | 18% |
| September | 22.17 | 12.85 | 4.96 | 4.36 | 20% |
| October | 19.24 | 6.71 | 3.28 | 9.25 | 48% |
| November | 17.98 | 5.06 | 1.71 | 11.21 | 62% |
| December | 18.19 | 4.18 | 1.29 | 12.72 | 70% |
| **Average** | **24.41** | **9.96** | **2.54** | **11.91** | **52%** |

[a] Assuming that flat-rate customers use 1.7 times as much water as metered customers.

## Spatial Allocation of Non-revenue Water

Non-revenue water has been estimated by pressure zone and allocated in the hydraulic model on an inch-diameter-mile basis to account for pipe length and diameter. Once water demands have been spatially allocated to the model, a water balance can be performed to compare consumption and supply in each pressure zone to determine non-revenue water in each zone. This process is covered in greater detail in the hydraulic modeling chapter.

The City started doing reservoir fall studies in 1992 and has consistently done them at least once per year since 1999 to quantify water loss by storage zone. These data were used to determine which pressure zones have the most leakage, and estimates in gallons per minute (gpm) were developed. These data will be used in conjunction with the pressure zone level water balance to refine water loss estimates in each zone. The data from the 2017 leak study are summarized in Table 3-13 and Figure 3-19.

### Table 3-13. Water Loss by Storage Zone (2017)

| Tank | Estimated Leakage (gpm) | Estimated Percentage of Total Leakage |
|---|---|---|
| 3 MILLION RES | 4,850 | 55% |
| # 1 RES | 2,899 | 33% |
| # 2 RES | 235 | 3% |
| EAST MSLA TANK | 218 | 2% |
| HILLVIEW TANK | 214 | 2% |
| HIGHPARK RES | 169 | 2% |
| ELK RIDGE TANK | 104 | 1% |
| SKYVIEW RES | 56 | 1% |
| WHITAKER 400K TANK | 43 | 0% |
| CRESTLINE TANKS | 21 | 0% |
| GHARRETT TANK | 16 | 0% |
| UPPER ELK RIDGE TANK | 6 | 0% |
| LINCOLN 6 TANK | 4 | 0% |
| UPPER PROSPECT | 1 | 0% |
| LINCOLN HILLS TANK | 0 | 0% |
| MANSION HEIGHTS TANK | 0 | 0% |
| TWITE 85K RES | 0 | 0% |
| TWITE 500K RES | 0 | 0% |
| **Total** | **8,838** | **100%** |

Source: 2017 City of Missoula Leak Study

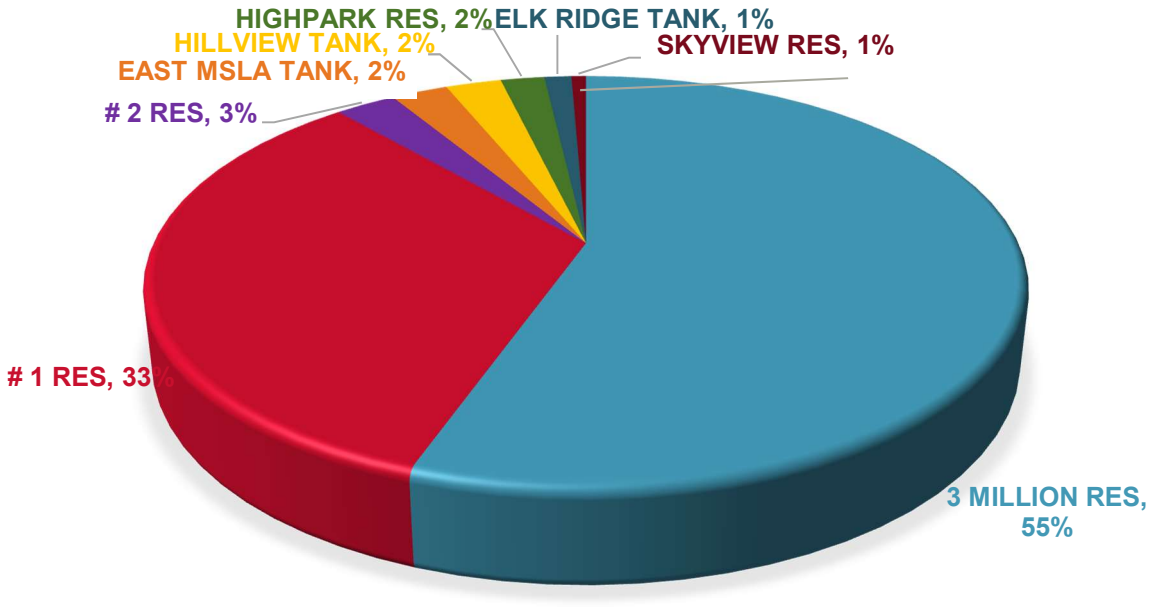



**Figure 3-19. Percentage of Total Leakage by Storage Area in 2012**
Source: 2012 City of Missoula Leak Study

### 3.3.3 Wells

According to Montana's Ground Water Information Center, there are 3,282 wells in the study area that are classified as either domestic, commercial, or public water supply. Some of these will likely connect to the City of Missoula water system over time, particularly domestic wells in areas of redevelopment. Because the number of wells is a relatively low percentage of the total population (<5%), they have not been taken into account for total water demands.

### 3.3.4 Other Public Water Supply Systems

There are a number of public water supply systems in the study area that are not currently served by the City of Missoula. The larger systems include Phantom Hills and the Wye Area water system. These two systems are designed to serve a total population of about 800 residential and 72 commercial connections. These systems have facilities and water rights to serve their customers. They may be integrated into the City of Missoula water system in the future, but further evaluations would be needed.

## 3.4 Water Duty Factors and Unit Demands

A water duty factor is defined as the daily water use per some specified unit (for example, acre, person, or dwelling unit) for a given land use type and is a common element of water system planning. Water duty factors were developed to describe current water use by land use and were then applied to future land use to estimate future water demands. The methodology used to develop duty factors involves correlating historical parcel-level water consumption data with its designated land use type so that the actual water user per acre or per unit can be calculated. These duty factors have been developed so that more-precise water demands can be projected and so that the basis of planning derived for evaluating facility sizing and adequacy is improved.

Average annual unit water demands are developed for specific land use types or water billing account types to project future water use. Since the amount of water required by a given land use can vary widely, Missoula's planning-level water unit demand factors were developed based on existing water use specific to customers in the service area. Because the type, location, and number of water customers change with time, typically the most recent years (2011–2017) of billing data are used for the historical water use trend analysis. Ideally, as the basis of planning for future demand conditions, unit demands should represent current Missoula demands independent of any short-term trends. With this in mind, Missoula's water use history was taken into consideration in determining the basis for current unit demands.

Unit demands for each land use type were calculated based on a 3-year average (2015–2017) of billing data for meters from each land use category for Missoula's entire existing service area. Meter data included Residential, Public Authority, Business (Commercial/Industrial), and Irrigation, with some meters having no (blank) land use designation. Unit demands were developed for residential and non-residential land use types to project future-condition demands.

Duty factors for residential land use could be calculated directly from the data provided by dividing the total amount of metered residential demand by the total meter count multiplied by the 2.30 persons per household estimate for 2037 reported in the TAZ data. Employees aren't equivalent to a full-time resident, so the employee count from the 2015 TAZ data had to be used to determine the non-residential duty factor. This required an estimate of the non-residential flat rate water use.

To determine non-residential flat rate water use, the City removed the irrigation and residential water demands from the total system water demand. The flat-rate use was estimated using the ratio of flat-rate customers to metered customers (0.15) and the assumption that flat-rate customers use 1.7 times as much water as metered customers. The estimated total non-residential demand was divided by the total number of employees to determine the non-residential duty factor. Table 3-14 lists the duty factors calculated from consumption data.

**Table 3-14. Water Duty Factors by Land Use (2015-2017) for Metered Customers**

| Land Use Category | 2015 | 2016 | 2017 | 3-year Average |
|---|---|---|---|---|
| Residential | 143.99 | 128.44 | 151.39 | 139.69 |
| Non-residential | 58.47 | 57.28 | 57.55 | 58.47 |

In gallons per capita per day (gpcd)

The resulting duty factor for residential development is consistent with that from the benchmark cities provided in the demand projections section below. It's slightly below the duty factors provided for Miles City and Rapid City and above the duty factor for Bozeman.

These duty factors represent local consumptive water use. Typically, the ratio of duty factors for non-residential to residential uses is between 20% and 30%. The ratio of duty factors calculated from Missoula's water use data is about 42%. This value can be influenced by the non-metered demand estimates but is considered to provide an acceptable conservative estimate of future-condition demand.

### 3.4.1 Benchmarking

Per-capita water use varies greatly between utilities. The U.S. Geological Survey's *Description of 2005–2010 Domestic Water Use for Selected U.S. Cities and Guidance for Estimating Domestic Water Use* examined water use data for 21 cities nationwide, including Helena and Miles City in Montana. Total per-capita water use varied from 78 gallons per capita per day (gpcd) to 294 gpcd, and 19 of the 21 city studies showed per-capita water use declining from 2005 to 2010. Table 3-15 shows per-capita water use for some cities in Montana and surrounding areas.

**Table 3-15. Benchmark Water Use for Cities in Montana and Surrounding Areas**

| City | Year | Average Gallons per Capita per Day (gpcd) |
|---|---|---|
| Miles City, MT | 2010 | 150 |
| Helena, MT | 2010 | 170 |
| Billings, MT | 2018 | 181 |
| Bozeman, MT[a] | 2015 | 113 |
| Rapid City, SD[b] | 2017 | 147 |
| **Missoula, MT[c]** | **2017** | **140** |

[a] Bozeman's gpcd dropped 8% between 2013 and 2015 in conjunction with the implementation of a water-conservation program.

[b] Source: Rapid City, South Dakota, website accessed September 17, 2017. Available at https://www.rcgov.org/rapid-city-news-room/water-conservation-measures-in-effect-2986.html.

[c] Value reported for Missoula reflects residential metered water use.

# 3.5 Population Projections

## 3.5.1 Population Growth Projections

Population growth projections were developed for a 20-year planning horizon using the most recent TAZ data, this is consistent with the 2018/2019 Wastewater Master Plan. The TAZ data includes 2015 population and employment numbers, and projected growth every 5-years out to 2045, including population and employment numbers for 2037[5]. The 2015 population data was adjusted using recent building permit data to determine the 2017 population.

Table 3-16 provides population projections by year within the study area boundary, and Figure 3-20 shows the growth graphically.

**Table 3-16. Residential Population Projections (2017–2045)**

| Year | Total Population | Incremental Growth | Percentage Growth |
|---|---|---|---|
| 2017 | 86,971 | — | — |
| 2022 | 90,631 | 3,660 | 4% |
| 2027 | 95,973 | 5,342 | 6% |
| 2032 | 103,633 | 7,660 | 8% |
| 2037 | 116,203 | 12,570 | 12% |
| 2045 | 141,421 | 25,218 | 22% |

Source: City-provided TAZ data
Values reflect TAZ projections in the study area.

[5] City transportation professionals created a 2037 data set specifically for use in the Water System Master Plan and the Wastewater Facility Plan.

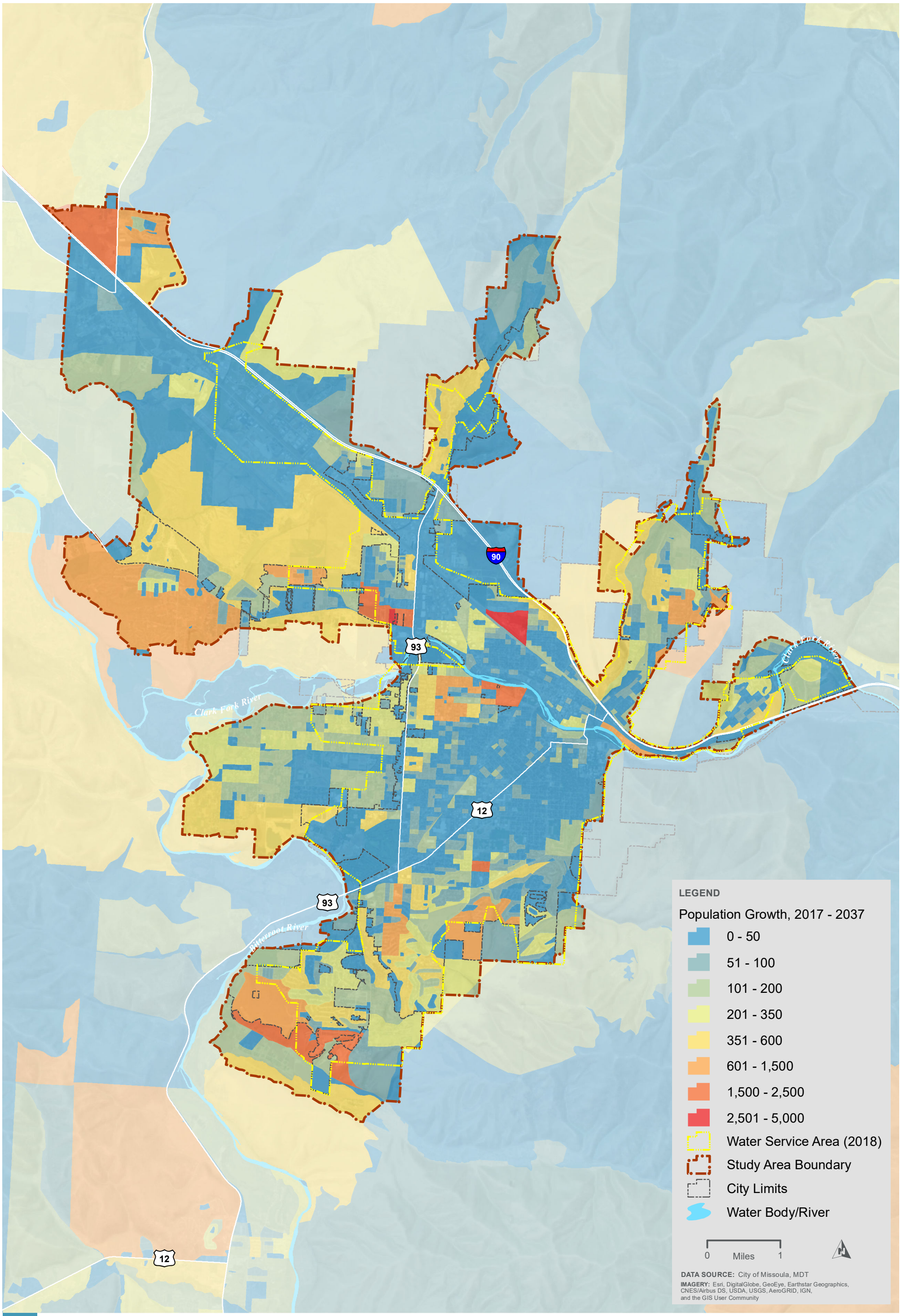



**FIGURE 3-20 POPULATION GROWTH BY TAZ (2037)**

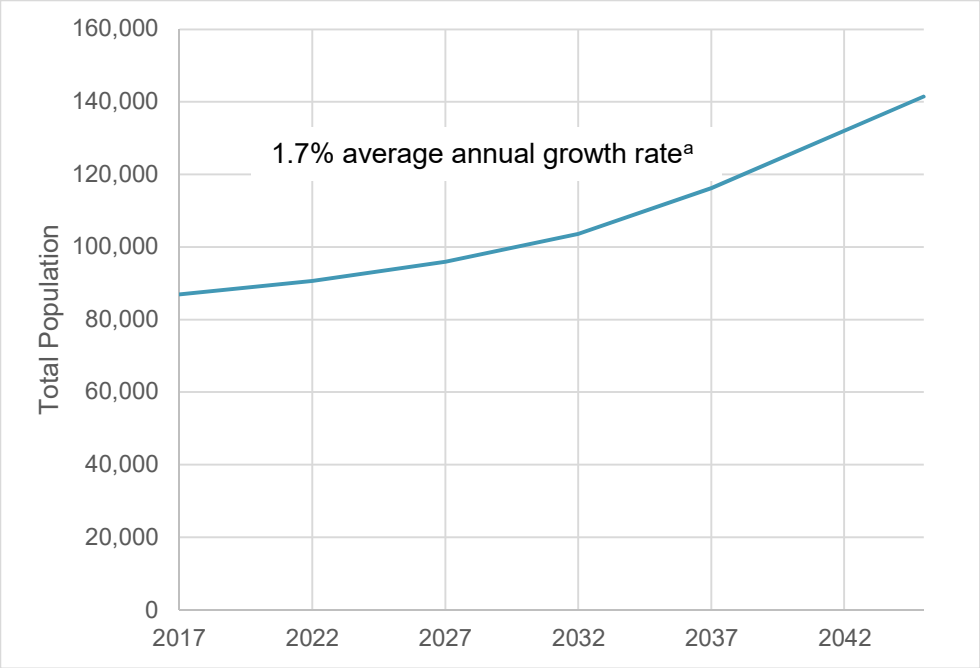



**Figure 3-21. Residential Growth in the Study Area**

The TAZ data have categories for Retail, Service, Basic, Education, Healthcare, and Leisure employment. The summation of each of these categories is presented as total employment. The consumption data provided by the City were sufficient to develop residential and non-residential factors to project growth. As a result, the total employment was used instead of projecting water use for specific employment categories. The percentage of total residential growth from 2017 to 2045 at each 5-year time-step observed was used to scale the non-residential growth for each planning time-step. The total incremental growth presented in the TAZ data (2045–2015) was multiplied by these percentages to determine non-residential growth at each interim time-step.

Table 3-17 presents the total employment at each 5-year time-step, the total incremental increase in employment, and the percent growth. Total employment projections are displayed graphically in Figure 3-23.

**Table 3-17. Employment or Non-residential Growth (2015–2045)**

| Year | Total Employment | Incremental Growth | Growth Percentage |
|---|---|---|---|
| 2015 | 65,235 | — | — |
| 2017 | 65,971 | 736 | 1% |
| 2022 | 67,812 | 1,840 | 3% |
| 2027 | 71,572 | 3,761 | 5% |
| 2032 | 76,965 | 5,393 | 7% |
| 2037 | 85,814 | 8,849 | 10% |
| 2045 | 103,567 | 17,753 | 17% |

Source: City-provided TAZ data
Values reflect TAZ projections in the study area.

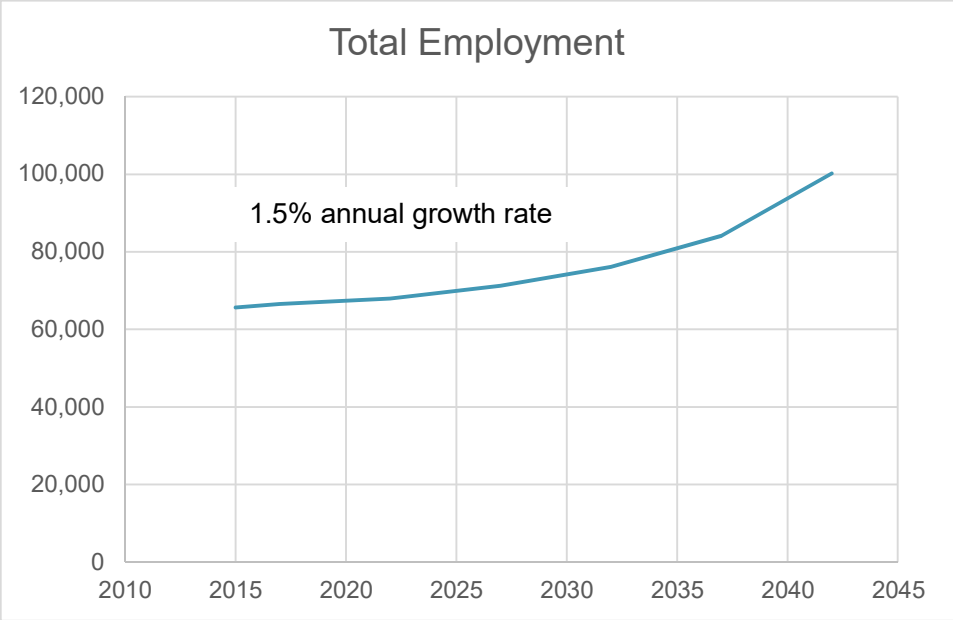



**Figure 3-22. Non-residential Growth**

## 3.6 Future Water Demand Projections

Future water demand projections enable the city to understand spatial and temporal patterns of future water use, plan for future water supply and storage locations and quantity, and plan for system expansion. The demand-forecasting approach developed for this Water System Master Plan update is based on the following factors:

- Baseline system demands for 2017 were developed from meter data. These demand are spatially allocated at the parcel level.
- Three time-steps have been developed, analyzed, and included in the hydraulic model.

- For Missoula, future growth will be estimated using the City's TAZ data to provide residential and non-residential growth estimates for the established planning time-steps.
- An assumption was made that flat-rate customers will continue converting to meters at the same rate they've been doing for the past few years; about 5% or 181 customers per year. As stated above, it is assumed that flat rate customers use about twice the water as metered customers; this is factored into the future water demand projections.
- Individual wells were assessed and because they are a small percentage of the overage population (<5%), they have not been accounted for in future water demand projections.
- There are a number of other public water supply systems in the study area boundary. Some of these may connect to the City's water system in the future. For the purpose of the basis of planning (population projections and future water demand projections), those customers served by other PWS's have been included in the demand forecasting.
- Results should be verified against city and county planning documents and should align with other ongoing planning efforts.

These factors are described in more detail below.

### 3.6.1 Near-Term Growth

Several large developments are either ongoing or have been approved and will likely be completed in the next 3 to 5 years. In addition, the City is undertaking several capital improvement projects, including main-replacement projects and new water storage facilities, that are either ongoing or will likely be completed in the next 3 to 5 years. Table 3-18 lists these developments along with their projected water demands, and Figure 3-2 shows these areas as well as planned capital improvements to the water system.

## Table 3-18. City's Near-Term Preliminary Plans for Development

| Development | Residential | Commercial | Projected Average Day Demand (gpm) |
|---|---|---|---|
| Hotel Fox | 250 multifamily units | 60,000 SF conference, 195-room hotel, 50,000 SF office, 35,000 SF retail | Multi-family = 45 |
| ROAM student living | 488 multifamily units | 6,500 SF retail | Multi-family = 87.84 |
| Millsite | 500–700 residential units (120 single family,400–600 multifamily) | 150,000–2000,000 SF | Residential = 42<br>Multi-family = 108 |
| Mercantile/Residence Inn | — | 24,000 SF retail/ convention, 160,000 SF hotel with 154 rooms | — |
| Teton at Maloney Ranch | Residential = 488 lots<br>Multi-family = 312 units | 2.88 acres | Residential = 171<br>Commercial = 2<br>Multi-family = 56<br>Irrigation = 21<br>Total = 250 |
| Miller Creek View and Linda Vista Estates | Residential = 488 lots<br>Multi-family = 132 units | 2.3 acres | Residential = 171<br>Commercial = 2<br>Multi-family = 24<br>Irrigation = 19<br>Total = 216 |

SF = square feet

LEGEND

- Near Term Significant System Improvements
- Near Term Significant Developments (1-5 yrs)
- Water Main
- Well
- Water Storage Facility
- City Limits
- Water Service Area

0 Miles 1

**DATA SOURCE:** City of Missoula, MDT

**IMAGERY:** Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Upper Lincoln Hills Tank
220,000 gal

Lower Lincoln Hills Tank
170,000 gal

Clark Fork River

Bitterroot River

See Inset Map

90 93 12

## Near Term Developments

| Name | Units | Commercial SF |
|---|---|---|
| 1. ROAM | 488 multifamily | 6,500 retail |
| 2. Mercantile/ Residence Inn | 154 hotel rooms | 24,000 retail/convention, 160,000 hotel |
| 3. Hotel Fox | 250 multifamily, 195 hotel rooms | 35,000 retail, 50,000 office, 60,000 conference |
| 4. Millsite | 500-700 (100 single family, 400-600 multifamily) | 150,000-200,000 |
| 5. Linda Vista Estates | 976 single family, 444 multifamily | -- |
| 6. Hillview Way | 610 total units | -- |

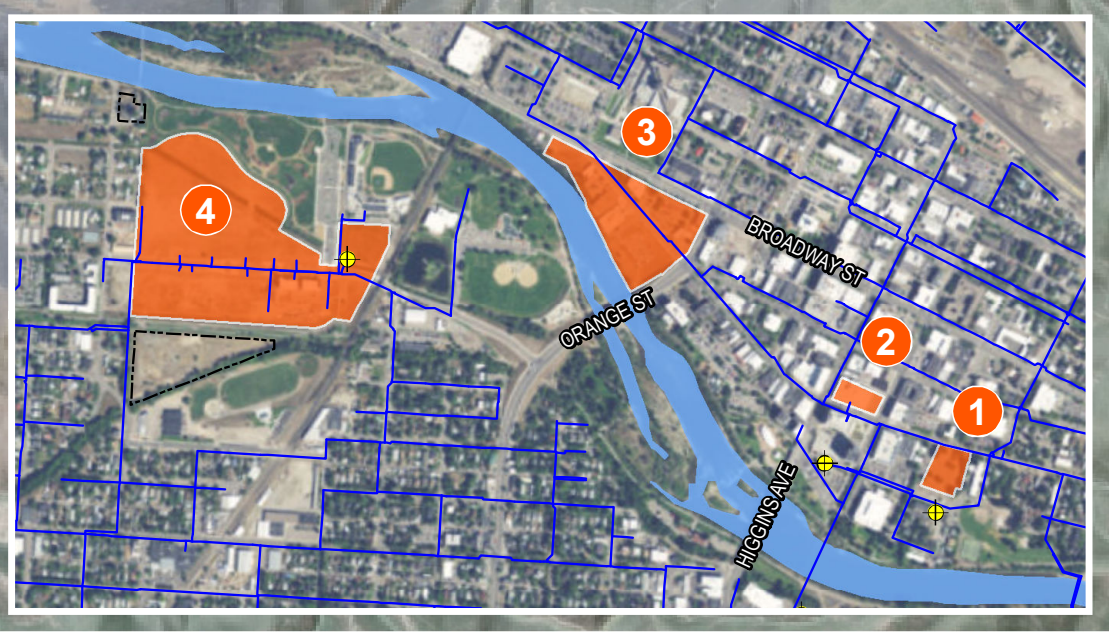



**FIGURE 3-23 NEAR TERM DEVELOPMENT**

## 3.6.2 Water Duty Factors

Average annual unit water demands are developed for specific land use types or water billing account types to project future water use. Since the amount of water required by a given land use can vary widely, Missoula's planning-level water duty factors are developed based on existing water use specific to customers in Missoula's service area.

**Table 3-19. Water Duty Factors for Individual Land Uses**

| Land Use Category | 3-year Average (gpcd) |
|---|---|
| Residential | 139.69 |
| Non-residential | 63.37 |

Ideally, as the basis of planning for future water demand conditions, unit demands should represent current demands independent of any short-term trends. With this in mind, the City took Missoula's water use history into consideration when determining the basis for current unit demands. Duty factors are presented in gallons per capita per day (gpcd). Table 3-19 lists the duty factors for individual land uses for Missoula.

## 3.6.3 Flat-Rate Customers

Converting flat-rate customers to metered use will help reduce water use across the city. To account for changes in water use trends, the City developed an annual conversion rate. Data from previous AWWA water audits provide trends in the number of flat-rate customers from 2010 through 2013. Other available data include the current wAccounts billing shapefile providing information for 2017, and an updated spreadsheet dated June 2018 that indicated the number of active flat rate customers is 3,127.

The 3-year (2011–2013) estimate for flat-rate consumption indicates that on average 241 customers were converted to metered use per year. However, the rate at which flat-rate customers are being converted to metered use is decreasing, since fewer flat-rate customers remain. From 2013 to 2017, about 135 customers per year converted to metered service. Assuming that the City pursues further efforts to convert flat-rate customers to metered use, a constant reduction rate can be established to eliminate flat-rate customers by the 20-year planning horizon.

The most recent data from the city indicates that there are about 3,127 flat-rate customers. To eliminate flat-rate customers within the 20-year planning horizon, a conversion rate of 156 customers, on average, per year is required, which is about 5% of existing flat-rate customers. This rate was used to develop demand projections.

Table 3-20 lists the data available to determine the rate needed to eliminate flat-rate customers.

**Table 3-20. Number of Flat-Rate Customers and Elimination Rate**

| Year | Number of Flat-Rate Customers | Change in Number of Flat-Rate Customers | Reduction Rate per Year |
|---|---|---|---|
| 2010 | 4,397 | — | — |
| 2011 | 4,094 | 303 | 7.4% |
| 2012 | 3,870 | 224 | 5.7% |
| 2013 | 3,674 | 196 | 5.3% |
| 2017 | 3,127 | 547 | 3.7% |
| Historical average reduction per year 2011–2013 / Average Reduction Rate | | | 241 / 4.75% |
| Per year flat-rate conversions needed to eliminate flat rate customers within the 20-year planning horizon | | | 156 per year |

The City may choose to implement policies and practices that would accelerate the flat-rate conversions, including the following;

- Require flat-rate customers to convert to meters upon sale of their property
- Require flat-rate customers to convert to meters during a water main replacement project
- Offer incentives for flat-rate customers to convert to meters
- Penalize flat-rate customers with higher water rates
- Provide loan or grant programs for homeowners to convert from flat rates to a meter and repair any leaking plumbing or leaking irrigation lines

Water-use reductions will be spatially allocated in the hydraulic model using the assumed flat rate customer conversion rate and the meter shapefile that identifies the locations of flat-rate customers.

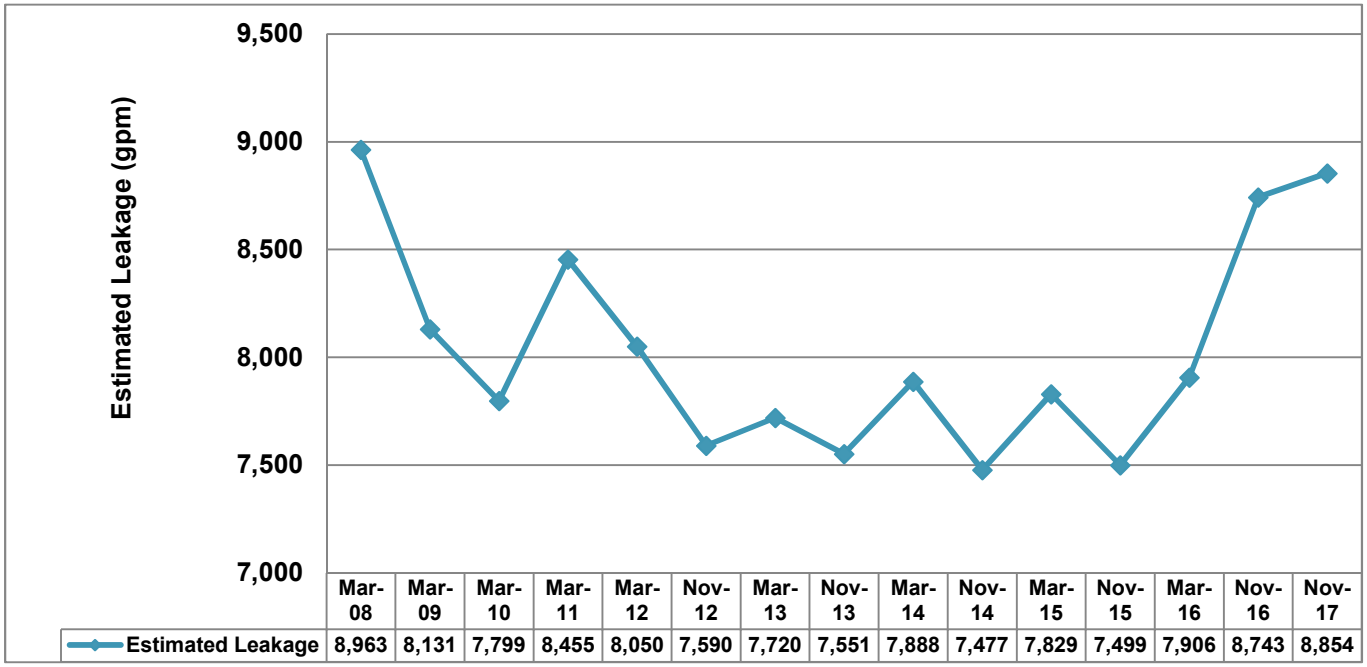
### 3.6.4 Non-Revenue Water

Non-revenue water includes many sources such as meter inaccuracies, water used for street sweeping, firefighting, hydrant flushing, construction water, main breaks, and water main and service line leaks.

To address water main leaks, the City has an annual renewal program to replace poor-condition pipelines that cause elevated water loss. In comparison to other cities, Missoula's climate causes increased water loss rates due to stresses put on the system during freeze-and-thaw cycles. In addition, because the soils found in the Missoula valley are porous and cobbly, water leaks rarely surface but instead are returned to the aquifer. The City has tracked water loss over the past 9 years, in part to determine the effect of the renewal program.

The renewal program has been on hold over the past 2 to 3 years during the condemnation trial and transition period, but the City has resumed a program of main replacements and completed a number of main replacement projects since taking over the system. This non-revenue water is allocated separately in the hydraulic model. To account for the improvements performed as part of the renewal program, the historic water loss data will be reviewed along with the miles of pipeline replaced to estimate reductions in water loss. Reinstating the renewal program may result in similar reductions in water loss as those that occurred from 2008 to 2015. Figure 3-24 shows the estimated leakage in the system while the renewal program was active and after it was put on hold. The estimates applied in the model are discussed in the hydraulic modeling chapter.

As stated in the City Growth Policy, adopted November 23, 2015, the City of Missoula has a "focus inward" policy that promotes infill and compact development where infrastructure and utilities already exist. This policy puts additional pressure and focus on maintaining and either rehabilitating or replacing existing infrastructure. A robust rehabilitation or replacement program will be important as Missoula continues to grow, and it's critical to reducing water loss.




| | Mar-08 | Mar-09 | Mar-10 | Mar-11 | Mar-12 | Nov-12 | Mar-13 | Nov-13 | Mar-14 | Nov-14 | Mar-15 | Nov-15 | Mar-16 | Nov-16 | Nov-17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Estimated Leakage | 8,963 | 8,131 | 7,799 | 8,455 | 8,050 | 7,590 | 7,720 | 7,551 | 7,888 | 7,477 | 7,829 | 7,499 | 7,906 | 8,743 | 8,854 |

**Figure 3-24. Estimated Water Leakage in Missoula (2008–2017)**

Source: City of Missoula Water Department, Reservoir Fall Studies

## 3.6.5 Future Demand Projections Summary

Future demand projection are presented below.

Table 3-21 and Table 3-22 summarize the water demand projections developed from the TAZ data. Table 3-21 provides the increase in residential population and correlated incremental increase in demand for each time-step provided in the TAZ data. Table 3-22 provides the estimated employment numbers and correlated incremental increase for each planning time-step. Table 3-23 provides the future demand projections incorporating residential growth, non-residential growth, and flat-rate customer demand and conversion.

## Table 3-21. Increase in Average Residential Water Demand (2017–2045)

| Year | Total Population within Study Boundary | Population Increase from Baseline 2017 | Incremental Demand Increase from Baseline (gpm) | Incremental Demand Increase from Baseline (MGD) |
|---|---|---|---|---|
| 2017a | 83,969 | — | — | — |
| 2022 | 87,475 | 3,506 | 340 | 0.49 |
| 2027 | 92,615 | 8,646 | 839 | 1.21 |
| 2032 | 100,033 | 16,064 | 1,558 | 2.24 |
| 2037 | 112,306 | 28,337 | 2,749 | 3.96 |
| 2042b | 137,029 | 53,061 | 5,147 | 7.41 |

[a] Baseline production is 24.68 MGd. Baseline demand including non-metered estimates is 13.89 MGd, which is calculated using a 3-year average.

[b] The study period is 2037. 2042 demands are only included for reference.

## Table 3-22. Increase in Average Non-residential Water Demand (2015–2045)

| Year | Total Employment within Study Boundary | Employment Increase from Baseline 2015 | Incremental Demand Increase from Baseline (gpm) |
|---|---|---|---|
| 2015 | 65,667 | — | — |
| 2017a | 66,579 | 912 | 37 |
| 2022 | 67,947 | 2,280 | 93 |
| 2027 | 71,289 | 5,622 | 228 |
| 2032 | 76,113 | 10,446 | 424 |
| 2037 | 84,094 | 18,427 | 748 |
| 2042 | 100,170 | 34,503 | 1,401 |

[a] Non-residential demand is estimated from 2015. To estimate the incremental increase from 2017 to 2022, growth from 2015 to 2022 was assumed to be linear so that growth from 2015 through 2017, which is accounted for in the consumption data, wasn't counted twice.

## Table 3-23. Historical and Projected Future Average and Max Day Demand in MGD (2011–2042)

| Year | Res and Non-Res Avg. Demand (MGD) | Res and Non-Res Max Demand (MGD) | Flat Rate Demand Estimate (MGD) | Flat Rate Reduction (MGD) | Converted Flat Rate Demand (MGD) | Average Day Demand (MGD) | Max Day Total Demand (MGD) | Peak Hour (MGD) |
|---|---|---|---|---|---|---|---|---|
| 2011 | 7.0 | 18.9 | 1.79 | | | 8.8 | 17.8 | 27.6 |
| 2012 | 9.6 | 26.0 | 2.46 | | | 12.1 | 24.5 | 38.0 |
| 2013 | 9.6 | 26.0 | 2.46 | | | 12.1 | 24.5 | 38.0 |
| 2014 | 9.6 | 25.8 | 2.44 | | | 12.0 | 24.4 | 37.9 |
| 2015 | 10.3 | 27.9 | 2.63 | | | 12.9 | 26.2 | 40.7 |
| 2016 | 9.6 | 26.1 | 2.46 | | | 12.2 | 24.7 | 38.3 |
| 2017 | 10.7 | 28.9 | 2.61 | | | 13.3 | 27.0 | 41.9 |
| 2022 | 11.3 | 30.6 | 1.96 | 0.65 | 0.33 | 13.6 | 27.6 | 42.8 |
| 2027 | 12.2 | 33.0 | 1.31 | 0.65 | 0.65 | 14.2 | 28.7 | 44.6 |
| 2032 | 13.6 | 36.6 | 0.65 | 0.65 | 0.98 | 15.2 | 30.9 | 48.0 |
| 2037 | 15.7 | 42.5 | 0.00 | 0.65 | 1.31 | 17.0 | 34.5 | 53.6 |
| 2042 | 20.1 | 54.3 | 0.00 | 0.00 | 1.31 | 21.4 | 43.5 | 67.4 |

[a] Reduction in demand due to the conversion of flat-rate customers is based on the estimate of flat-rate consumption using the average from 2015 through 2017 (3.58 MGD) as the current flat-rate demand.

[b] Total demand is the summation of residential and non-residential demand, the flat-rate demand estimate, and the converted flat-rate demand. The flat-rate reduction is removed from the flat-rate demand estimate column.

[C] The 3-year average estimate for flat rate consumption was applied to 2017 demands to accommodate flat rate demand reduction estimates.

d These are customer demand and demand estimates only and do not include no-revenue water.

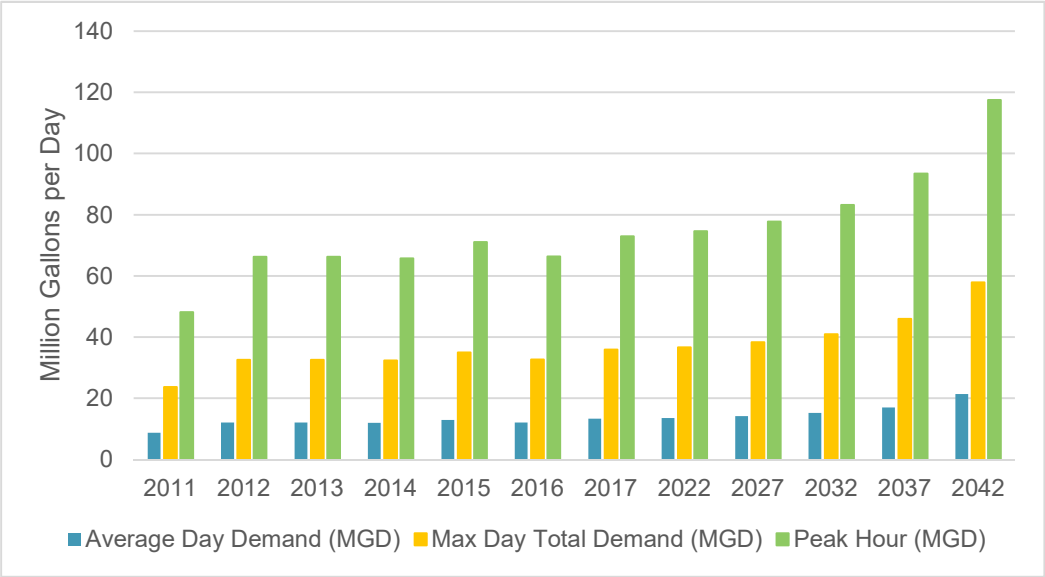



**Figure 3-25. Water Demand Projections (2010–2050)**

This figure shows summation of incremental growth on top of future water demand. Flat-rate consumption per customer (2017 estimate) is assumed constant in the future, and reductions are applied based on the percentage of flat-rate customer conversions proposed to eliminate flat-rate customers by the end of the planning period.

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# Chapter 4
# Water Rights

2018 Water System Master Plan
(Draft)

*Missoula, MT*

# 4.1 Introduction

The City of Missoula acquired the privately owned water utility, Mountain Water Company, on June 22, 2017. With the acquisition, the City took ownership of the infrastructure and water rights associated with Mountain Water Company. The City of Missoula is the owner of 124 water rights from both groundwater and surface water sources. It is important to understand these rights because they define the quantity of water that the City has a legal right to use and will dictate future growth and expansion. The purpose of this chapter is to summarize the status of the City of Missoula's water rights with regard to the permitted flow rates and volumes and also compare the existing use with the permitted appropriations. This assessment relied on data derived from the DNRC Water Rights Bureau's records, water use records obtained from their archives and a variety of unpublished reports. A discussion regarding the history and rules pertinent to Montana's water-right permitting process is presented as preface to better understand the complexities of the City's water rights.

## 4.1.1 Water Rights Background

Water rights in Montana are guided by the Doctrine of Prior Appropriation (i.e. first in time, first in right). A person's right to use water depends on when the use of water began. The first person to use water from a source established the first right; the second person could establish a right to the remaining water, and so on. During dry years, the person with the first right has the first chance to use the available water to fulfill their right. The holder of the second right has the next chance. Water users are limited to the amount of water that can be beneficially used.

### Montana Water Use Act

The Montana Water Use Act of 1973, Title 85, Chapter 2 Montana Code Annotated (MCA) is the most comprehensive change in Montana's water right laws in the State's history. The act changed water rights administration significantly in a number of ways:

- All water rights existing prior to July 1, 1973, are to be finalized through a statewide adjudication process in state courts.
- A permit system was established for obtaining water rights for new or additional water developments.
- An authorization system was established for changing water rights.
- A centralized records system was established. Prior to 1973, water rights were recorded inconsistently in county courthouses throughout the state.
- A system was provided to reserve water for future consumptive uses and to maintain minimum in-stream flows for water quality, and fish and wildlife.

### Water Rights Administration

Water rights in Montana are managed by three entities: the Department of Natural Resources and Conservation (DNRC), the Montana Water Court, and the district courts. DNRC administers the portions of the Montana Water Use Act that relate to water uses

after June 30, 1973. DNRC provides assistance to the Water Court, which is responsible for adjudicating water rights that existed before July 1, 1973.

Montana is divided into four water divisions, and the Water Court presides over each division for the purpose of adjudicating existing water rights. The Water Court decides any legal issues certified to it by DNRC that may arise in connection with a permit or change applications, or in disputes filed in the district courts. The district courts can issue injunctive relief while it certifies water right issues to the Water Court for decision.

DNRC maintains a central records system for all permits, changes, and certificates issued after June 30, 1973, and for all existing water rights filed as part of the statewide adjudication.

## Adjudication of Existing Water Rights

In 1979, the legislature passed Senate Bill 76 amending the adjudication procedures originally established by the Montana Water Use Act. Rather than adjudicating existing (historic) water rights one basin at a time, the legislature opted for a comprehensive general adjudication of the entire state. Existing water rights are those that originated before July 1, 1973, the effective date of the Montana Water Use Act.

The Reserved Water Rights Compact Commission (RWRCC) was created to negotiate compacts with federal agencies and Indian tribes to quantify their reserved water rights in Montana. The RWRCC is an integral part of the statewide adjudication process.

On June 8, 1979, the Montana Supreme Court issued an order requiring every person claiming ownership of an existing water right to file a statement of claim for that right with the DNRC no later than January 1, 1982. Stockwater and domestic claims for groundwater or instream flow were exempted from this process, though such claims could be filed voluntarily. Existing water rights not filed by the deadline would, by statute, be conclusively presumed to have been abandoned.

On December 7, 1981, the Montana Supreme Court extended the deadline to April 30, 1982. Over 200,000 claims were received by the deadline. A number of late filed claims were received after that deadline. In 1992, the Montana Supreme Court ruled that untimely-filed claims were forfeited.

In 1993, the legislature passed Senate Bill 310, which provided, under certain terms and conditions, the remission of the forfeiture of existing rights caused by the failure to comply with the April 30, 1982 deadline. Essentially, the remission bill revived previously forfeited late claims and allowed an opportunity for users to file additional late water right claims in the general adjudication process.

The priority date of a late claim may be subordinated to other timely filed existing water rights. The deadline for filing late claims was July 1, 1996. Approximately 4,900 late claims were filed by the July 1, 1996 deadline.

In 1997, the legislature passed Senate Bill 108, which generally revised the water adjudication laws relating to different types of decrees. This legislation allows the Water Court to adjudicate water right claims and to review federal reserved water right compacts when necessary, and without the need to wait until other types of claims in the same basin are ready for inclusion into a decree. In addition, the bill added two new sections to the law. One requires objections to be filed at the initial decree stage, and the other allows

claimants an opportunity to file counter objections. Since all the claims cannot be adjudicated at once, claims are being decreed by basin for each of Montana's 85 drainage basins.

DNRC's role in the process is to provide technical assistance to the Water Court. Prior to the issuance of a decree, DNRC examines each claim for completeness, accuracy, and reasonableness. The elements of a water right, individually and in combination, are checked using examination rules adopted by the Montana Supreme Court. If DNRC finds apparent discrepancies in the claimed right, the claimant is contacted to discuss the issues. If the apparent discrepancies can be resolved, the claimant amends the claim voluntarily. If the issues cannot be resolved, the water right remains as claimed, but DNRC attaches a remark identifying the potential problem. After all claims in a basin are examined, DNRC issues a Summary Report to the Water Court. This report is available to the public. The court uses this report in preparing the decree for the basin.

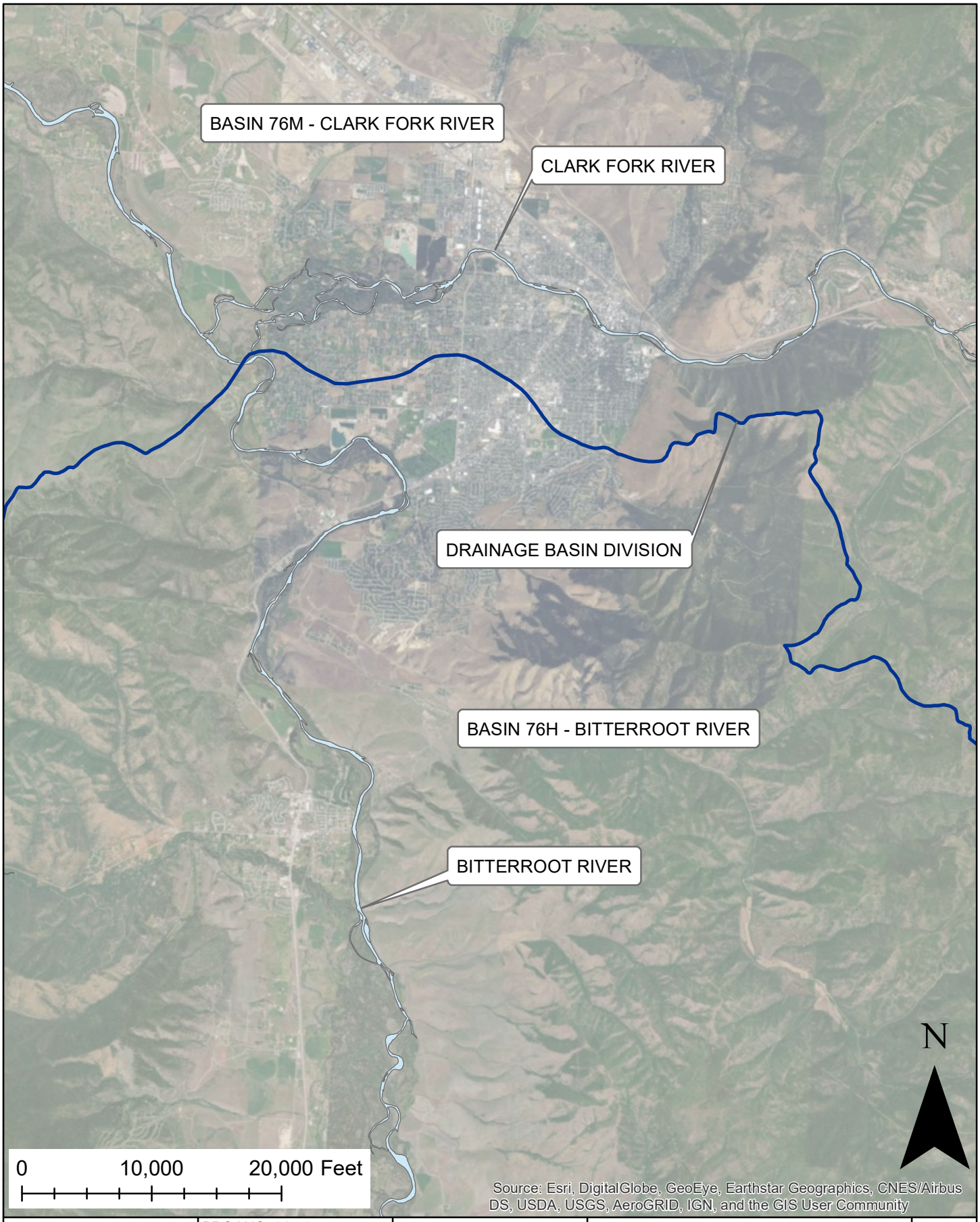
The City of Missoula's statements of claim have been through this process and are now part of a temporary preliminary decree. However, these water rights were reviewed under a previous standard and the DNRC has been directed to re-examine all claims in decrees issued prior to March 28, 1997, so long as they are not final decrees. As such, the City of Missoula's claims will be subject to the re-examination. The re-examination will focus on elements that could cause problems for water distribution under a final decree and the application of standards that make claims more consistent throughout Montana. Summary reports are due in the fall of 2022. Once issues raised in the re-examination are addressed through the Water Court, the next step will be a preliminary decree, which can only occur once the reserved water rights within the basin have been negotiated and agreed to. After that time, the Water Court will issue a final decree. To date the Water Court has issued only six final decrees for the 85 hydrologic basins throughout the state.

### Drainage Basin Demarcation

The City of Missoula is unique in that the city limits are located within two drainage basins: 76M – the Clark Fork River Basin between the Blackfoot and Flathead Rivers; and 76H – the Bitterroot River Basin. As such, the City of Missoula has water rights with differing prefix designations. The drainage basin prefix is utilized to describe the administrative basin from which water is diverted. The drainage basin boundary is the topographic divide between the Bitterroot River and the Clark Fork River. A copy of the drainage basin map illustrating the dividing line between 76M and 76H is provided as Figure 4-1. Given the City's ability to move water throughout the distribution system, water can be diverted from Basin 76H and returned to basin 76M – resulting in what the DNRC refers to as an inter-basin transfer of water.

## 4.2 Municipal Water Rights

The City of Missoula owns 59 water rights with a designated beneficial use of "municipal". The beneficial use term "municipal" is defined as water appropriated by and provided for those in and around a municipality or an unincorporated town. Municipal water use has a very broad designation encompassing all aspects of a community's water demands, including: potable (domestic), lawn and garden irrigation, commercial, industrial, and recreational uses of water.




| | | | | |
|---|---|---|---|---|
| Applied Water CONSULTING LLC | PROJ NO: 945-17 | DRAWN: IRT | MISSOULA WATER RIGHTS | FIGURE 4-1 |
| | LOCATION: MISSOULA, MT | PROJ MGR: R.NOBLE | | |
| | SCALE: 1"=10,000' | CHECKED: | DRAINAGE DIVIDE MAP | |
| | FILE NAME: DRAINAGES | DATE: NOV/05/2018 | | |

### 4.2.1 Municipal Statements of Claim

The following narrative provides a discussion of each of Missoula's statements of claim designated for municipal use.

#### Rattlesnake Creek Statements of Claim

The City of Missoula has seven statements of claim for municipal use that allow for the direct diversion of water from Rattlesnake Creek. Each claim represents an expansion of the water system serving the City of Missoula since the mid 1860's. The statements of claim were filed by Mountain Water Company (MWC) as part of the state-wide adjudication of water rights. In total, the seven claims allow for a maximum flow rate of 55.6 cfs (24,953 gpm) and volume of up to 40,352.87 acre-feet per (13,149,000,000 gallons) year.

Table 4-1 provides a summary of each of the Rattlesnake Creek municipal water rights. A detailed discussion of each water right is provided in the following sections.

**Table 4-1. Municipal Statements of Claim Associated with Direct Flow of Rattlesnake Creek**

| Water Right | Priority Date | Version Type | Source | Diversion Means | Flow Rate (cfs) | Flow Rate (gpm) | Volume (AF) |
|---|---|---|---|---|---|---|---|
| 76M 40170 00 | 4/1/1866 | Change Authorization | Rattlesnake Creek / Groundwater | Wells / Headgate | 23.65 | 10,614 | 17,164.65 |
| 76M 40171 00 | 11/16/1868 | Change Authorization | Rattlesnake Creek / Groundwater | Wells / Headgate | 4.00 | 1,795 | 2,903.11 |
| 76M 40172 00 | 4/1/1871 | Change Authorization | Rattlesnake Creek / Groundwater | Wells / Headgate | 0.34 | 152.6 | 246.38 |
| 76M 40173 00 | 5/1/1871 | Change Authorization | Rattlesnake Creek / Groundwater | Wells / Headgate | 1.62 | 727 | 1,175.76 |
| 76M 40174 00 | 4/1/1881 | Change Authorization | Rattlesnake Creek / Groundwater | Wells / Headgate | 1.16 | 521 | 841.90 |
| 76M 40175 00 | 5/1/1881 | Change Authorization | Rattlesnake Creek / Groundwater | Wells / Headgate | 8.70 | 3,905 | 6,314.27 |
| 76M 40176 00 | 6/1/1887 | Change Authorization | Rattlesnake Creek / Groundwater | Wells / Headgate | 16.13 | 7,239 | 11,706.80 |
| **Total** | | | | | **55.60** | **24,953** | **40,352.87** |

Note: Each water right allows diversion from Rattlesnake Creek or the following wells: #3A, #3B, #21 #30, #31, #32, #33, #34,

MWC obtained two change authorizations that are associated with these statements of claim. Change Authorization 76M 26358-99, which encompasses 62 of MWC's water rights (including all of those discussed in the following section), was authorized by DNRC

on December 1, 2003. The primary purpose of this change authorization was to standardize and expand the place of use for the existing water rights. This change authorization provided MWC the ability to move water throughout the entire distribution system. A map illustrating the place of use authorized under this change is provided as Figure 4-2. The current water right abstracts reflects this change authorization. A project completion notice for this change authorization is due December 31, 2024.

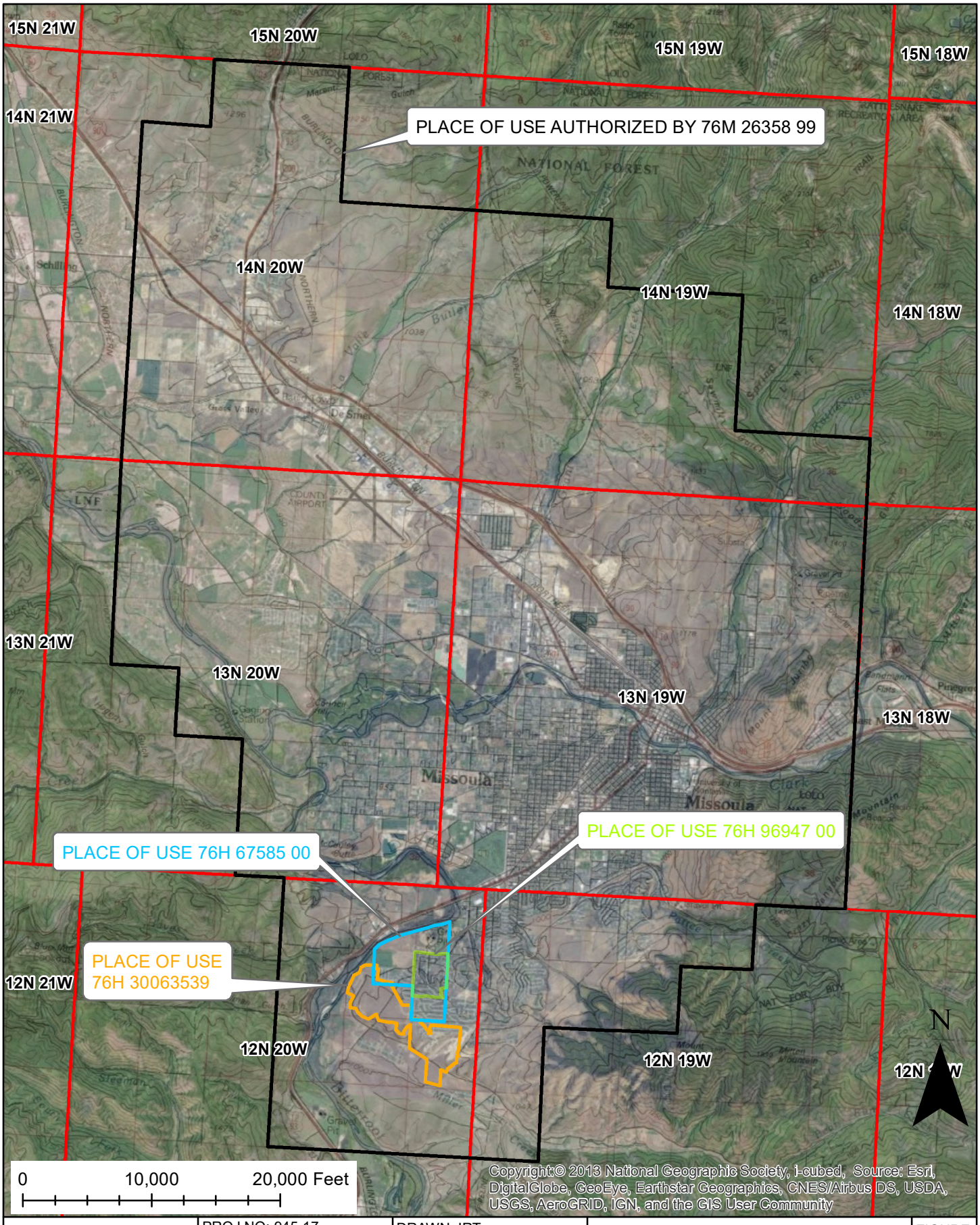
The initial water right change (76M 40170-99) was authorized by the DNRC on November 25, 1998. A Project Completion Notice was filed by MWC on February 4, 2009. The change authorization allows the flow rate and volume of water appropriated via direct flow from Rattlesnake Creek (via Statements of Claim 76M 40170 00, 76M 40171 00, 76M 40172 00, 76M 40173 00, 76M 40174 00, 76M 40175 00, and 76M 40176 00) to be diverted from eight wells. Five of the wells: (#30 – Bank Street; #31 – Kiwanis St; #32 – Arthur Ave; #33 – Gerald Ave; and #34 – Maurice Ave) are located within 0.5 miles of the confluence and within 100 yards of the Clark Fork River. The other three wells (#3A – South Ave; #3B – South Ave; and #21 – E Central) divert water from the Missoula Valley Aquifer within 1.5 miles of the confluence of Rattlesnake Creek and the Clark Fork River. A map illustrating the points of diversion associated with this change authorization is provided as Figure 4-3. Change Authorization 76M 40170-99 allows these eight wells to be operated under the historic priority dates when water is available in Rattlesnake Creek at the historic point of diversion for the surface water rights (SWSWNE Section 2, Township 13 North, Range 19 West). When water is not available to satisfy the historic surface water rights on Rattlesnake Creek, the wells are operated under the existing water rights that have a junior priority date. This change authorization allows water to be diverted in any combination from Rattlesnake Creek or the Missoula Aquifer (groundwater) up to the historic flow rates and volume of water rights on Rattlesnake Creek.

#### STATEMENT OF CLAIM 76M 40170 00

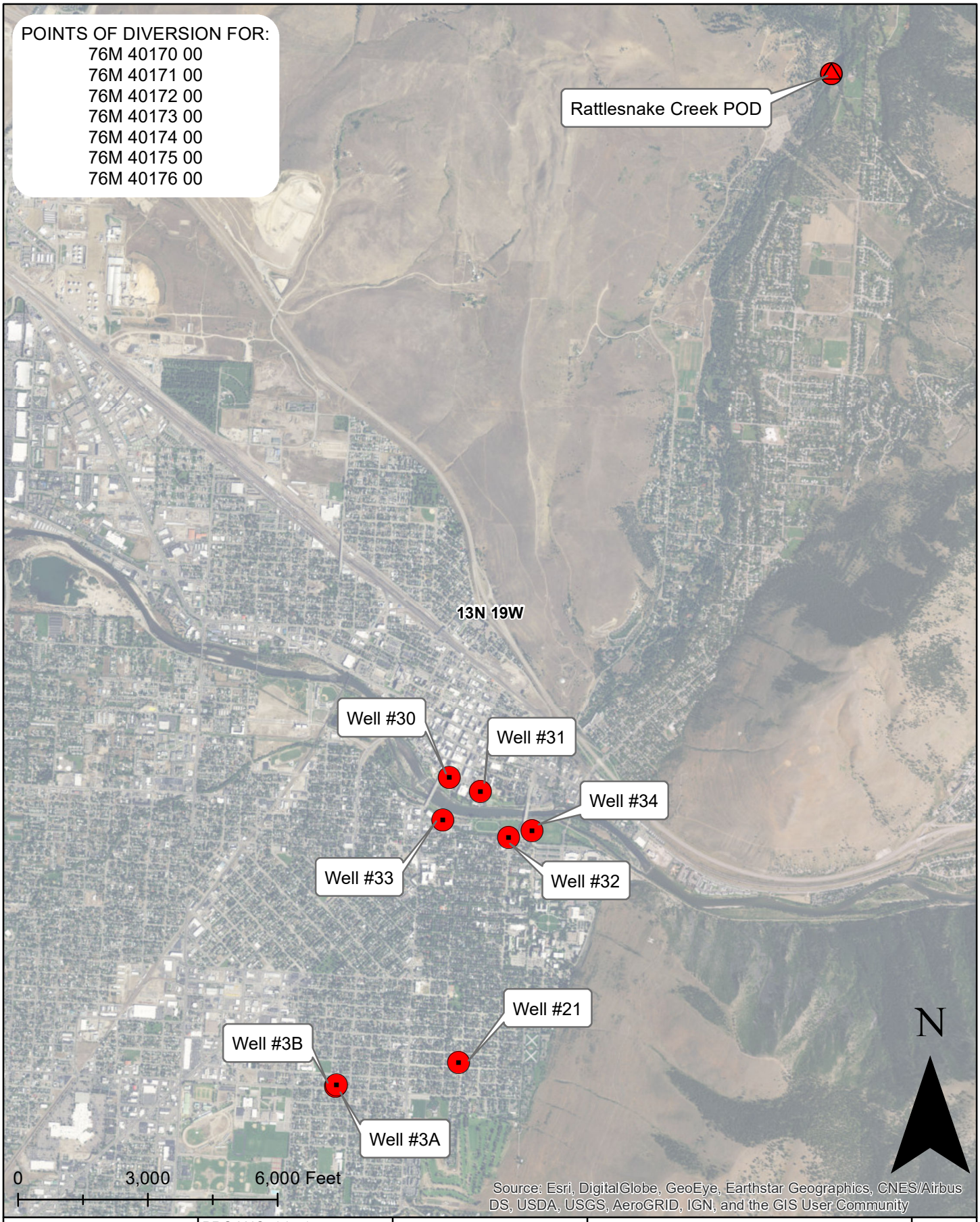
Statement of Claim 76M 40170 00 is one of seven water rights claimed by MWC for the diversion of direct flow of water from Rattlesnake Creek. The claim has a priority date of April 1, 1866 and allows for year-round diversion for municipal purposes. MWC objected to the water right and the flow rate and volume were subsequently amended through the Water Court to 23.65 cfs and 17,164.65 acre-feet, respectively. Water can be diverted from the historic diversion on Rattlesnake Creek or any of the eight wells identified in Change Authorization 76M 40170-99. The points of diversion associated with Statement of Claim 76M 40170 00 are illustrated in Figure 4-3 and the place of use is shown in Figure 4-2.

#### STATEMENT OF CLAIM 76M 40171 00

Statement of Claim 76M 40171 00 is one of the seven water rights for the direct diversion of water from Rattlesnake Creek. This claim has a priority date of November 16, 1868 for year-round diversion of water for municipal use. MWC objected to the water right during the adjudication process and the flow rate and volume were subsequently amended by the Water Court to 4.0 cfs and 2,903.11 acre-feet, respectively. Water can be diverted from the historic diversion on Rattlesnake Creek or any of the eight wells identified in Change Authorization 76M 40170-99. The points of diversion associated with Statement of Claim 76M 40171 00 are illustrated in Figure 4-3 and the place of use is shown in Figure 4-2.




| | | | | |
|---|---|---|---|---|
| Applied Water CONSULTING LLC | PROJ NO: 945-17 | DRAWN: IRT | MISSOULA WATER RIGHTS | FIGURE 4-2 |
| | LOCATION: MISSOULA, MT | PROJ MGR: R.NOBLE | | |
| | SCALE: 1"=10,000' | CHECKED: | MUNICIPAL WATER RIGHTS - PLACE OF USE | |
| | FILE NAME: PLACEOFUSE | DATE: NOV/01/2018 | | |




| | | | | |
|---|---|---|---|---|
| Applied Water CONSULTING LLC | PROJ NO: 945-17 | DRAWN: IRT | MISSOULA WATER RIGHTS | FIGURE 4-3 |
| | LOCATION: MISSOULA, MT | PROJ MGR: R.NOBLE | | |
| | SCALE: 1"=3,000' | CHECKED: | RATTLESNAKE CREEK DIRECT FLOW RIGHTS | |
| | FILE NAME: DIRECT FLOW | DATE: NOV/01/2018 | | |

### STATEMENT OF CLAIM 76M 40172 00

Statement of Claim 76M 40172 00 is one of the seven claims for the direct diversion of water from Rattlesnake Creek. The claimed priority date is April 1, 1871 and the claim allows for municipal use. MWC objected to the water right and the flow rate and volume were subsequently amended, through the Water Court, to 152.6 gpm (0.34 cfs) and 246.38 acre-feet, respectively. This water right allows for year-round diversion from the historic diversion on Rattlesnake Creek or any of the eight wells identified in Change Authorization 76M 40170-99. The points of diversion associated with Statement of Claim 76M 40172 00 are illustrated in Figure 4-3 and the place of use is shown in Figure 4-2.

### STATEMENT OF CLAIM 76M 40173 00

Statement of Claim 76M 40173 00 is also one of the seven claims filed by MWC for the direct diversion of water from Rattlesnake Creek. The claim has a priority date of May 1, 1871 for municipal use. MWC objected to the water right as part of the adjudication process and the flow rate and volume were subsequently amended by the Water Court to 1.62 cfs and 1,175.76 acre-feet, respectively. This water right allows for continuous year-round diversion from the historic diversion on Rattlesnake Creek or any of the eight wells identified in Change Authorization 76M 40170-99. The points of diversion associated with Statement of Claim 76M 40173 00 are illustrated in Figure 4-3 and the place of use is shown in Figure 4-2.

### STATEMENT OF CLAIM 76M 40174 00

Statement of Claim 76M 40174 00 is one of seven claims allowing for the direct diversion of water from Rattlesnake Creek. This claim has a priority date of April 1, 1881 for municipal use. MWC filed an objection to the water right and the flow rate and volume were subsequently amended by the Water Court to 1.16 cfs and 841.90 acre-feet, respectively. This water right allows for continuous year-round diversion from the historic diversion on Rattlesnake Creek or any of the eight wells identified in Change Authorization 76M 40170-99. The points of diversion associated with Statement of Claim 76M 40173 00 are illustrated in Figure 4-3 and the place of use is shown in Figure 4-2.

### STATEMENT OF CLAIM 76M 40175 00

Statement of Claim 76M 40175 00 is one of seven claims filed by MWC for the direct diversion of water from Rattlesnake Creek. This claim has a priority date of May 1, 1881 for year-round municipal use. MWC objected to the water right and the flow rate and volume were subsequently amended by the Water Court to 8.70 cfs and 6,314.27 acre-feet, respectively. This water right allows for continuous year-round diversion from the historic diversion on Rattlesnake Creek or any of the eight wells identified in Change Authorization 76M 40170-99. The points of diversion associated with Statement of Claim 76M 40175 00 are illustrated in Figure 4-3 and the place of use is shown in Figure 4-2.

### STATEMENT OF CLAIM 76M 40176 00

Statement of Claim 76M 40176 00 is one of the seven water rights for direct diversion of water from Rattlesnake Creek. This claim has a priority date of June 1, 1887 and allows for year-round diversion of water for municipal use. MWC objected to the water right during the adjudication process, and the flow rate and volume were subsequently amended through the Water Court to 16.13 cfs and 11,706.8 acre-feet, respectively.

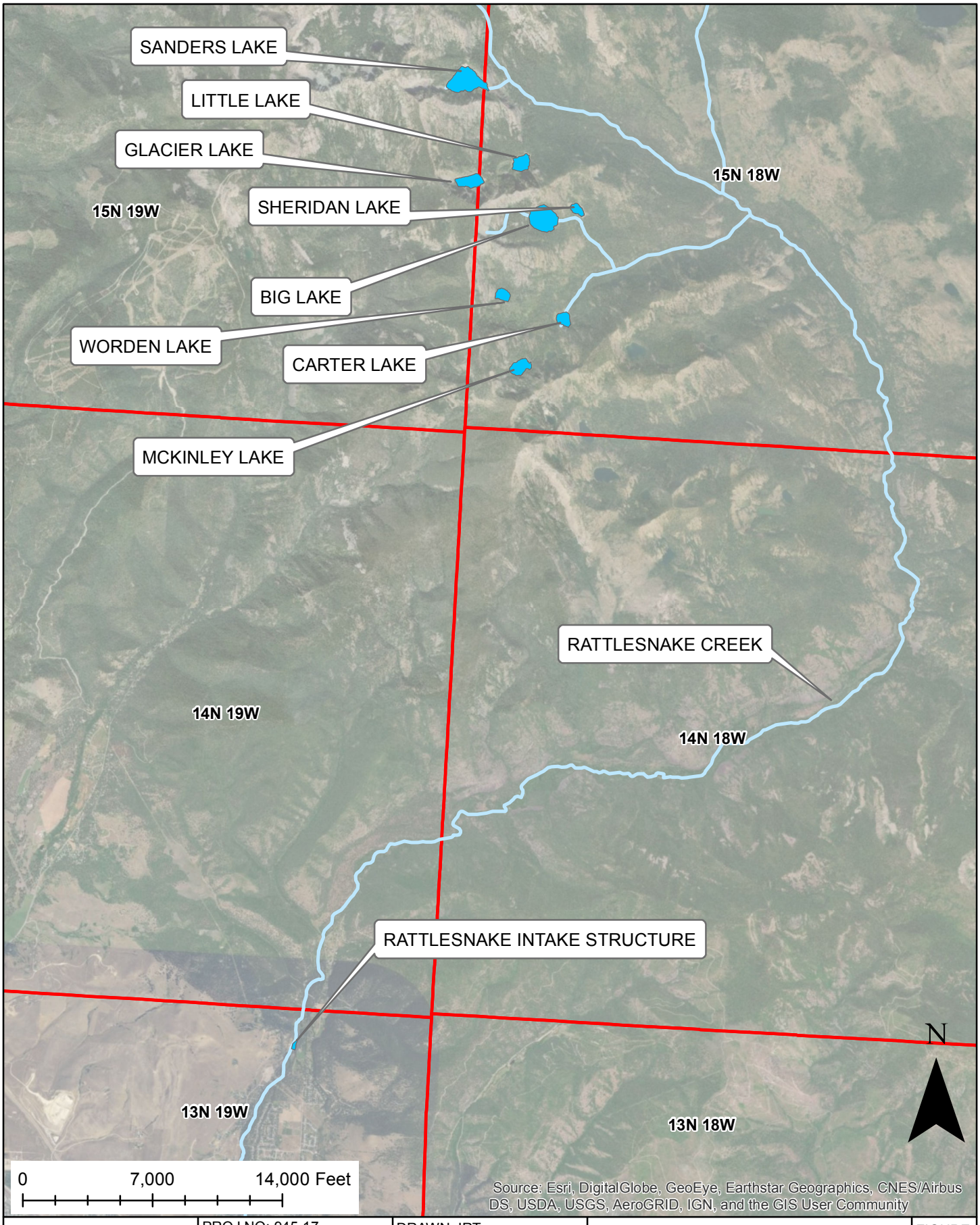
Water can be diverted from the historic diversion on Rattlesnake Creek or any of the eight wells identified in Change Authorization 76M 40170-99. The points of diversion associated with Statement of Claim 76M 40176 00 are illustrated in Figure 4-3 and the place of use is shown in Figure 4-2.

## Rattlesnake Creek Wilderness Dam Statements of Claim

The City of Missoula has eight statements of claim for dams located within the Rattlesnake Creek drainage basin. These claims allow water to be captured and stored in Little Lake, Sanders Lake, Glacier Lake, Sheridan Lake, Big Lake, Carter Lake, Worden Lake, and McKinley Lake and released for municipal purposes during periods of low stream flow. Water is conveyed through natural stream channels and diverted into the municipal water system through the historic diversion on Rattlesnake Creek. These claims allow for a total storage volume of up to 2,624 acre-feet per year and allow the natural flow of Rattlesnake Creek to be augmented by up to 21.94 cfs. Water is released from the dams into the Rattlesnake Creek drainage where it is diverted downstream into the City's intake on Rattlesnake Creek. Table 4-2 provides a summary of the Rattlesnake Creek reservoir storage water rights. A map illustrating the location of the wilderness dams relative to the general features in the area is provided as Figure 4-4. A detailed discussion of each water right is provided in the following sections.

**Table 4-2. Municipal Statements of Claim Associated with Rattlesnake Creek Wilderness Dams**

| Water Right | Priority Date | Version Type | Source | Reservoir | Flow Rate (cfs) | Flow Rate (gpm) | Volume (AF) |
|---|---|---|---|---|---|---|---|
| 76M 26358 00 | 8/30/1919 | Change Authorization | Rattlesnake Creek | Little Lake | 2.5 | 1,122 | 300.00 |
| 76M 26361 00 | 8/30/1919 | Change Authorization | Rattlesnake Creek | Sanders Lake | 7.54 | 3,384 | 905.00 |
| 76M 26362 00 | 8/30/1919 | Change Authorization | Rattlesnake Creek | Glacier Lake | 1.76 | 790 | 212.00 |
| 76M 26363 00 | 8/30/1919 | Change Authorization | Rattlesnake Creek | Sheridan Lake | 0.96 | 431 | 115.00 |
| 76M 26364 00 | 8/30/1919 | Change Authorization | Rattlesnake Creek | Big Lake | 5.22 | 2,343 | 623.00 |
| 76M 26365 00 | 11/6/1923 | Change Authorization | Rattlesnake Creek | Carter Lake | 1.43 | 642 | 170.00 |
| 76M 26366 00 | 9/8/1923 | Change Authorization | Rattlesnake Creek | Worden Lake | 0.89 | 398 | 104.00 |
| 76M 26367 00 | 8/13/1923 | Change Authorization | Rattlesnake Creek | McKinley Lake | 1.64 | 736 | 195.00 |
| **Total** | | | | | **21.94** | **9,845** | **2,624.00** |




| | | | | |
|---|---|---|---|---|
| Applied Water CONSULTING LLC | PROJ NO: 945-17 | DRAWN: IRT | MISSOULA WATER RIGHTS | FIGURE 4-4 |
| | LOCATION: MISSOULA, MT | PROJ MGR: R.NOBLE | | |
| | SCALE: 1"=7,000' | CHECKED: | WILDERNESS DAMS | |
| | FILE NAME: DIRECT FLOW | DATE: NOV/01/2018 | | |

Change Authorization 76M 26358-99, which encompasses 62 of MWC's water rights (including all of those discussed in the following section), was authorized by DNRC on December 1, 2003. The primary purpose of this change authorization was to standardize and expand the place of use for of the existing water rights. This change authorization provided MWC the ability to move water throughout the entire distribution system. A map illustrating the place of use authorized under this change is provided as Figure 4-2. The current water right abstracts reflects this change authorization. A project completion notice for this change authorization is due December 31, 2024.

### STATEMENT OF CLAIM 76M 26358 00

Statement of Claim 76M 26358 00 allows for storage in and diversion of water from Little Lake. The claim is for year-round municipal use of water stored in Little Lake with a priority date of August 30, 1919. MWC objected to the water right and the Water Court subsequently amended the flow rate and volume to 2.5 cfs and 300 acre-feet, respectively. This volume of water is sufficient to allow diversion continuously for a period of 60 days at the maximum flow rate of 2.5 cfs.

Little Lake is located in the SENENW of Section 19, Township 15 North, Range 18 West. Water is stored in Little Lake and released through the natural drainage to the City's intake located in the SWSWNE of Section 2, Township 13 North, Range 19 West. A map illustrating the location of Little Lake relative to the other features in the area is provided as Figure 4-4.

### STATEMENT OF CLAIM 76M 26361 00

Statement of Claim 76M 26361 00 allows for storage in and diversion of water from Sanders Lake. The claim is for year-round municipal use of water stored in Sanders Lake with a priority date of August 30, 1919. MWC objected to the water right and the Water Court subsequently amended the flow rate and volume to 7.54 cfs and 905 acre-feet, respectively. This volume is sufficient to allow water to be diverted continuously for a period of 60 days at the maximum flow rate of 7.54 cfs.

The Sanders Lake diversion is located in the SWNENE of Section 13, Township 15 North, Range 18 West. Water is stored in Sanders Lake and released through the natural drainage to the City's intake located in the SWSWNE of Section 2, Township 13 North, Range 19 West. A map illustrating the location of Sanders Lake relative to the other features in the area is provided as Figure 4-4.

### STATEMENT OF CLAIM 76M 26362 00

Statement of Claim 76M 26362 00 allows for storage in and diversion of water from Glacier Lake. The claim is for year-round municipal use of water stored in Glacier Lake with a priority date of August 30, 1919. MWC objected to the water right and the Water Court subsequently amended the flow rate and volume to 1.76 cfs and 212 acre-feet, respectively. This volume of water is sufficient to allow the diversion of water continuously for a period of 60 days at the maximum flow rate of 1.76 cfs.

Glacier Lake dam is located in the SWSWNW of Section 19, Township 15 North, Range 18 West. Water is stored in Glacier Lake and released through the natural drainage to the City's intake located in the SWSWNE of Section 2, Township 13 North, Range 19 West. A

map illustrating the location of Glacier Lake relative to the other features in the area is provided as Figure 4-4.

### STATEMENT OF CLAIM 76M 26363 00

Statement of Claim 76M 26363 00 allows for storage in and diversion of water from Sheridan Lake. The claim is for year-round municipal use of water stored in Sheridan Lake with a priority date of August 30, 1919. MWC objected to the water right and the Water Court subsequently amended the flow rate and volume to 431 gpm (0.96 cfs) and 115 acre-feet, respectively. This volume of water is sufficient to allow the diversion of water continuously for a period of 60 days at the maximum flow rate of 431 gpm.

The Sheridan Lake dams are located in the NWSWSW and SWNWSW of Section 20, Township 15 North, Range 18 West. Water is stored in Sheridan Lake and released through the natural drainage to the City's intake located in the SWSWNE of Section 2, Township 13 North, Range 19 West. A map illustrating the location of Sheridan Lake relative to the other features in the area is provided as Figure 4-4.

### STATEMENT OF CLAIM 76M 26364 00

Statement of Claim 76M 26364 00 allows for storage in and diversion of water from Big Lake. The claim is for year-round municipal use of water stored in Big Lake with a priority date of August 30, 1919. MWC objected to the water right and the Water Court subsequently amended the flow rate and volume to 5.22 cfs and 623 acre-feet, respectively. This volume of water is sufficient to allow the diversion of water continuously for a period of 60 days at the maximum flow rate of 5.22 cfs.

The Big Lake dam is located in the NWSESE of Section 19, Township 15 North, Range 18 West. Water is stored in Big Lake and released through the natural drainage to the City's intake located in the SWSWNE of Section 2, Township 13 North, Range 19 West. A map illustrating the location of Big Lake relative to the other features in the area is provided as Figure 4-4.

### STATEMENT OF CLAIM 76M 26365 00

Statement of Claim 76M 26365 00 allows for storage in and diversion of water from Carter Lake. The claim is for year-round municipal use of water stored in Carter Lake with a priority date of November 6, 1923. MWC objected to the water right and the Water Court subsequently amended the flow rate and volume to 1.43 cfs and 170 acre-feet, respectively. This volume of water is sufficient to allow the diversion of water continuously for a period of 60 days at the maximum flow rate of 1.43 cfs.

The Carter Lake dam is located in the SENESE of Section 30, Township 15 North, Range 18 West. Water is stored in Carter Lake and released through the natural drainage to the City's intake located in the SWSWNE of Section 2, Township 13 North, Range 19 West. A map illustrating the location of Carter Lake relative to the other features in the area is provided as Figure 4-4.

### STATEMENT OF CLAIM 76M 26366 00

Statement of Claim 76M 26366 00 allows for storage in and diversion of water from Worden Lake. The claim is for year-round municipal use of water stored in Worden Lake with a priority date of September 8, 1923. MWC objected to the water right and the Water

Court subsequently amended the flow rate and volume to 398 gpm (0.89 cfs) and 104 acre-feet, respectively. This volume of water is sufficient to allow the diversion of water continuously for a period of 60 days at the maximum flow rate of 398 gpm.

The Worden Lake dam is located in the SENESW of Section 30, Township 15 North, Range 18 West. Water is stored in Worden Lake and released through the natural drainage to the City's intake located in the SWSWNE of Section 2, Township 13 North, Range 19 West. A map illustrating the location of Worden Lake relative to the other features in the area is provided as Figure 4-4.

#### STATEMENT OF CLAIM 76M 26367 00

Statement of Claim 76M 26367 00 was filed August 5, 1981 by MWC for storage in and diversion from McKinley Lake, a tributary of Rattlesnake Creek. The claimed water is for year-round municipal uses of water stored in McKinley Lake with a priority date of August 13, 1923. . MWC objected to the water right and the Water Court subsequently amended the flow rate and volume to 1.64 cfs and 195 acre-feet, respectively. This volume of water is sufficient to allow the diversion of water continuously for a period of 60 days at the maximum flow rate of 1.64 cfs.

The McKinley Lake dam is located in the NESWNE of Section 31, Township 15 North, Range 18 West. Water is stored in McKinley Lake and released through the natural drainage to the City's intake located in the SWSWNE of Section 2, Township 13 North, Range 19 West. A map illustrating the location of McKinley Lake relative to the other features in the area is provided as Figure 4-4.

## Municipal Well Statements of Claim

The City of Missoula has 30 statements of claim for wells designated as municipal use. On paper, these water rights appropriate a total of 32,969 gpm and up to 49,569.24 acre-feet per year for municipal use within the City of Missoula. Table 4-3 provides a summary of each of the municipal groundwater claims. A detailed discussion of each water right is provided in the following sections. A map illustrating the locations of each well is provided as Figure 4-5.

**Table 4-3. Municipal Statements of Claim Associated with Wells**

| Water Right | Priority Date | Version Type | Source | Diversion Means | Well ID / GWIC | Flow Rate (gpm) | Volume (AF) |
|---|---|---|---|---|---|---|---|
| 76M 26357 00 | 9/24/1973 | Change Authorization | Groundwater | Well | #37 / 68306 | 120 | 194.06 |
| 76M 26359 00 | 12/28/1972 | Change Authorization | Groundwater | Well | #28 / 132890 | 33 | 53.37 |
| 76H 26360 00 | 8/5/1981 | Change Authorization | Groundwater | Well | #14 / 132030 | 1,000 | 1,613.00 |
| 76M 26368 00 | 11/21/1968 | Change Authorization | Groundwater | Well | #17 / 132891 | 1,000 | 1,617.15 |
| 76M 40143 00 | 5/31/1935 | Change Authorization | Groundwater | Well | #1 / 151949 | 1,200 | 1,937.83 |

## Table 4-3. Municipal Statements of Claim Associated with Wells

| Water Right | Priority Date | Version Type | Source | Diversion Means | Well ID / GWIC | Flow Rate (gpm) | Volume (AF) |
|---|---|---|---|---|---|---|---|
| 76M 40144 00 | 5/31/1935 | Change Authorization | Groundwater | Well | #2 / 69155 | 1,200 | 1,937.83 |
| 76M 40145 00 | 5/31/1935 | Change Authorization | Groundwater | Well | #3A / 151950 | 1,200 | 1,937.83 |
| 76M 40146 00 | 12/31/1937 | Redundant Well | Groundwater | Well (x2) | #4 / 132849; #43 / 240491 | 800 | 1,291.88 |
| 76M 40147 00 | 5/31/1958 | Change Authorization | Groundwater | Well | #7 / 132856 | 1,200 | 1,937.83 |
| 76M 40148 00 | 8/31/1954 | Change Authorization | Groundwater | Well | #8 / 132857 | 1,200 | 1,937.83 |
| 76H 40149 00 | 5/31/1955 | Change Authorization | Groundwater | Well | #9 / 69353 | 1,000 | 1,613.00 |
| 76M 40150 00 | 6/30/1957 | Change Authorization | Groundwater | Well | #10 / 132850 | 1,200 | 1,937.83 |
| 76M 40151 00 | 7/31/1957 | Change Authorization | Groundwater | Well | #11 / 132860 | 1,200 | 1,937.83 |
| 76M 40152 00 | 9/28/1964 | Redundant Well | Groundwater | Well (x2) | #12 / 132848; #43 / 240491 | 1,200 | 1,937.83 |
| 76M 40153 00 | 9/28/1964 | Change Authorization | Groundwater | Well | #13 / 68519 | 800 | 1,291.88 |
| 76M 40154 00 | 3/10/1967 | Change Authorization | Groundwater | Well | #15 / 68453 | 148 | 239.51 |
| 76H 40155 00 | 3/10/1967 | Change Authorization | Groundwater | Well | #16 / 132828 | 1,000 | 1,613.00 |
| 76H 40156 00 | 8/28/1968 | Change Authorization | Groundwater | Well | #18 / 66872 | 1,000 | 1,613.00 |
| 76M 40157 00 | 5/13/1969 | Change Authorization | Groundwater | Well | #19 / 151948 | 1,200 | 1,937.83 |
| 76M 40158 00 | 6/2/1969 | Change Authorization | Groundwater | Well | #20 / 132839 | 1,200 | 1,937.83 |
| 76M 40159 00 | 7/7/1969 | Change Authorization | Groundwater | Well | #21 / 132851 | 1,200 | 1,937.83 |
| 76M 40160 00 | 12/31/1949 | Change Authorization | Groundwater | Well | #22 / 132841 | 1,200 | 1,937.83 |
| 76M 40161 00 | 7/31/1948 | Change Authorization | Groundwater | Well | #23 / 132025 | 305 | 486.67 |
| 76M 40162 00 | 6/30/1955 | Change Authorization | Groundwater | Well | #24 / 69412 | 450 | 725.78 |
| 76M 40163 00 | 11/18/1970 | Change Authorization | Groundwater | Well | #25 / 132861 | 1,000 | 1,611.23 |
| 76H 40164 00 | 9/27/1972 | Change Authorization | Groundwater | Well | #26 / 132834 | 1,000 | 1,613.00 |

**Table 4-3. Municipal Statements of Claim Associated with Wells**

| Water Right | Priority Date | Version Type | Source | Diversion Means | Well ID / GWIC | Flow Rate (gpm) | Volume (AF) |
|---|---|---|---|---|---|---|---|
| 76M 40165 00 | 8/5/1981 | Change Authorization | Groundwater | Well | #27 / 132844 | 1,475 | 2,380.55 |
| 76H 40166 00 | 9/24/1973 | Change Authorization | Groundwater | Well | #29 / 67046 | 1,000 | 1,613.00 |
| 76H 107536 00 | 12/18/1973 | Change Authorization | Groundwater | Well (x2) | #38/66867; #39/154873 | 3,998 | 6,449.20 |
| 76M 108816 00 | 1/16/1963 | Change Authorization | Groundwater | Well (x2) | #41/68413; #42/68599 | 2,440 | 296.00 |
| **Totals** | | | | | | **32,969** | **49,569** |

Change Authorization 76M 26358-99, which encompasses 62 of MWC's water rights (including all of those discussed in the following section), was authorized by DNRC on December 1, 2003. The primary purpose of this change authorization was to standardize and expand the place of use for of the existing water rights. This change authorization provided MWC the ability to move water throughout the entire distribution system. A map illustrating the place of use authorized under this change is provided as Figure 4-2. The current water right abstracts reflects this change authorization. A project completion notice for this change authorization is due December 31, 2024.

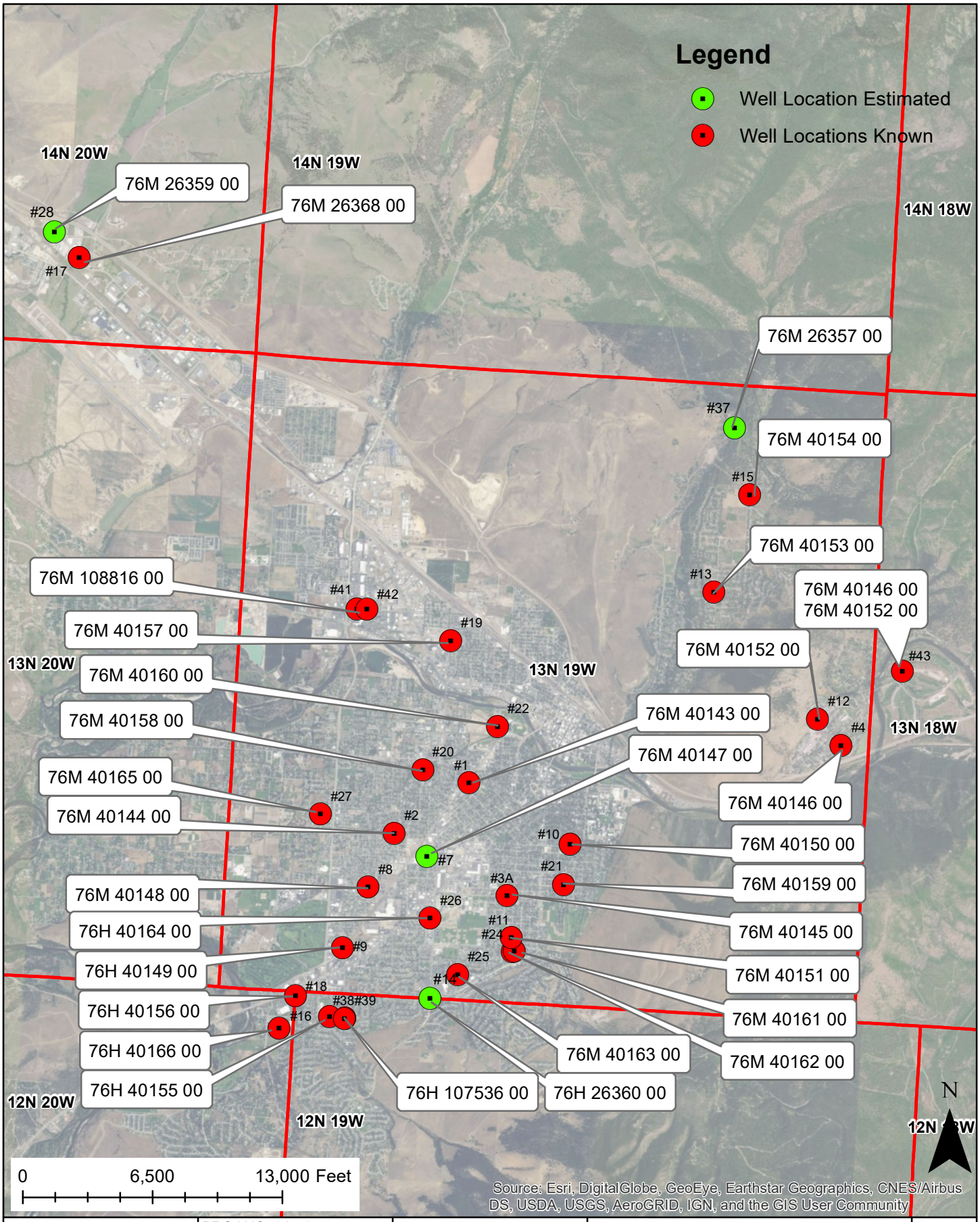
#### STATEMENT OF CLAIM 76M 26357 00

Statement of Claim 76M 26357 00 was filed for municipal use from Well #37 and has a priority date of September 24, 1973. The well is located near the City's Rattlesnake Creek intake and dam. It appears that the well was utilized to service the caretaker's house and dam facility. Well #37 was drilled by Camp Well Drilling to a depth of 57 feet in 1973. A Notice of Completion of Groundwater Appropriation by Means of Well was filed by Montana Power Company (MPC) on September 24, 1973. The priority date was modified by the DNRC to conform to the date the Notice of Completion was filed by MPC. A copy of the well log (GWIC ID 68306) is provided in Attachment W.

Statement of Claim 76M 26357 00 allows for diversion of groundwater from Well #37 at a rate of up to 120 gpm and volume of up to 194.06 acre-feet per year for municipal use; this volume equates to year-round diversion at 120 gpm. The well is located in the SWSWNE of Section 2, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5. This well does not appear to be connected to the municipal water system in any capacity.

#### STATEMENT OF CLAIM 76M 26359 00

Statement of Claim 76M 26359 00 was filed for municipal use of Well #28 with a priority date of December 28, 1972. The well is located northwest of the airport. Well #28 was drilled by Camp Well Drilling in September 1972 to a depth of 375 feet. A Notice of Completion of Groundwater Appropriation by Means of Well was filed by MPC on November 28, 1973. A copy of the well log (GWIC ID 132890) is provided in Attachment W.




| | | | |
|---|---|---|---|
| Applied Water CONSULTING LLC | PROJ NO: 945-17 | DRAWN: IRT | MISSOULA WATER RIGHTS |
| | LOCATION: MISSOULA, MT | PROJ MGR: R.NOBLE | |
| | SCALE: 1"=6,500' | CHECKED: | MUNICIPAL CLAIMS BY WELLS |
| | FILE NAME: MUNICIPALS | DATE: NOV/01/2018 | FIGURE 4-5 |

Statement of Claim 76M 26359 00 allows for diversion of groundwater from Well #28 at a rate of up to 33 gpm and volume of 53.37 acre-feet per year for municipal uses; this volume equates to year-round diversion at 33 gpm. The well is located in the SWSWSW of Section 26, Township 14 North, Range 20 West. The point of diversion associated with this claim is illustrated in Figure 4-5. This well is currently not contributing to the municipal water system in any capacity.

### STATEMENT OF CLAIM 76H 26360 00

Statement of Claim 76H 26360 00 was filed for municipal use of Well #14, which is located near the intersection of South Russell and 39th Street. Well #14 was originally drilled to a depth of 101 feet in 1965. However, in an effort to mitigate sand production, the well was deepened to a total depth of 145 feet in 1976. A copy of the well log (GWIC ID 132030) is provided in Attachment W. MWC objected to and later amended the water right to more accurately reflect the historic use of water. Although the priority date originally claimed was June 1, 1965, the Water Court changed the priority date to the date of the claim filing because a notice of groundwater development was not filed in Missoula County, as required for groundwater developments after January 1, 1962. A notice of groundwater development for the deepening of Well #14 was filed by MWC on August 5, 1981. This ground water development is duplicative of Statement of Claim 76H 26360 00; as such, the groundwater certificate has been terminated.

Statement of Claim 76H 26360 00 allows for diversion of groundwater from Well #14 at a rate of up to 1,000 gpm and volume of 1,613 acre-feet per year for municipal use. The well is located in the SESESE of Section 32, Township 13 North. The point of diversion associated with this claim is illustrated in Figure 4-5. This well is currently not contributing to the municipal water system in any capacity.

### STATEMENT OF CLAIM 76M 26368 00

Statement of Claim 76M 26368 00 was filed for municipal use of Well #17 with a priority date of November 21, 1968. The well is located near the airport in Section 35, Township 14 North, Range 20 West. The well was originally constructed to serve the Momont Industrial Park, including the airport. Well #17 was drilled by Camp Well Drilling in October 1968 to a depth of 360 feet. A Notice of Appropriation of Groundwater was filed by MPC on November 21, 1968. A copy of the well log (GWIC ID 132891) is provided in Attachment W.

Statement of Claim 76M 26368 00 allows for diversion of groundwater from Well #17 at a rate of up to 1,000 gpm and volume of 1,617.15 acre-feet per year; this volume equates to year-round diversion at 1,000 gpm). The well is located in the SWNENW of Section 25, Township 14 North, Range 20 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40143 00

Statement of Claim 76M 40143 00 was filed for municipal use of Well #1, with a priority date of May 31, 1935. The well is located adjacent to the Montana Rail Link Bitterroot Branch Line railroad tracks at 6th Street West and Ivy Street. Well #1 was drilled in 1934 to a depth of 120 feet. A Declaration of Vested Groundwater Rights was filed by MPC on February 1, 1962. A copy of the well log (GWIC ID 151949) is provided in Attachment W.

MWC objected to the water right and it was amended by the Water Court to more accurately reflect the place of use associated with this statement of claim.

Statement of Claim 76M 40143 00 allows for diversion of groundwater from Well #1 at a rate of up to 1,200 gpm and volume of 1,937.83 acre-feet per year; this volume equates to year-round diversion at 1,200 gpm. The well is located in the SWSESW of Section 21, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40144 00

Statement of Claim 76M 40144 00 allows for municipal use of water diverted from Well #2 and has a priority date of May 31, 1935. Well #2 was drilled in 1934 to a depth of 90 feet. MPC filed a Declaration of Vested Groundwater Rights on February 1, 1962. A copy of the well log (GWIC ID 69155) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the place of use associated with this statement of claim.

Statement of Claim 76M 40144 00 allows for diversion of groundwater from Well #2 at a rate of up to 1,200 gpm and volume of 1,937.83 acre-feet per year; this volume equates to year-round diversion at 1,200 gpm. The well is located in the SWSWNE of Section 29, Township 13 North, Range 19 West. The point of diversion and place of use associated with this claim are illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40145 00

Statement of Claim 76M 40145 00 was filed for municipal use of Well #3 (3A) with a priority date of May 31, 1935. The well is located off of South Avenue (Lot 15, Block 42 Homevale Addition Subdivision). Well #3 (3A) is cased to a depth of 116 feet. A Declaration of Vested Groundwater Rights was filed by MPC on February 1, 1962. A copy of the well log (GWIC ID 151950) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the place of use associated with this statement of claim.

Statement of Claim 76M 40145 00 allows for diversion of groundwater from Well #3 (3A) at a rate of up to 1,200 gpm and volume of 1,937.83 acre-feet per year; this volume equates to year-round diversion at 1,200 gpm. The well is located in the SESWSE of Section 28, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40146 00

Statement of Claim 76M 40146 00 was filed for municipal use Well #4 located in East Missoula (Lot 4, Block 49) and Well #43 with a priority date of December 31, 1937. Well #4 was drilled in 1937 to a depth of 100 feet and cased to a depth of 86 feet. A Declaration of Vested Groundwater Rights was filed by MPC on February 1, 1962. A copy of the well log (GWIC ID 132849) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the place of use associated with this statement of claim. The water right abstract includes a redundant point of diversion (Well #43) on this claim. Well #43 was drilled by O'Keefe Drilling to a depth of 134 feet; the well was completed June 26, 2007. A copy of the well log (GWIC ID 240491) is provided in Attachment W.

Statement of Claim 76M 40146 00 allows for diversion of groundwater from Well #4 and Well #43 at a rate of up to 800 gpm and volume of 1,291.88 acre-feet per year; this volume equates to year-round diversion at 800 gpm. Well #4 is located in the SESWNE of Section 24, Township 13 North, Range 19 West and Well #43 is located in the SENWSW of Section 18, Township 13 North, Range 18 West. The points of diversion associated with this claim are illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40147 00

Statement of Claim 76M 40147 00 was filed for municipal use of Well #7 with a priority date of May 31, 1958. The well is located in the old MPC Service Center Shop off of Russell Street. Well #7 was drilled in 1958 to a depth of 110 feet. MPC filed a Declaration of Vested Groundwater Right on February 1, 1962. A copy of the well log (GWIC ID 132856) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the point of diversion and place of use associated with this statement of claim.

Statement of Claim 76M 40147 00 allows for diversion of groundwater from Well #7 at a rate of up to 1,200 gpm and volume of 1,937.83 acre-feet per year; this volume equates to year-round diversion at 1,200 gpm. The well is located in the SENESE of Section 29, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5. This well is currently not contributing to the municipal water system in any capacity.

### STATEMENT OF CLAIM 76M 40148 00

Statement of Claim 76M 40148 00 allows for municipal use of Well #8 with a priority date of August 31, 1954. According to the well log, the well was drilled in August 1954 to a depth of 117 feet. A Declaration of Vested Groundwater Rights was filed by MPC on February 1, 1962. A copy of the well log (GWIC ID 132857) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the point of diversion and place of use associated with this statement of claim.

Statement of Claim 76M 40148 00 allows for diversion of groundwater from Well #8 at a rate of up to 1,200 gpm and volume of 1,937.83 acre-feet per year; this volume equates to year-round diversion at 1,200 gpm. The well is located in the SWSESW of Section 29, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76H 40149 00

Statement of Claim 76H 40149 00 allows for municipal use of Well #9 with a priority date of May 31, 1955. The well is located adjacent to the Montana Rail Link railroad tracks and Dixon Avenue. Well #9 was drilled in 1955 to a depth of 132 feet. A Declaration of Vested Groundwater Rights was filed by MPC on February 1, 1962. A copy of the well log (GWIC ID 69353) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the point of diversion and place of use associated with this statement of claim.

Statement of Claim 76H 40149 00 allows for diversion of groundwater from Well #9 at a rate of up to 1,000 gpm and volume of 1,613 acre-feet per year; this volume equates to

year-round diversion at 1,000 gpm. The well is located in the NENWSW of Section 32, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40150 00

Statement of Claim 76M 40150 00 allows for municipal use of Well #10 with a priority date of June 30, 1957. The well is located off of Hilda Avenue (SE corner of Lot 2, Block 43, Hammond Addition 3). Well #10 was drilled in 1957 to a depth of 147.7 feet. MPC filed a Declaration of Vested Groundwater Rights on February 1, 1962. A copy of the well log (GWIC ID 132850) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the point of diversion and place of use associated with this statement of claim.

Statement of Claim 76M 40150 00 allows for diversion of groundwater from Well #10 at a rate of up to 1,200 gpm and up to 1,937.83 acre-feet per year; this volume equates to year-round diversion at 1,200 gpm. The well is located in the SWSENW of Section 27, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40151 00

Statement of Claim 76M 40151 00 was filed for municipal use of Well #11 with a priority date of July 31, 1957. The well is located near Agnes Street and Park Street (SE corner of Lot 7, Block 5, Bitterroot Homes Addition). Well #11 was drilled in 1957 to a depth of 117 feet and a Declaration of Vested Groundwater Rights was filed by MPC on February 1, 1962. A copy of the well log (GWIC ID 132860) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the place of use associated with this statement of claim.

Statement of Claim 76M 40151 00 allows for diversion of groundwater from Well #11 at a rate of up to 1,200 gpm and volume of 1,937.83 acre-feet per year; this volume equates to year-round diversion at 1,200 gpm. The well is located in the SESWNE of Section 33, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40152 00

Statement of Claim 76M 40152 00 allows for municipal use of Well #12 and Well #43 with a priority date of September 28, 1964. The well is located in the near 5$^{th}$ Street and Sunset Lane (Lot 1, Block 1, Art Pine Addition – East Missoula). Well #12 was drilled in 1964 to a depth of 107 feet. A Declaration of Vested Groundwater Rights was filed by MPC on February 1, 1962. A copy of the well log (GWIC ID 132848) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the place of use associated with this statement of claim. The water right includes a redundant point of diversion (Well #43) on this claim. Well #43 was drilled by O'Keefe Drilling to a depth of 134 feet; the well was completed June 26, 2007. A copy of the well log (GWIC ID 240491) is provided in Attachment W.

Statement of Claim 76M 40152 00 allows for diversion of groundwater from Well #12 and Well #43 located at a rate of up to 1,200 gpm and volume of 1,937.83 acre-feet per year. Well #12 is located in the SWNWNE of Section 24, Township 13 North, Range 19 West

and Well #43 is located in the SENWSW of Section 18, Township 13 North, Range 18 West. This volume equates to year-round diversion at 1,200 gpm. The points of diversion associated with this claim are illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40153 00

Statement of Claim 76M 40153 00 allows municipal use of Well #13 with a priority date of September 28, 1964. The well is located south of Mountain View Drive in the East Rattlesnake area and was drilled in 1964 to a depth of 130 feet. A Notice of Completion of Groundwater Appropriation by Means of Well was filed by MPC on September 28, 1964. A copy of the well log (GWIC ID 68519) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the place of use associated with this statement of claim.

Statement of Claim 76M 40153 00 allows for diversion of groundwater from Well #13 at a rate of up to 800 gpm and volume of 1,291.88 acre-feet per year; this volume equates to year-round diversion at 800 gpm. The well is located in the NENENW of Section 14, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40154 00

Statement of Claim 76M 40154 00 was filed for municipal use of Well #15 with a priority date of March 10, 1967. The well is located near Rattlesnake Drive and Tamarack Street in the East Rattlesnake area and was drilled in 1965 to a depth of 151 feet. A Notice of Completion of Groundwater Appropriation by Means of Well was filed by MPC on March 10, 1967. A copy of the well log (GWIC ID 68453) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the point of diversion and place of use associated with this statement of claim.

Statement of Claim 76M 40154 00 allows for diversion of groundwater from Well #15 at a rate of up to 148 gpm and volume of 239.51 acre-feet per year; this volume equates to year-round diversion at 148 gpm. The well is located in the NWNWNE of Section 11, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5. This well is currently not contributing to the municipal water system in any capacity.

### STATEMENT OF CLAIM 76H 40155 00

Statement of Claim 76H 40155 00 allows for municipal use of Well #16 with a priority date of March 10, 1967. Well #16 is located adjacent to 24$^{th}$ Street and was drilled in 1966 to a depth of 120 feet. A Notice of Completion of Groundwater Appropriation by Means of Well was filed by MPC on March 10, 1967. A copy of the well log (GWIC ID 132828) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the point of diversion and place of use associated with this statement of claim.

Statement of Claim 76H 40155 00 allows for diversion of groundwater from Well #16 at a rate of up to 1,000 gpm and volume of 1,613 acre-feet per year; this volume equates to year-round diversion at 1,000 gpm. The well is located in the SWNENW of Section 6, Township 12 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76H 40156 00

Statement of Claim 76H 40156 00 allows for municipal use of Well #18 with a priority date of August 28, 1968. The well is located adjacent to Garrett Avenue and was drilled in 1966 by Camp Well Drilling to a depth of 105 feet. A Notice of Completion of Groundwater Appropriation by Means of Well was filed by MPC on August 28, 1968. A copy of the well log (GWIC ID 66872) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the place of use associated with this statement of claim.

Statement of Claim 76H 40156 00 allows for diversion of groundwater from Well #18 at a rate of up to 1,000 gpm and volume of 1,613 acre-feet per year; this volume equates to year-round diversion at 1,000 gpm. The well is located in the NWNWNW of Section 6, Township 12 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40157 00

Statement of Claim 76M 40157 00 was filed for municipal use of Well #19 with a priority date of May 13, 1969. The well is located near Rattlesnake Drive and Tamarack Street in the East Rattlesnake area. Well #19 was drilled in 1969 to a depth of 109.5 feet. A Notice of Completion of Groundwater Appropriation by Means of Well was filed by MPC on May 13, 1969. A copy of the well log (GWIC ID 151948) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the place of use associated with this statement of claim.

Statement of Claim 76M 40157 00 allows for diversion of groundwater from Well #19 at a rate of up to 1,200 gpm and volume of 1,937.83 acre-feet per year; this volume equates to year-round diversion at 1,200 gpm. The well is located in the NWNWSW of Section 16, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40158 00

Statement of Claim 76M 40158 00 allows for municipal use Well #20 with a priority date of June 2, 1969. The well is located off of Catlin Drive south of 4$^{th}$ Street West. Well #20 was drilled in 1969 to a depth of 143.7 feet. A Notice of Appropriation of Groundwater was filed by MPC on June 2, 1969. A copy of the well log (GWIC ID 132839) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the place of use associated with this statement of claim.

Statement of Claim 76M 40158 00 allows for diversion of groundwater from Well #20 at a rate of up to 1,200 gpm and volume of 1,937.83 acre-feet per year; this volume equates to year-round diversion at 1,200 gpm. The well is located in the NWSESE of Section 20, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40159 00

Statement of Claim 76M 40159 00 was filed for municipal use of Well #21 with a priority date of July 7, 1969. Well #21 is located near Hilda Avenue and E Central Ave and was drilled in 1969 to a depth of 137 feet. A Notice of Appropriation of Groundwater was filed

by MPC on July 7, 1969. A copy of the well log (GWIC ID 132851) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the point of diversion and place of use associated with this statement of claim.

Statement of Claim 76M 40159 00 allows for diversion of groundwater from Well #21 at a rate of up to 1,200 gpm and 1,937.83 acre-feet per year; this volume equates to year-round diversion at 1,200 gpm. The well is located in the NESWSW of Section 27, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40160 00

Statement of Claim 76M 40160 00 allows for municipal use Well #22 with a priority date of December 31, 1949. The well is located near the intersection of Walnut and Wyoming Streets. Well #22 was drilled in 1949 to a depth of 92 feet and a Notice of Completion of Groundwater Development by Means of Well was filed in December of 1949. A copy of the well log (GWIC ID 132841) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the point of diversion and place of use associated with this statement of claim.

Statement of Claim 76M 40160 00 allows for diversion of groundwater from Well #22 at a rate of up to 1,200 gpm and volume of 1,937.83 acre-feet per year; this volume equates to year-round diversion at 1,200 gpm. The well is located in the NESWNE of Section 21, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40161 00

Statement of Claim 76M 40161 00 was filed for municipal use of Well #23 with a priority date of July 31, 1948. The well is located near the intersection of Pattee Creek Drive and Park Street. Well #23 was drilled in 1945 to a depth of 116 feet. A copy of the well log (GWIC ID 132025) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the point of diversion and place of use associated with this statement of claim.

Statement of Claim 76M 40161 00 allows for diversion of groundwater from Well #23 at a rate of up to 305 gpm and volume of 486.67 acre-feet per year; this volume equates to year-round diversion at 305 gpm. The well is located in the NWNESE of Section 33, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40162 00

Statement of Claim 76M 40162 00 allows for municipal use of Well #24 with a priority date of June 30, 1955. Well #24 is located near the intersection of Pattee Creek Drive and Park Street and was drilled in 1948 to a depth of 120 feet. A Declaration of Vested Groundwater Rights was filed in December of 1970. A copy of the well log (GWIC ID 69412) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the point of diversion and place of use associated with this statement of claim.

Statement of Claim 76M 40162 00 allows for diversion of groundwater from Well #24 at a rate of up to 450 gpm and volume of 725.78 acre-feet per year; this volume equates to year-round diversion at 450 gpm. The well is located in the NWNESE of Section 33, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40163 00

Statement of Claim 76M 40163 00 was filed for municipal use of Well #25 with a priority date of November 18, 1970. Well #25 is located near the intersection of Stephens Avenue and 34th Street and was drilled in 1966 to a depth of 146 feet. A Notice of Completion of Groundwater Appropriation by Means of Well was filed in December of 1970. A copy of the well log (GWIC ID 132861) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the point of diversion and place of use associated with this statement of claim.

Statement of Claim 76M 40163 00 allows for diversion of groundwater from Well #25 at a rate of up to 1,000 gpm and volume of 1,611.23 acre-feet per year; this volume equates to year-round diversion at 1,000 gpm. The well is located in the NWSESW of Section 33, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76H 40164 00

Statement of Claim 76H 40164 00 allows for municipal use of Well #26 with a priority date of September 27, 1972. The well is located adjacent to Garrett Avenue and was drilled by Camp Well Drilling in 1971 to a depth of 125 feet. A Notice of Completion of Groundwater Appropriation by Means of Well was filed by MPC on September 27, 1972. A copy of the well log (GWIC ID 132834) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the place of use associated with this statement of claim.

Statement of Claim 76H 40164 00 allows for diversion of groundwater from Well #26 at a rate of up to 1,000 gpm and volume of 1,613 acre-feet per year; this volume equates to year-round diversion at 1,000 gpm. The well is located in the SENENE of Section 32, Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 40165 00

Statement of Claim 76M 40165 00 was filed for municipal use of Well #27 with a priority date of August 5, 1981. The well is located off of 26th Avenue between Spurgin Road and Sunset Lane. Well #27 was drilled in 1972 to a depth of 125 feet. A Notice of Completion of Groundwater Development was filed August 5, 1981. A copy of the well log (GWIC ID 132844) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the point of diversion and place of use associated with this statement of claim.

Statement of Claim 76M 40165 00 allows for diversion of groundwater from Well #27 at a rate of up to 1,475 gpm and volume of 2,380.55 acre-feet per year; this volume equates to year-round diversion at 1,475 gpm. The well is located in the NWSENE of Section 30,

Township 13 North, Range 19 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76H 40166 00

Statement of Claim 76H 40166 00 allows for municipal use of Well #29 with a priority date of September 24, 1973. The well is located adjacent to Orchard Avenue and was drilled by Camp Well Drilling in 1973 to a depth of 136 feet. A Notice of Completion of Groundwater Appropriation by Means of Well was filed by MPC on September 24, 1973. A copy of the well log (GWIC ID 67046) is provided in Attachment W. MWC objected to the water right and it was amended by the Water Court to more accurately reflect the place of use associated with this statement of claim.

Statement of Claim 76H 40166 00 allows for diversion of groundwater from Well #29 at a rate of up to 1,000 gpm and volume of 1,613 acre-feet per year; this volume equates to year-round diversion at 1,000 gpm. The well is located in the NWSENE of Section 1, Township 12 North, Range 20 West. The point of diversion associated with this claim is illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76H 107536 00

Statement of Claim 76H 107536 00 was filed for municipal use of water diverted from Well #38 and Well #39 with a priority date of December 18, 1973. The wells are located near the Linda Vista Subdivision east of 23rd Street. Well completion information on the abstract indicates there are two wells, both of which are 126 feet deep. The wells were completed by Liberty Drilling and Pump Company in June 1971. A copy of the well logs (GWIC ID 66867 and 154873) are provided in Attachment W. The Bureau of Indian Affairs objected to this water right, resulting in an amendment to the priority date (December 18, 1973) and the points of diversion through the Water Court.

Statement of Claim 76H 107536 00 allows for diversion of groundwater from two wells, Well #38 and Well #39, both of which are located in the SENENW of Section 6, Township 12 North, Range 19 West. Water can be diverted at a rate of up to 3,998 gpm (in combination) for an annual diverted volume of 6,449.2 acre-feet; this volume equates to year-round diversion at 3,998 gpm. The points of diversion and place of use associated with this claim are illustrated in Figure 4-5.

### STATEMENT OF CLAIM 76M 108816 00

Statement of Claim 76M 26368 00 was filed by the City of Missoula - Special Improvement District #459 on October 28, 1981. Prior to filing the claim, the City of Missoula filed an application to change on January 22, 1981. The application to change was filed to modify the purpose from domestic and industrial to municipal and to add the new storage tanks constructed as part of the system. The subsequent statement of claim, with a priority date of January 16, 1963, was then filed for the proposed use rather than the historic use. As such, the DNRC claim file does not reflect the use of water prior to July 1, 1973.

Both the change application and statement of claim are for municipal use of water diverted from two wells (Well #41 and Well #42) located near Palmer Street. The water system was utilized to serve Special Improvement District 459 with a period of use from October 1 through March 31, annually. A new permit application (76M 31907 00) was filed on the same wells to include water use from April 1 to September 30, annually. Well #41 was

constructed for the American Crystal Sugar Company in 1962 and is drilled to a depth of 218 feet below ground surface (bgs). Well #42 was drilled by Camp Well Drilling and Pump Company to a depth of 171 feet; well construction was completed on June 5, 1981. A copy of the well logs (GWIC ID 68413 and 68599) are provided in Attachment W. Water right ownership was transferred from the City of Missoula to MWC on May 31, 2001.

Statement of Claim 76M 108816 00 allows the diversion of groundwater from Wells #41 and 42 at a rate of up to 2,440 gpm and volume of 296 acre-feet per year. The wells are located in the NESWNW and NWSWNW of Section 17, Township 13 North, Range 19 West. Water can be stored in two storage tanks located in the SWSESW and W2NWNW of Section 32, Township 14 North, Range 19 West. The points of diversion associated with this claim are illustrated in Figure 4-5. The period of diversion is from October 1 to March 31, annually. The claim is utilized in combination with 76M 31907 00 which has a period of diversion from April 1 through September 30, annually.

### 4.2.2 Municipal Provisional Permits

The City of Missoula has 14 provisional permits for municipal use; each associated with a groundwater diversion (well). In combination, these provisional permits provide a flow rate of 34,379 gpm (76.6 cfs) and volume of 43,694.77 acre-feet per year for municipal purposes within the City of Missoula. Table 4-4 provides a summary of each of the municipal provisional permits. A detailed discussion of each water right is provided in the following sections. A map illustrating the locations of each well is provided as Figure 4-6.

**Table 4-4. Municipal Provisional Permits Associated with Wells**

| Water Right | Priority Date | Version Type | Source | Diversion Means | Well ID / GWIC | Flow Rate (gpm) | Volume (AF) |
|---|---|---|---|---|---|---|---|
| 76M 706 00 | 10/15/1973 | Change Authorization | Groundwater | Well | #30 / 132845 | 2,000 | 3,186.00 |
| 76M 5452 00 | 5/7/1975 | Change Authorization | Groundwater | Well | #31 / 69073 | 3,000 | 4,839.00 |
| 76M 5604 00 | 6/3/1975 | Change Authorization | Groundwater | Well | #32 / 69078 | 3,000 | 4,839.00 |
| 76M 6616 00 | 10/7/1975 | Change Authorization | Groundwater | Well | #33 / 69077 | 2,989 | 4,821.29 |
| 76M 10378 00 | 11/12/1976 | Change Authorization | Groundwater | Well | #34 / 69063 | 3,000 | 4,839.00 |
| 76H 14489 00 | 8/5/1977 | Change Authorization | Groundwater | Well | #35 / 132858 | 2,500 | 4,032.00 |
| 76M 23029 00 | 6/6/1979 | Change Authorization | Groundwater | Well (x3) | #36/68567; #41/68413; #42/68599 | 1,150 | 1,508.00 |
| 76M 31907 00 | 1/22/1981 | Change Authorization | Groundwater | Well | #42 / 68599 | 2,440 | 296.00 |
| 76M 53867 00 | 8/22/1983 | Change Authorization | Groundwater | Well | #3B / 132854 | 3,000 | 4,838.29 |

**Table 4-4. Municipal Provisional Permits Associated with Wells**

| Water Right | Priority Date | Version Type | Source | Diversion Means | Well ID / GWIC | Flow Rate (gpm) | Volume (AF) |
|---|---|---|---|---|---|---|---|
| 76M 53868 00 | 8/22/1983 | Change Authorization | Groundwater | Well | #30 / 132845 | 2,500 | 4,031.00 |
| 76M 53872 00 | 8/22/1983 | Change Authorization | Groundwater | Well | #34 / 69063 | 3,000 | 4,838.29 |
| 76H 70436 00 | 4/5/1989 | Change Authorization | Groundwater | Well | #38 / 66867; #39 / 154873 | 3,800 | 500.00 |
| 76M 91259 00 | 9/14/1994 | Change Authorization | Groundwater | Well | #41 / 68413; #42 / 68599 | n/a | 504.00 |
| 76H 30063539 | 6/28/2012 | Original Right | Groundwater | Well | #45A/25057; #45B/251974; #45C/251976 | 2,000 | 622.90 |
| *76H 67585 00 | 1/25/1988 | Original Right | Groundwater | Well (x2) | #40A / 67309; #40B / 67310 | 500 | 350.00 |
| *76H 96947 00 | 1/26/1996 | Original Right | Groundwater | Well | #40C / 127528 | 175 | 120.00 |
| **Total** | | | | | | **35,054** | **44,165** |

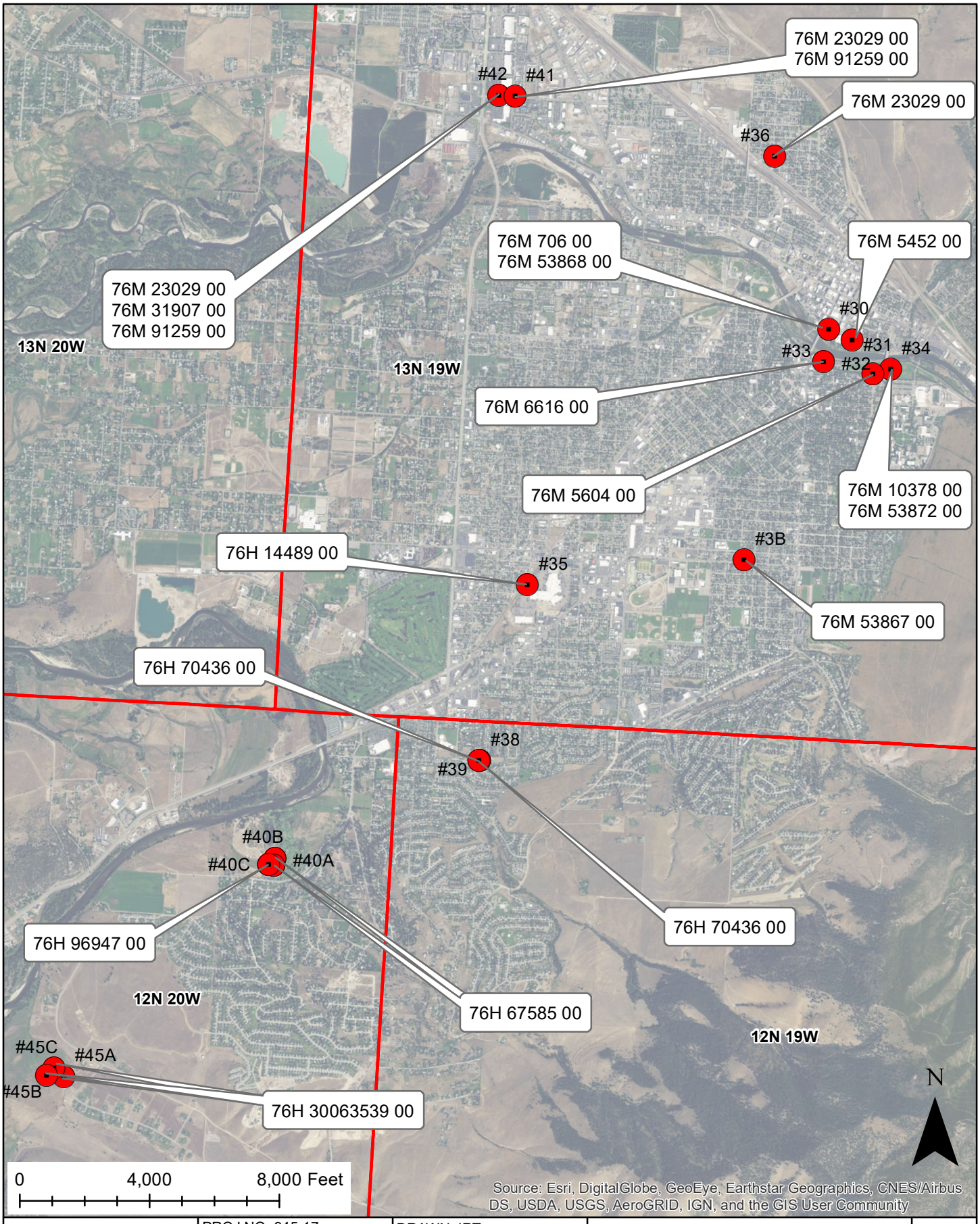
Note: *Ownership not updated to City of Missoula, currently listed as Linda Vista Water Company, care of Mountain Water Company.

Change Authorization 76M 26358-99, which encompasses 62 of MWC's water rights (including all of those discussed in the following section except 76H 30063539), was authorized by DNRC on December 1, 2003. The primary purpose of this change authorization was to standardize and expand the place of use for of the existing water rights. This change authorization provided MWC the ability to move water throughout the entire distribution system. A map illustrating the place of use authorized under this change is provided as Figure 4-2. The current water right abstracts reflects this change authorization. A project completion notice for this change authorization is due December 31, 2024.

#### PROVISIONAL PERMIT 76M 706 00

Provisional Permit 76M 706 00 is for Well #30, located off of Bank Street. The water right application was submitted by MPC on October 15, 1973 and issued July 2, 1974. Well #30 was drilled by Camp Well Drilling and Pump Company to a depth of 176 feet and construction was completed on January 25, 1974. A copy of the well log (GWIC ID 132845) is provided in Attachment W. Water right ownership was transferred from MPC to MWC on October 3, 1983.

Provisional Permit 76M 706 00 allows for diversion of groundwater from Well #30 at a rate of up to 2,000 gpm and volume of 3,186 acre-feet per year for municipal use. This volume equates to continuous year-round pumping at 2,000 gpm. The well is located in the NENWSW of Section 22, Township 13 North, Range 19 West. The point of diversion associated with this permit is illustrated in Figure 4-6.




| | | | | |
|---|---|---|---|---|
| Applied Water CONSULTING LLC | PROJ NO: 945-17 | DRAWN: IRT | MISSOULA WATER RIGHTS | FIGURE 4-6 |
| | LOCATION: MISSOULA, MT | PROJ MGR: R.NOBLE | | |
| | SCALE: 1"=4,000' | CHECKED: | MUNICIPAL PROVISIONAL PERMITS | |
| | FILE NAME: PPBYWELL | DATE: NOV/01/2018 | | |

### PROVISIONAL PERMIT 76M 5452 00

Provisional Permit 76M 5452 00 covers Well #31, located off of Kiwanis Street and Clay Street near the Clark Fork River. The permit application was submitted by MPC on May 7, 1975 and issued May 25, 1976. Well #31 was drilled by Camp Well Drilling and Pump Company to a depth of 135 feet; well construction was completed on December 10, 1976. A copy of the well log (GWIC ID 69073) is provided in Attachment W. Water right ownership was transferred from MPC to MWC on October 3, 1983.

Provisional Permit 76M 5452 00 allows for diversion of groundwater from Well #31 at a rate of up to 3,000 gpm and volume of 4,839 acre-feet per year for municipal use. This volume equates to year-round diversion at 3,000 gpm. The well is located in the SENWSW of Section 22, Township 13 North, Range 19 West. The point of diversion associated with this permit is illustrated in Figure 4-6.

### PROVISIONAL PERMIT 76M 5604 00

Provisional Permit 76M 5604 00 is for Well #32, which is located off of Arthur Avenue and South Fifth Street East. The permit application was submitted by MPC on June 3, 1975 and the permit was issued May 25, 1976. Well #32 was drilled by Camp Well Drilling and Pump Company to a depth of 139.5 feet; well construction was completed on August 17, 1976. A copy of the well log (GWIC ID 69078) is provided in Attachment W. Water right ownership was transferred from MPC to MWC on October 3, 1983.

Provisional Permit 76M 5604 00 allows for diversion of groundwater from Well #32 at a rate of up to 3,000 gpm and volume of 4,839 acre-feet per year for municipal use. This volume equates to year-round diversion at 3,000 gpm. The well is located in the NENWSW of Section 22, Township 13 North, Range 19 West. The point of diversion associated with this permit is illustrated in Figure 4-6.

### PROVISIONAL PERMIT 76M 6616 00

Provisional Permit 76M 6616 00 is for Well #33, which is located off of Gerald Avenue and South Fourth Street East. The permit application was submitted by MPC on October 7, 1975 and the permit was issued November 4, 1976. Well #33 was drilled by Camp Well Drilling and Pump Company to a depth of 147 feet; well construction was completed on August 17, 1977. A copy of the well log (GWIC ID 69077) is provided in Attachment W. Water right ownership was transferred from MPC to MWC on October 3, 1983.

Provisional Permit 76M 6616 00 allows for diversion of groundwater from Well #33 at a rate of up to 2,989 gpm and volume of 4,821.29 acre-feet per year for municipal use. This volume equates to year-round diversion at 2,989 gpm. The well is located in the NWSWSW of Section 22, Township 13 North, Range 19 West. The point of diversion associated with this permit is illustrated in Figure 4-6.

### PROVISIONAL PERMIT 76M 10378 00

Provisional Permit 76M 10378 00 allows diversion from Well #34, which is located off of Maurice Avenue near the Clark Fork River. The permit application was submitted by MPC on November 12, 1976 and the permit was issued December 12, 1976. Well #34 was drilled by Camp Well Drilling and Pump Company to a depth of 196 feet, but was subsequently backfilled to 134 feet bgs. Well construction was completed on February 2,

1978. A copy of the well log (GWIC ID 69063) is provided in Attachment W. Water right ownership was transferred from MPC to MWC on October 3, 1983.

Provisional Permit 76M 10378 00 allows for diversion of groundwater from Well #34 at a rate of up to 3,000 gpm and volume of 4,839 acre-feet per year for municipal use. This volume equates to year-round diversion at 3,000 gpm. The well is located in the NESESW of Section 22, Township 13 North, Range 19 West. The point of diversion associated with this permit is illustrated in Figure 4-6.

### PROVISIONAL PERMIT 76H 14489 00

Provisional Permit 76H 14489 00 covers Well #35, located near Southgate Mall. The permit application was submitted by MPC in August 1978 and the permit was issued August 7, 1978. A project completion notice was filed September 27, 1978. Well completion information on the abstract indicates the well is 117 feet deep. However, documentation submitted by MPC indicates the total depth of the well is 145 feet deep. Per the well driller's log, the well was constructed with 18-inch steel casing to a depth of 145 feet bgs and perforated from 104 to 129 feet bgs. The well was competed completed July 18, 1978, by Camp Well Drilling & Pump Supply. A copy of the well log (GWIC ID 132858) is provided in Attachment W. Water right ownership was transferred from MPC to MWC on October 3, 1983.

Provisional Permit 76H 14489 00 allows for diversion of groundwater from Well #35 at a rate of up to 2,500 gpm and volume of 4,032 acre-feet per year for municipal use. This volume equates to year-round diversion at 2,500 gpm. The well is located in the SENENW of Section 32, Township 13 North. The point of diversion associated with this permit is illustrated in Figure 4-6.

### PROVISIONAL PERMIT 76M 23029 00

Provisional Permit 76M 23029 00 was originally issued for Well #36, located off of Dickens Street between Stoddard and Defoe Streets. The well was located in the NENWSE of Section 16, Township 13 North, Range 19 West. The application was submitted by MWC on June 6, 1979 and the permit was issued on April 24, 1980. The provisional permit allowed for a maximum flow rate of 1,200 gpm and up to 1,936 acre-feet per year to be diverted from Well #36. The well is completed in January of 1980 to a depth of 131 feet and perforated from 100 to 120 feet bgs. A copy of the well log (GWIC ID 68567) is provided in Attachment W. Well use was discontinued in 1999 due to a contaminant plume associated with Montana White Pine and Sash.

Due to the forced shut down of Well #36, MWC submitted change application 76M 30052087 on October 21, 2011. The purpose of the change was to add two additional points of diversion (Well #41 and Well #42) to Provisional Permit 76M 23029 00. MWC documented a maximum historic diversion of 1,150 gpm and 1,508 acre-feet of water diverted water from Well #36. The change was authorized on August 5, 2013, thereby allowing MWC to continue diverting water under Provisional Permit 76M 23029 00.

Provisional Permit 76M 23029 00 allows for diversion of groundwater from Well #36, Well #41, and Well #42 at a rate of up to 1,150 gpm and volume of 1,508 acre-feet per year for municipal uses. The wells (#36, #41, and #42 are located in the NENWSE of Section 16, and NESWNW and NWSWNW of Section 17, Township 13 North, Range 19 West,

respectively. The points of diversion associated with this permit are illustrated in Figure 4-6.

### PROVISIONAL PERMIT 76M 31907 00

Provisional Permit 76M 31907 00 covers Well #42, located off of Palmer Street. The application was submitted by the City of Missoula for Special Improvement District 459 on January 7, 1981 and the permit was amended on January 22, 1981. The permit was issued August 27, 1981. The permit was filed for both Well #41 and Well #42; however, DNRC issued the permit with Well #42 as the only point of diversion. Well #41 was constructed for the American Crystal Sugar Company in 1962 and is drilled to a depth of 218 feet bgs. Well #42 was drilled by Camp Well Drilling and Pump Company to a depth of 171 feet; construction was completed on June 5, 1981. A copy of the well log (GWIC ID 68599) is provided in Attachment W. Water right ownership was transferred from the City of Missoula to MWC on May 31, 2001.

Provisional Permit 76M 31907 00 allows for diversion of groundwater from Well #42 at a rate of up to 2,440 gpm and volume of 296 acre-feet per year. The well is located in the NESWNW of Section 17, Township 13 North, Range 19 West. The point of diversion associated with this permit is illustrated in Figure 4-6. The period of diversion is from April 1 to September 30, annually. This permit is utilized in combination with Statement of Claim 76M 108816 which has a period of diversion from October 1 through March 31, annually.

### PROVISIONAL PERMIT 76M 53867 00

Provisional Permit 76M 53867 00 covers Well #3B located off South Avenue (Lot 15 Homevale Addition Subdivision). The permit application was submitted by MPC on August 22, 1983 and the permit was issued November 23, 1983. Well #3B was drilled by Camp Well Drilling and Pump Company to a depth of 192 feet, and is perforated from 80-104 feet bgs, 149-152 feet bgs, and 177-180 feet bgs; well construction was completed on November 13, 1984. A copy of the well log (GWIC ID 132854) is provided in Attachment W. Water right ownership was transferred from MPC to MWC on October 3, 1983

Provisional Permit 76M 53867 00 allows for diversion of groundwater from Well #3B at a rate of up to 3,000 gpm and volume of 4,838.29 acre-feet per year for municipal use. This volume equates to year-round diversion at 3,000 gpm. The well is located in the SESWSE of Section 28, Township 13 North, Range 19 West. The point of diversion associated with this permit is illustrated in Figure 4-6.

### PROVISIONAL PERMIT 76M 53868 00

Provisional Permit 76M 53868 00 allows for the pumping rate of Well #30 to be increased. The permit application was submitted on August 22, 1983 and DNRC issued the permit November 23, 1983. Provisional Permit 76M 706 00 allows for a flow rate of 2,000 gpm and a volume of 3,186 acre-feet to be diverted from Well #30. Provisional Permit 76M 53868 increases the flow rate to 4,500 gpm and volume to 7,217 acre-feet per year. A project completion notice is due December 31, 2024.

Well #30 was drilled by Camp Well Drilling and Pump Company to a depth of 176 feet; well construction was completed on January 25, 1974. A copy of the well log (GWIC ID 132845) is provided in Attachment W. Water right ownership was transferred from MPC to MWC on October 3, 1983.

Provisional Permit 76M 53868 00 allows for diversion of groundwater from Well #30 at a rate of up to 2,500 gpm and volume of 4,031 acre-feet per year for municipal use. This volume equates to year-round diversion at 2,500 gpm. As noted above, Provisional Permits 76M 53868 00 and 76M 706 00 share the same point of diversion and allow diversion from Well #30 of up to 4,500 gpm and volume of 7,217acre-feet. The well is located in the NWNWSW of Section 22, Township 13 North, Range 19 West. The point of diversion and place of use associated with this permit are illustrated in Figure 4-6.

### PROVISIONAL PERMIT 76M 53872 00

Provisional Permit 76M 53872 00 allows the pumping rate of Well #34 to be increased. The permit application was submitted by MPC on August 22, 1983 and the permit was issued November 23, 1983. Provisional Permit 76M 10378 00 allows for water to be diverted from Well #34 at a flow rate of 3,000 gpm and a volume of 4,838.29 acre-feet per year. Provisional Permit 76M 53872 increases the flow rate to 6,000 gpm and the volume to 9,678 acre-feet per year. A project completion notice is due December 31, 2024.

Well #34 was drilled by Camp Well Drilling and Pump Company to a depth of 196 feet, but was subsequently backfilled to 134 feet bgs; well construction was completed on February 2, 1978. A copy of the well log (GWIC ID 69063) is provided in Attachment W. Water right ownership was transferred from MPC to MWC on October 3, 1983.

Provisional Permit 76M 53872 00 allows for diversion of groundwater from Well #34 at a rate of up to 3,000 gpm and volume of 4,838.29 acre-feet per year for municipal use. This volume equates to year-round diversion at 3,000 gpm. As noted above, provisional permits 76M 53872 00 and 76M 10378 00 share the same point of diversion and allow diversion from Well 34 of up to 6,000 gpm and 9,678 acre-feet. The well is located in the NESESW of Section 22, Township 13 North, Range 19 West. The point of diversion associated with this permit is illustrated in Figure 4-6.

### PROVISIONAL PERMIT 76H 70436 00

Provisional Permit 76H 70436 00 covers Well #38 and Well #39, which are located near the Linda Vista Subdivision east of 23rd Street. The permit application was submitted by Clark Fork Water Company, Inc. in April 1989, for the expanded use of Well #38 and Well #39. Statement of Claim 76H 107536 00 covers the original development from these two wells. This water right was acquired by MWC in 1992 and a project completion notice was filed December 3, 1999. Well completion information on the abstract indicates there are two wells, both of which are 125.5 feet deep. The wells were completed in June 1971 by Liberty Drilling and Pump Company. A copy of the well logs (GWIC ID 66867 and 154873) are provided in Attachment W.

Provisional Permit 76H 70436 00 allows for diversion of groundwater from two wells, Well #38 and Well #39 at a combined rate of up to 3,800 gpm and volume of up to 500 acre-feet per year for municipal use. Both wells are located in the SWNWNE of Section 6, Township 12 North, Range 19 West. The points of diversion associated with this permit are illustrated in Figure 4-6.

### PROVISIONAL PERMIT 76M 91259 00

Provisional Permit 76M 91259 00 covers the use of Well #41 and Well #42, which are located off of Palmer Street. The permit application was submitted by the City of Missoula

on September 14, 1994 for expanded water use in the Grant Creek and Reserve Street areas as growth in this area exceeded the existing water rights (76M 108816 00 and 76M 31907 00). The permit was issued March 28, 1995. Well #41 was constructed for the American Crystal Sugar Company in 1962 and is drilled to a depth of 218 feet bgs. Well #42 was drilled by Camp Well Drilling and Pump Company to a depth of 171 feet; well construction was completed on June 5, 1981. Copies of the well logs (GWIC ID 68413 and 68599) are provided in Attachment W. Water right ownership was transferred from the City of Missoula to MWC on May 31, 2001. A Project Completion Notice was filed on August 29, 2006.

Provisional Permit 76M 91259 00 allows for diversion of groundwater from Well #41 and Well #42 at a rate of up to 2,440 gpm and volume of 504 acre-feet per year for municipal use. In combination with Statement of Claim 76M 108816 00 and 76M 31907 00, the total appropriated volume from Well #41 and Well #42 is 800 acre-feet per year. The wells are located in the NESWNW and NWSWNW of Section 17, Township 13 North, Range 19 West, respectively. The points of diversion associated with this permit are illustrated in Figure 4-6.

### PROVISIONAL PERMIT 76H 30063539

Provisional Permit 76H 30063539 allows diversion from the three Maloney Ranch public water supply wells (#45A, #45B, and #45C). The wells are associated with the Teton Addition at Maloney Ranch, Miller Creek View, and Linda Vista Subdivisions. The permit application was submitted by MWC on June 28, 2012 and the DNRC issued the permit May 6, 2014. The water right allows two of the wells to be pumped simultaneously. Water is diverted from the wells to one of the storage tanks serving the development. A copy of the well logs associated with the development (GWIC ID 25057, 251974, and 251976) are provided in Attachment W.

Well #45A, #45B, and #45C are located within the Bitterroot River drainage basin (76H). Pumping of these wells results in depletions to the nearby surface water bodies of Miller Creek and the Bitterroot River. Water rights appropriated within the Bitterroot River are in excess of the natural stream flow which result in an adverse effect to existing water right holders. As such, depletions to surface water had to be mitigated in order to obtain Provisional Permit 76H 30063539.

Nine water rights from Miller Creek are utilized to mitigate surface water depletions associated with Provisional Permit 76H 30063539. MWC utilized the historic irrigation water rights they purchased on Miller Creek to mitigate depletions associated with the Lower Miller Creek Water System permitted under this permit. MWC was granted Change Authorization 76H 30063540, which retired all or portions of historic irrigation water rights 76H 10179 00, 76H 10180 00, 76H 10181 00, 76H 10182 00, 76H 105162 00, 76H 105163 00, 76H 105164 00, 76H 105165 00, and 76H 214431 00. In total, 233 acres of irrigation from Miller Creek and 50.06 acres of lawn and garden irrigation and 113.5 domestic connections served from a historic well (associated with Provisional Permit 76H 77270-00 for the Twite Well) were retired to mitigate the depletions to the Bitterroot River associated with Provisional Permit 76H 30063539. A detailed discussion of these water rights is provided in the following section. A notice of completion is due December 31, 2019.

Provisional Permit 76H 30063539 allows the diversion of groundwater from Wells #45A, #45B, and #45C at a combined rate of up to 2,000 gpm and volume of 622.90 acre-feet per

year for municipal use. Water can be used to serve 1,477 residential connections including lawn and park irrigation. The maximum diverted volume for any month may not exceed the volumes allocated by the DNRC and outlined on the abstract. The diversion schedule specified ensures compliance with the mitigation proposed under Change Authorization 76H 30064540. Under this water right a total of 176.8 acres are able to be irrigated. The wells are all located in the SENWNW of Section 12, Township 14 North, Range 20 West) The point of diversion associated with this permit are illustrated in Figure 4-6. The place of use associated with this permit is illustrated in Figure 4-2.

## Linda Vista Water Company Water Rights

Two water rights were identified that should be transferred to the City of Missoula. These water rights are currently listed under the ownership of Linda Vista Water Company, c/o Mountain Water Company. Our understanding is that these water rights were originally filed by and owned by Linda Vista Water Company, which was sold to Mountain Water Company. As such, ownership updates are required for two water rights identified. A discussion of each of these water rights is provided below.

### PROVISIONAL PERMIT 76H 67585 00

Provisional Permit 76H 67585 00 allows diversion from two public water supply wells (#40A and #40B) located west of Miller Creek Road and utilized to serve the Linda Vista Subdivision. The permit application was submitted by Linda Vista Water Company on February 19, 1988 and the DNRC issued the permit January 2, 1990. Both wells were constructed by Jeromes Drilling. Well #40A was drilled to a depth of 100 feet; well construction was completed in March 3, 1988. Well #40B was drilled to a total depth of 110 feet bgs; well construction was completed March 22, 1988. A copy of the well logs associated with this water right (GWIC ID 67309 and 67310) are provided in Attachment W. A project completion notice was filed on December 3, 1999.

Provisional Permit 76H 67585 00 allows for diversion of groundwater from Well #40A and Well #40B at a rate of up to 500 gpm and volume of 350 acre-feet per year for municipal use. The wells are located in the SWSESW of Section 1, Township 12 North, Range 20 West. The points of diversion associated with this permit are illustrated in Figure 4-6. The place of use associated with this permit is illustrated in Figure 4-2. Information provided with the project completion notice indicates that these wells have been connected to the greater MWC distribution system. Although not critical, if this is the case, a change in place of use may be prudent to include the entire distribution system.

### PROVISIONAL PERMIT 76H 96947 00

Provisional Permit 76H 96947 00 allows diversion from a third Linda Vista supply well (#40C) that serves the Linda Vista Subdivision. The permit application was submitted by Linda Vista Water Company on January 26, 1996 and the DNRC issued the permit February 26, 1997. Well #40C was drilled by Jeromes Drilling to a depth of 110 feet bgs; well construction was completed in March 25, 1992. A copy of the well log associated with this water right (GWIC ID 127528) is provided in Attachment W. A project completion notice was filed on December 24, 2007.

Provisional Permit 76H 96947 00 allows for diversion of groundwater from Well #40C at a rate of up to 175 gpm and volume of 120 acre-feet per year for multiple-domestic use. The

well is located in the SWSESW of Section 1, Township 12 North, Range 20 West. The point of diversion associated with this permit is illustrated in Figure 4-6. The place of use associated with this permit is illustrated in Figure 4-2. Information provided with the project completion notice indicates that this well was connected to the greater MWC distribution system. If this is the case, at some point in the future a change in place of use may be warranted to include the entire distribution system and change the purpose to municipal.

### 4.2.3 Mitigation Water Rights

MWC utilized the historic irrigation water rights they purchased on Miller Creek to mitigate surface water depletions associated with Provisional Permit 76H 30063539. MWC was granted change authorization 76H 30063540, which retired all of or portions of historic irrigation water rights 76H 10179 00, 76H 10180 00, 76H 10181 00, 76H 10182 00, 76H 105162 00, 76H 105163 00, 76H 105164 00, 76H 105165 00, and 76H 214431 00. In total, 233 acres of irrigation from Miller Creek and 50.06 acres of lawn and garden irrigation, and 113.5 domestic connections served from a historic well (associated with Provisional Permit 76H 77270) were retired to mitigate the depletions to the Bitterroot River associated with provisional permit 76H 30063539. A notice of completion is due December 31, 2019.

Montana Fish, Wildlife and Parks (FWP) objected to the issuance of Provisional Permit 76H 30063539, and suggested that Change Authorization 76H 30063540 was insufficient to mitigate the depletions associated with the proposed development at full build-out. Although the DNRC was satisfied with the mitigation water provided in the change application, MWC made an agreement with FWP to retire an additional 96.3 acres of irrigation to further offset depletions associated with Provisional Permit 76H 30063539. MWC subsequently obtained change authorization 76H 30069868, which converts portions of historic irrigation water rights 76H 105162 00, 105163 00, 105164 00, 105165 00, and 76H 214431 00 from the irrigation purpose to marketing for mitigation/aquifer recharge. This change mitigates the consumptive use of future water developments impacting the Bitterroot River. A maximum of 96.3 acres will be retired from irrigation under this change authorization, providing 0.98 acre-feet per acre to mitigate future consumptive use. The maximum reduction results in 8.39 cfs in Miller Creek, including 937 acre-feet of water historically diverted for irrigation (of which 90.5 acre-feet was consumed). The remaining 51.7 acres associated with these water rights will remain irrigated. Marketing for mitigation will be implemented when pumping from the groundwater authorized under Provisional Permit 76H 30063539 reaches 380 acre-feet in one year, at that time 96.3 acres of irrigation must be retired. The notice of completion is due December 31, 2034.

Table 4-5 summarizes each of the water rights utilized for mitigation. A detailed discussion of each water right is provided in the following of sections.

**Table 4-5. Statements of Claim Utilized for Mitigation of Provisional Permit 76M 30063539**

| Water Right | Priority Date | Version Type | Source | Diversion Means | Purpose | Flow Rate (CFS) | Volume (AF) |
|---|---|---|---|---|---|---|---|
| 76H 10179 00 | 6/1/1877 | Change Authorization | Miller Creek | Instream | Mitigation | 0.81 | 61.00 |

**Table 4-5. Statements of Claim Utilized for Mitigation of Provisional Permit 76M 30063539**

| Water Right | Priority Date | Version Type | Source | Diversion Means | Purpose | Flow Rate (CFS) | Volume (AF) |
|---|---|---|---|---|---|---|---|
| 76H 10180 00 | 9/1/1878 | Change Authorization | Miller Creek | Instream | Mitigation | 1.25 | 93.00 |
| 76H 10181 00 | 10/20/1883 | Change Authorization | Miller Creek | Instream | Mitigation | 1.23 | 89.00 |
| 76H 10182 00 | 6/7/1878 | Change Authorization | Miller Creek | Instream | Mitigation | 1.06 | 77.00 |
| 76H 105162 00 | 6/1/1877 | Change Authorization | Miller Creek | Instream / Headgate | Mitigation / Irrigation | 4.19 | 578.00 |
| 76H 105163 00 | 6/7/1878 | Change Authorization | Miller Creek | Instream / Headgate | Mitigation / Irrigation | 5.19 | 716.00 |
| 76H 105164 00 | 9/1/1878 | Change Authorization | Miller Creek | Instream / Headgate | Mitigation / Irrigation | 6.25 | 855.00 |
| 76H 105165 00 | 5/1/1889 | Change Authorization | Miller Creek | Instream / Headgate | Mitigation / Irrigation | 1.25 | 162.00 |
| 76H 214431 00 | 6/30/1973 | Change Authorization | Miller Creek | Instream / Headgate | Mitigation / Irrigation | 13.2 | 1047.00 |
| 76H 77270 00 | 3/29/1991 | Change Authorization | Groundwater | Instream | Mitigation | 0.56 | 128.23 |
| **Total** | | | | | | **34.99** | **3,806.23** |

## "Twite" Water Rights

### STATEMENT OF CLAIM 76H 10179 00

Statement of Claim 76H 10179 00 is one of nine water rights from Miller Creek that are utilized to mitigate depletions to surface water associated with Provisional Permit 76H 30063539. This claim was filed March 13, 1981 by Marion Benedick and Marjorie Boggess for irrigation water diverted from Miller Creek. The point of diversion was the Lower Baker Ditch. The water right has a priority date of June 1, 1877. Water was diverted for seasonal use from May 1 to August 31, annually. MWC purchased the water rights from the Lloyd Twite Family Partnership on December 28, 2009 and changed the use from irrigation to mitigation water.

The irrigation associated with 76H 10179 00 included 36 acres historically irrigated by the Twite Family Partnership that were retired. As a result, water is left instream to offset depletions to the Bitterroot River associated with Provisional Permit 76H 30063539. Mitigation provided under this water right occurs in lower Miller Creek, below the point of diversion to the confluence with the Bitterroot River. The point of diversion and places of

use associated with this claim are illustrated in Figure 4-7. Statement of Claim 76H 10179 00 has a flow rate of 0.81 cfs, and allows the historical diverted volume of 61.0 acre-feet per year to remain in Miller Creek (of which approximately 25.16 acre-feet per year were consumed).

### STATEMENT OF CLAIM 76H 10180 00

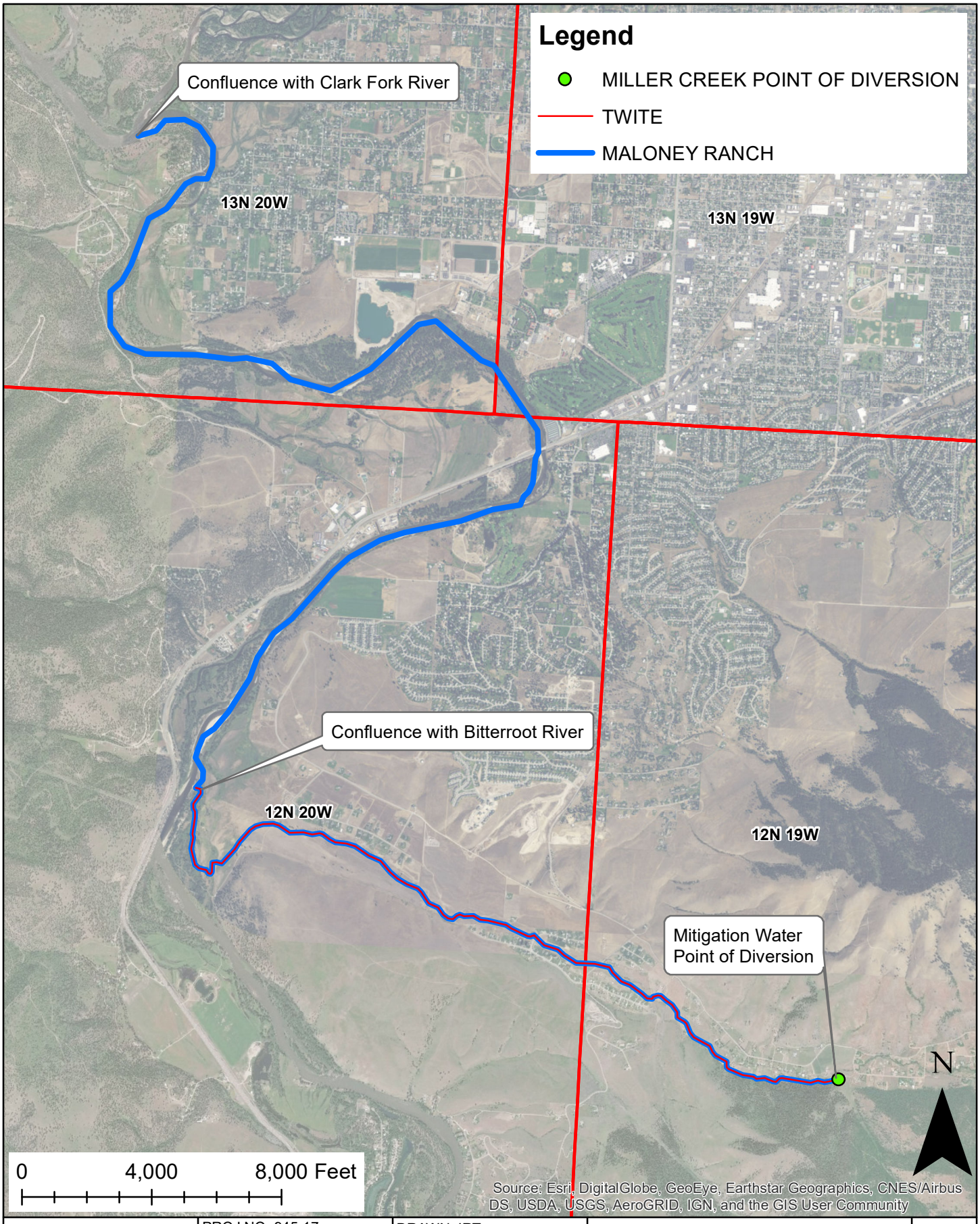
Statement of Claim 76H 10180 00 is one of nine water rights from Miller Creek that are utilized to mitigate depletions to surface water associated with Provisional Permit 76H 30063539. This claim was filed March 13, 1981 by Marion Benedick and Marjorie Boggess for irrigation water diverted from Miller Creek. The point of diversion was the Lower Baker Ditch. The water right has a priority date of September 1, 1878. Water was diverted for seasonal use from May 1 to August 31, annually. MWC purchased the water rights from the Lloyd Twite Family Partnership on December 28, 2009 and changed the usse from irrigation to mitigation water.

The irrigation associated with 76H 10180 00 included 36 acres historically irrigated by the Twite Family Partnership. Water is no longer diverted under this water right (76H 10180 00); instead, water is left to flow instream to offset depletions to the Bitterroot River associated with Provisional Permit 76H 30063539. Mitigation provided under this water right occurs in lower Miller Creek, below the point of diversion to the confluence with the Bitterroot River. The point of diversion and places of use associated with this claim are illustrated in Figure 4-7. Statement of Claim 76H 10180 00 has a flow rate of 1.25 cfs, and allows the historical diverted volume of 93 acre-feet per year to remain in Miller Creek (of which approximately 9.01 acre-feet per year were consumed).

### STATEMENT OF CLAIM 76H 10181 00

Statement of Claim 76H 10181 00 is one of nine water rights from Miller Creek that are utilized to mitigate depletions to surface water associated with Provisional Permit 76H 30063539. This claim was filed March 13, 1981 by Marion Benedick and Marjorie Boggess for irrigation water diverted from Miller Creek. The point of diversion was the Lower Baker Ditch. The water right has a priority date of October 10, 1883. Water was diverted for seasonal use from May 1 to August 31, annually. MWC purchased the water rights from the Lloyd Twite Family Partnership on December 28, 2009 and changed the use from irrigation to mitigation water.

The irrigation associated with 76H 10181 00 included 36 acres historically irrigated by the Twite Family Partnership that were retired for the purpose of mitigation. Water is no longer diverted under this water right (76H 10181 00). Instead, water is left instream to offset depletions to the Bitterroot River associated with Provisional Permit 76H 30063539. Mitigation provided under this water right occurs in lower Miller Creek, below the point of diversion to the confluence with the Bitterroot River. The point of diversion and places of use associated with this claim are illustrated in Figure 4-7. Statement of Claim 76H 10181 00 has a flow rate of 1.23 cfs, and allows the historical diverted volume of 89 acre-feet per year to remain in Miller Creek (of which approximately 4.26 acre-feet per year were consumed).

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|---|---|---|---|
| Applied Water CONSULTING LLC | PROJ NO: 945-17 | DRAWN: IRT | MISSOULA WATER RIGHTS |
| | LOCATION: MISSOULA, MT | PROJ MGR: R.NOBLE | |
| | SCALE: 1"=4,000' | CHECKED: | MITIGATION WR PLACE OF USE |
| | FILE NAME: MITIGATION | DATE: NOV/02/2018 | FIGURE 4-7 |

#### STATEMENT OF CLAIM 76H 10182 00

Statement of Claim 76H 10182 00 is one of nine water rights from Miller Creek that are utilized to mitigate depletions to surface water associated with Provisional Permit 76H 30063539. This claim was filed March 13, 1981 by Marion Benedick and Marjorie Boggess for irrigation water diverted from Miller Creek. The point of diversion was the Lower Baker Ditch. The water right has a priority date of June 7, 1878. Water was diverted for seasonal use from May 1 to August 31, annually. MWC purchased the water rights from the Lloyd Twite Family Partnership on December 28, 2009 and changed the use from irrigation to mitigation water.

The irrigation associated with 76H 10182 00 included 36 acres historically irrigated by the Twite Family Partnership. Water is no longer diverted under this water right (76H 10182 00). Instead, water is left instream to offset depletions to the Bitterroot River associated with Provisional Permit 76H 30063539. Mitigation provided under this water right, occurs in lower Miller Creek, below the point of diversion to the confluence with the Bitterroot River. The point of diversion and places of use associated with this claim are illustrated in Figure 4-7. Statement of Claim 76H 10182 00 has a flow rate of 1.06 cfs, and allows the historical diverted volume of 77 acre-feet per year to remain in Miller Creek (of which approximately 2.29 acre-feet per year were consumed).

## "Maloney Ranch Co." Water Rights

#### STATEMENT OF CLAIM 76H 105162 00

Statement of Claim 76H 105162 00 is one of nine water rights from Miller Creek that is utilized to mitigate depletions to surface water associated with Provisional Permit 76H 30063539. This claim was filed November 24, 1981 by Maloney Ranch Company for irrigation water diverted from six points of diversion on Miller Creek with a priority date of June 1, 1877. Maloney Ranch Company, Washington Water and Power Company, MPC, and others objected to the water right, which was subsequently amended by the Water Court to 4.19 cfs for irrigation of 413 acres. MWC purchased the water rights from Maloney Ranch Company on December 29, 2009, and changed the use from irrigation to mitigation. The number of historically irrigated acres was reduced from 413 acres to 345 acres through the change application process.

A total of 293.3 acres of irrigation associated with 76H 105162 00 shall be retired and the water historically diverted for irrigation will remain in Miller Creek to mitigate depletions associated with Provisional Permit 76H 30063539. The remaining 51.7 acres will continue to be irrigated. Mitigation water provided under this water right occurs in lower Miller Creek, below the point of diversion to the confluence with the Bitterroot River, and the Bitterroot River to its confluence with the Clark Fork River. The points of diversion and place of use associated with this claim are illustrated in Figure 4-7. Statement of Claim 76H 105162 00 has a flow rate of 4.19 cfs, and allows the historical diverted volume of 578 acre-feet per year to remain in Miller Creek, of which approximately 219.26 acre-feet per year was historically consumed.

#### STATEMENT OF CLAIM 76H 105163 00

Statement of Claim 76H 105163 00 is one of nine water rights from Miller Creek that are utilized to mitigate depletions to surface water associated with Provisional Permit 76H

30063539. This claim was filed November 24, 1981 by Maloney Ranch Company for irrigation water diverted from six points of diversion on Miller Creek with a priority date of June 7, 1878. Maloney Ranch Company, Washington Water and Power Company, MPC, and others objected to the water right, which was subsequently amended by the Water Court to 5.19 cfs for irrigation of 413 acres. MWC purchased the water rights from Maloney Ranch Company on December 29, 2009, and changed the use from irrigation to mitigation. The number of historically irrigated acres was reduced from 413 acres to 345 acres through the change application process.

A total of 293.3 acres of irrigation associated with 76H 105163 00 will be retired and the water historically diverted for irrigation shall remain in Miller Creek to mitigate depletions associated with Provisional Permit 76H 30063539. The remaining 51.7 acres of irrigation shall continue to be irrigated. Mitigation water provided under this water right occurs in lower Miller Creek, below the point of diversion to the confluence with the Bitterroot River, and the Bitterroot River to its confluence with the Clark Fork River. The points of diversion and place of use associated with this claim are illustrated in Figure 4-7. Statement of Claim 76H 105163 00 has a flow rate of 5.19 cfs, and allows the historical diverted volume of 716 acre-feet per year to remain in Miller Creek, of which approximately 123.15 acre-feet per year was historically consumed.

#### STATEMENT OF CLAIM 76H 105164 00

Statement of Claim 76H 105164 00 is one of nine water rights from Miller Creek that are utilized to mitigate depletions to surface water associated with Provisional Permit 76H 30063539. This claim was filed November 24, 1981 by Maloney Ranch Company for irrigation water diverted from six points of diversion on Miller Creek with a priority date of September 1, 1878. Maloney Ranch Company, Washington Water and Power Company, MPC, and others objected to the water right, which was subsequently amended by the Water Court to 6.25 cfs for irrigation of 413 acres. MWC purchased the water rights from Maloney Ranch Company on December 29, 2009, and changed the use from irrigation to mitigation. The number of historically irrigated acres was reduced from 413 acres to 345 acres through the change application process.

A total of 293.3 acres of irrigation associated with 76H 105164 00 will be retired and the water historically diverted for irrigation shall remain in Miller Creek to mitigate depletions associated with Provisional Permit 76H 30063539. The remaining 51.7 acres of irrigation shall continue to be irrigated. Mitigation water provided under this water right occurs in lower Miller Creek, below the point of diversion to the confluence with the Bitterroot River, and the Bitterroot River to its confluence with the Clark Fork River. The points of diversion and place of use associated with this claim are illustrated in Figure 4-7. Statement of Claim 76H 105164 00 has a flow rate of 6.25 cfs, and allows the historical diverted volume of 855 acre-feet per year to remain in Miller Creek, of which approximately 29.21 acre-feet per year was historically consumed.

#### STATEMENT OF CLAIM 76H 105165 00

Statement of Claim 76H 105165 00 is one of nine water rights from Miller Creek that are utilized to mitigate depletions to surface water associated with Provisional Permit 76H 30063539. This claim was filed November 24, 1981 by Maloney Ranch Company for irrigation water diverted from six points of diversion on Miller Creek with a priority date of

May 1, 1889. Maloney Ranch Company, Washington Water and Power Company, MPC, and others objected to the water right, which was amended by the Water Court to 1.25 cfs for irrigation of 413 acres. MWC purchased the water rights from Maloney Ranch Company on December 29, 2009, and changed the use from irrigation to mitigation. The number of historically irrigated acres was reduced from 413 acres to 345 acres through the change application process.

A total of 293.3 acres of irrigation associated with 76H 105165 00 shall be retired and the water historically diverted for this purpose shall remain in Miller Creek to mitigate depletions associated with Provisional Permit 76H 30063539. The remaining 51.7 acres of irrigation shall continue to be irrigated. Mitigation water provided under this water right occurs in lower Miller Creek, below the point of diversion to the confluence with the Bitterroot River, and the Bitterroot River to its confluence with the Clark Fork River. The points of diversion and place of use associated with this claim are illustrated in Figure 4-7. Statement of Claim 76H 105165 00 has a flow rate of 1.25 cfs, and allows the historical diverted volume of 162 acre-feet per year to remain in Miller Creek, of which approximately 2.45 acre-feet per year was historically consumed.

#### STATEMENT OF CLAIM 76H 214431 00

Statement of Claim 76H 214431 00 is one of nine water rights from Miller Creek that are utilized to mitigate depletions to surface water associated with Provisional Permit 76H 30063539. This claim is a late claim filing and was filed February 1, 1994 by Maloney Ranch Company for irrigation water diverted from six points of diversion on Miller Creek with a priority date of April 5, 1933. However, due to the late claim filing status, the enforceable priority date is June 30, 1973. Maloney Ranch Company filed the water right for 13.20 cfs to cover 370 acres of irrigation. MWC purchased the water rights from Maloney Ranch Company on December 29, 2009, and changed the use from irrigation to mitigation. The number of historically irrigated acres was reduced from 370 acres to 345 acres through the change application process.

A total of 293.3 acres of irrigation associated with 76H 214431 00 shall be retired and the water historically diverted for this purpose shall remain in Miller Creek to mitigate depletions associated with Provisional Permit 76H 30063539. The remaining 51.7 acres of irrigation shall continue to be irrigated. Mitigation water provided under this water right occurs in lower Miller Creek, below the point of diversion to the confluence with the Bitterroot River, and the Bitterroot River to its confluence with the Clark Fork River. The points of diversion and place of use associated with this claim are illustrated in Figure 4-7. Statement of Claim 76H 214431 00 has a flow rate of 13.2 cfs, and allows the historical diverted volume of 1,047 acre-feet per year to remain in Miller Creek, of which approximately 15.92 acre-feet per year was historically consumed.

#### PROVISIONAL PERMIT 76H 77270 00

Provisional Permit 76H 77270 00 was originally issued for irrigation and multiple-domestic uses associated with Linda Vista Subdivisions 1, 2, 3, and 5. The permit application was submitted by Linda Vista Water Company on March 29, 1991 and the DNRC issued the permit August 23, 1991. The maximum flow rate was 455 gpm and the volume was 341.32 acre-feet per year. A copy of the well log associated with the development (GWIC ID 67312) is provided in Attachment W. MWC purchased Linda Vista Water Company and

the appurtenant water right on July 29, 1998. Since that time, the use has been changed to mitigation water.

Water is no longer diverted under water right 76H 77270 00. Instead, water is left in the aquifer to offset depletions to the Bitterroot River associated with Provisional Permit 76H 30063539. Mitigation provided under this water right occurs in lower Miller Creek to the confluence with the Bitterroot River. The points of diversion and place of use associated with this claim are illustrated in Figure 4-7.

## 4.3 Irrigation Water Rights

### 4.3.1 Irrigation Statements of Claim

The City of Missoula has six statements of claim for irrigation wells. These wells are utilized to serve a variety of facilities including the City Cemetery, Sewage Treatment Plant, and various city parks. Table 4-6 summarizes each of the irrigation groundwater claims. A detailed discussion of each water right is provided in the following sections. A map illustrating the locations of each well is provided as Figure 4-8.

**Table 4-6. Irrigation Statements of Claim Associated with Wells**

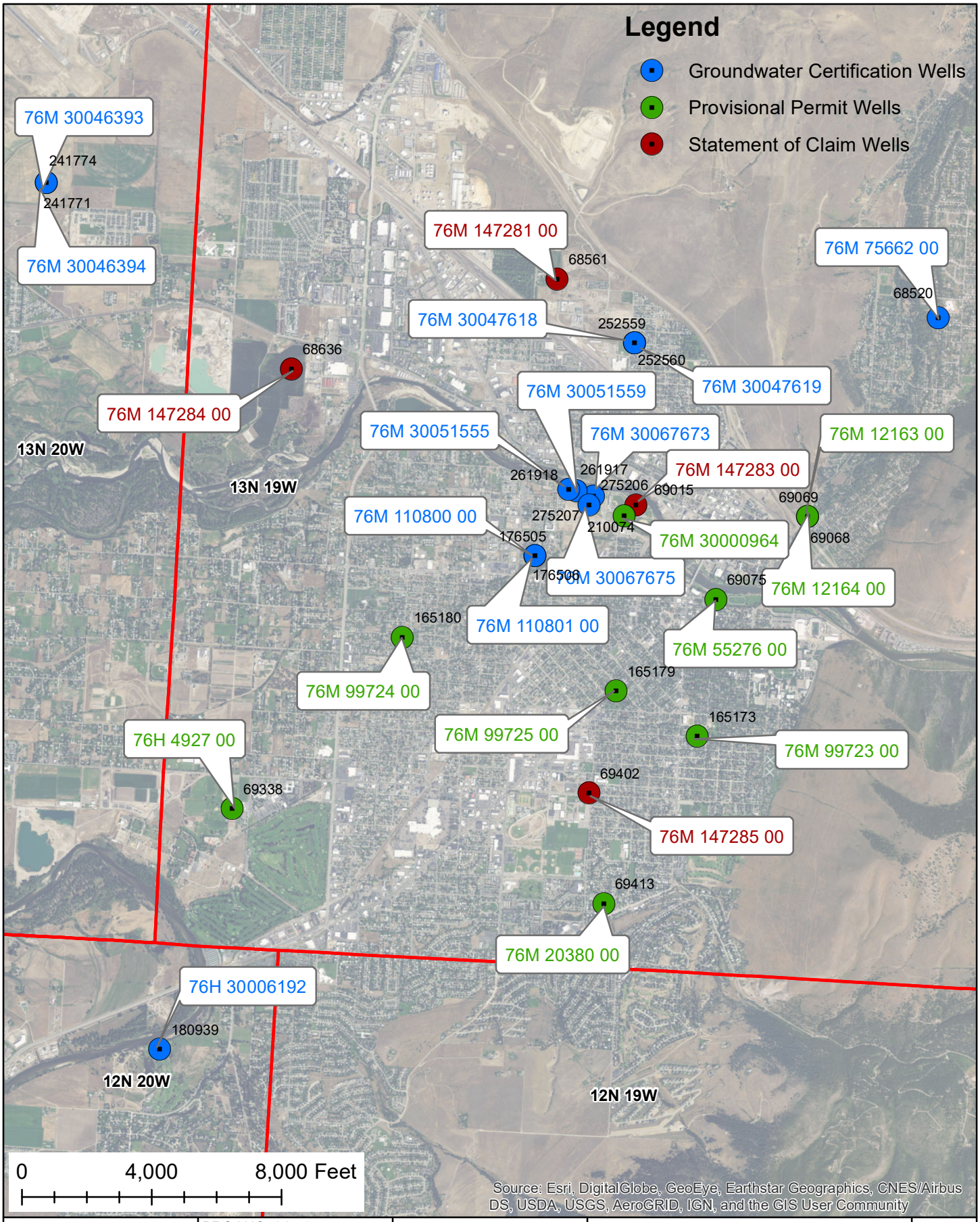
| Water Right | Priority Date | Facility / Park | Well ID / GWIC | Flow Rate (gpm) | Volume (AF) | Acres |
|---|---|---|---|---|---|---|
| 76M 147280 00 | 4/14/1947 | City Cemetery | n/a | 561 | 87 | 33 |
| 76M 147281 00 | 3/6/1969 | City Cemetery | 68561 | 800 | 87 | 48 |
| 76M 147282 00 | 3/1/1955 | City Cemetery | n/a | 85.3 | 19 | 5 |
| 76M 147283 00 | 12/1/1939 | McCormick Park | 69015 | 300 | 61.9 | 25.5 |
| 76M 147284 00 | 12/30/1963 | City Sewer | 68636 | 68 | 37.6 | 4 |
| 76H 147285 00 | 1/21/1963 | Play Fair Park | 69402 | 300 | 106.68 | 41.35 |

#### STATEMENT OF CLAIM 76M 147280 00

Statement of Claim 76M 147280 00 is for the irrigation well at the City Cemetery with a priority date of April 14, 1947. Water is diverted from an onsite well and utilized to irrigate 33 acres. A copy of the well log associated with the development (GWIC ID 68564) is provided in Attachment IW. Per the claim, water is diverted in the SWSESE of Section 8, Township 13 North, Range 19 West and utilized in the SESE of Section 8, and the SESE of Section 17 in Township 13 North, Range 19 West. A review of the project map and scanned documents indicates that the place of use is listed incorrectly and the irrigation in Section 17 should occur in the N2NENE.

#### STATEMENT OF CLAIM 76M 147281 00

Statement of Claim 76M 147281 00 was also filed for irrigation water at the City Cemetery and has a priority date of March 6, 1969. Objections were filed against that claim as originally submitted and it was subsequently modified by the Water Court. Water is




| | | | |
|---|---|---|---|
| Applied Water CONSULTING LLC | PROJ NO: 945-17 | DRAWN: IRT | MISSOULA WATER RIGHTS |
| | LOCATION: MISSOULA, MT | PROJ MGR: R.NOBLE | |
| | SCALE: 1"=4,000' | CHECKED: | IRRIGATION WATER WELLS |
| | FILE NAME: IRRIGATNWLS | DATE: NOV/01/2018 | |

FIGURE 4-8

diverted from an onsite well constructed in 1969. A copy of the well log associated with the development (GWIC ID 68561) is provided in Attachment IW. Per the claim, water is diverted in the NENWNW of Section 16, Township 13 North, Range 19 West and utilized to irrigate a total of 48 acres in Of Sections 8, 9, 16, and 17 of Township 13 North, Range 19 West.

STATEMENT OF CLAIM 76M 147282 00

Statement of Claim 76M 147282 00 was filed for irrigation water at the City Cemetery and a priority date of March 1, 1955. Objections were filed against that claim as originally submitted and it was subsequently modified by the Water Court. Water is diverted from an onsite well that existed when the City purchased the property. A well log could not be located for the well associated with this water right. Per the claim, water is diverted in the NENWNW of Section 16, Township 13 North, Range 19 West and utilized to irrigate a total of 5 acres in the NENWNW of Sections 16, Township 13 North, Range 19 West.

STATEMENT OF CLAIM 76M 147283 00

Statement of Claim 76M 147283 00 was filed for the irrigation water at McCormick Park and a priority date of December 1, 1939. The City filed a change application on January 1, 1987, which was granted by the DNRC on June 5, 1987. The change authorized the point of diversion to be moved to a replacement well constructed in April 1987. A copy of the well log associated with the development (GWIC ID 69015) is provided in Attachment IW. Per the change authorization, water is diverted in the NESWNE of Section 21, Township 13 North, Range 19 West and utilized to irrigate a total of 25.5 acres in the NE of Section 21, Township 13 North, Range 19 West.

STATEMENT OF CLAIM 76M 147284 00

Statement of Claim 76M 147284 00 was filed for the irrigation water at the City Sewer Treatment Plant. The claimed priority date is December 30, 1963. Water is diverted from an onsite well. A copy of the well log associated with the development (GWIC ID 68636) is provided in Attachment IW. Per the claim, water is diverted in the NESESW of Section 18, Township 13 North, Range 19 West and utilized to irrigated 4 acres in the SESW of Section 18, Township 13 North, Range 19 West.

STATEMENT OF CLAIM 76H 147285 00

Statement of Claim 76H 147285 00 is for the old irrigation well at Play Fair Park and has a priority date of January 21, 1963. Water is diverted from the onsite well and utilized to irrigate 41.35 acres. A copy of the well log associated with the development (GWIC ID 69402) is provided in Attachment IW. Per the claim, water is diverted in the SESWNW of Section 33, Township 13 North, Range 19 West and utilized to irrigated 41.35 acres generally located in the NW of Section 33, Township 13 North, Range 19 West.

### 4.3.2 Irrigation Permits

The City of Missoula has ten Provisional Permits associated with 11 irrigation wells throughout the City. These wells are utilized to serve numerous city parks. Table 4-7 summarizes each of the irrigation well permits. A detailed discussion of each water right is

provided in the following sections. A map illustrating the locations of each well is provided as Figure 4-8.

**Table 4-7. Irrigation Provisional Permits Associated with Wells**

| Water Right | Priority Date | Facility / Park | Well ID / GWIC | Flow Rate (gpm) | Volume (AF) | Acres |
|---|---|---|---|---|---|---|
| 76H 4927 00 | 2/25/1975 | Fort Missoula Park | 69338 | 705 | 135 | 52 |
| 76M 12163 00 | 4/11/1977 | Jacobs Island Park | 69081 | 98.74 | 20 | 5 |
| 76M 12164 00 | 4/11/1977 | Greenough Park | 69068 / 69069 | 80 | 17.7 | 5 |
| 76M 20380 00 | 9/21/1978 | Play Fair Park | 69413 | 200 | 41.24 | 25 |
| 76M 55276 00 | 1/30/1984 | John Toole Riverside Park | 69075 | 308 | 38.1 | 15 |
| 76M 81009 00 | 3/11/1992 | Clark Fork Natural Park | n/a | 250 | 38.66 | 10 |
| 76M 99723 00 | 12/6/1996 | Bonner Park | 165173 | 100 | 12.5 | 5 |
| 76M 99724 00 | 12/6/1996 | Franklin Park | 165180 | 110 | 11 | 4.4 |
| 76M 99725 00 | 12/6/1996 | Sunset Memorial Park | 165179 | 150 | 12 | 4.8 |
| 76M 30000964 | 2/12/2002 | Ogren Park - Allegiance Field | 210074 | 76 | 8 | 4.64 |

PROVISIONAL PERMIT 76H 4927 00

Provisional Permit 76H 4927 00 was submitted by Missoula County on August 25, 1975 and issued by the DNRC on January 1, 1976. The permit allows for diversion of groundwater from an irrigation well at the Fort Missoula Park at a pumping rate of 705 gpm and volume of 135 acre-feet per year to irrigate a total of 52 acres. A copy of the well log associated with the development (GWIC ID 69338) is provided in Attachment IW. Per the permit, water is diverted in the SENESNW of Section 31, Township 13 North, Range 19 West and utilized to irrigate a total of 52 acres in the NW of Section 31, Township 13 North, Range 19 West. The current owner of record for the water right is the Parks and Recreation Department.

PROVISIONAL PERMIT 76M 12163 00

Provisional Permit 76M 12163 00 was submitted by Missoula Parks and Recreation on April 11, 1977 and DNRC issued the permit on June 23, 1977. The permit allows for diversion of groundwater from an irrigation well at Jacobs Island Park at a pumping rate of 98.74 gpm and volume of 20 acre-feet per year to irrigate a total of 5 acres. A copy of the well log associated with the development (GWIC ID 69069) is provided in Attachment IW. Per the permit, water is diverted in the SWNESE of Section 22, Township 13 North, Range 19 West and utilized to irrigate a total of 5 acres in the SE of Section 22, Township 13 North, Range 19 West.

PROVISIONAL PERMIT 76M 12164 00

Provisional Permit 76M 12164 00 was submitted by Missoula Parks and Recreation on April 11, 1977 and issued by DNRC on June 6, 1977. The permit allows for diversion of groundwater from two irrigation wells at Greenough Park at a pumping rate of 80 gpm and volume of 17.7 acre-feet per year to irrigate a total of 5 acres. A copy of the well logs associated with the development (GWIC ID 69068 and 69069) are provided in Attachment IW. Per the permit, water is diverted in the NESWNE of Section 22, Township 13 North, Range 19 West and utilized to irrigate a total of 5 acres in the NE of Section 22, Township 13 North, Range 19 West.

PROVISIONAL PERMIT 76M 20380 00

Provisional Permit 76M 20380 00 was submitted by Missoula Parks and Recreation on September 21, 1978 and issued by the DNRC on March 3, 1979. The permit allows for diversion of groundwater from a well at Play Fair Park at a pumping rate of 200 gpm and volume of 41.24 acre-feet per year to irrigate a total of 25 acres. A copy of the well log associated with the water right (GWIC ID 69413) is provided in Attachment IW. Per the permit, water is diverted in the SWSENW of Section 33, Township 13 North, Range 19 West and utilized to irrigate a total of 25 acres in the SENW of Section 33, Township 13 North, Range 19 West.

PROVISIONAL PERMIT 76M 55276 00

Provisional Permit 76M 55276 00 was submitted by Missoula Parks and Recreation on January 30, 1984 and issued by the DNRC on June 27, 1984. The permit allows for diversion of groundwater from a well at John Toole Riverside Park at a pumping rate of 308 gpm and volume of 38.1 acre-feet per year to irrigate a total of 15 acres. A copy of the well log associated with the water right (GWIC ID 69075) is provided in Attachment IW. Per the permit, water is diverted in the NESWSW of Section 22, Township 13 North, Range 19 West and utilized to irrigate a total of 15 acres in the SW of Section 22, Township 13 North, Range 19 West.

PROVISIONAL PERMIT 76M 81009 00

Provisional Permit 76M 81009 00 was submitted by Missoula Parks and Recreation on March 11, 1992 and issued by the DNRC on August 5, 1992. The permit allows for diversion of groundwater from a well located near the Clark Fork Natural Park at a pumping rate of 250 gpm and volume of 38.66 acre-feet per year to irrigate a total of 10 acres. Per the permit, water is diverted in the NWNESE of Section 21, Township 13 North, Range 19 West and utilized to irrigate a total of 10 acres in the SENE and NESE of Section 21, Township 13 North, Range 19 West.

PROVISIONAL PERMIT 76M 99723 00

Provisional Permit 76M 99723 00 was submitted by Missoula Parks and Recreation on December 6, 1996 and issued by the DNRC on April 9, 1997. The permit allows for diversion of groundwater from a well at Bonner Park at a pumping rate of 100 gpm and volume of 12.5 acre-feet per year to irrigate a total of 5 acres. A copy of the well log associated with the water right (GWIC ID 165173) is provided in Attachment IW. Per the permit, water is diverted in the NENWSW of Section 27, Township 13 North, Range 19

West and utilized to irrigate a total of 5 acres in the NENWSW of Section 27, Township 13 North, Range 19 West.

PROVISIONAL PERMIT 76M 99724 00

Provisional Permit 76M 99724 00 was submitted by Missoula Parks and Recreation on December 6, 1996 and issued by the DNRC on April 9, 1997. The permit allows for diversion of groundwater from a well at Franklin Park at a pumping rate of 110 gpm and volume of 11.0 acre-feet per year to irrigate a total of 4.4 acres. A copy of the well log associated with the water right (GWIC ID 165180) is provided in Attachment IW. Per the permit, water is diverted in the SENENW of Section 29, Township 13 North, Range 19 West and utilized to irrigate a total of 4.4 acres in the SENENW of Section 29, Township 13 North, Range 19 West.

PROVISIONAL PERMIT 76M 99725 00

Provisional Permit 76M 99725 00 was submitted by Missoula Parks and Recreation on December 6, 1996 and issued by the DNRC on April 9, 1997. The permit allows for diversion of groundwater from a well at Sunset Memorial Park at a pumping rate of 150 gpm and volume of 12.0 acre-feet per year to irrigate a total of 4.8 acres. A copy of the well log associated with the water right (GWIC ID 165179) is provided in Attachment IW. Per the permit, water is diverted in the SESWNE of Section 28, Township 13 North, Range 19 West and utilized to irrigate a total of 4.8 acres in the SESWNE of Section 29, Township 13 North, Range 19 West.

PROVISIONAL PERMIT 76M 30000964

Provisional Permit 76M 30000964 was submitted by Playball Missoula on February 12, 2002; DNRC issued the permit on April 2, 2003. Water right ownership was transferred to the City of Missoula on February 6, 2007. The permit allows for diversion of groundwater from a well near Ogren Park at Allegiance Field at a pumping rate of 76 gpm and volume of 8.0 acre-feet per year to irrigate a total of 4.64 acres at the facility. A copy of the well log associated with the water right (GWIC ID 210074) is provided in Attachment IW. Per the permit, water is diverted in the NWSWNE of Section 21, Township 13 North, Range 19 West and utilized to irrigate a total of 4.64 acres in the NWSWNE and SWNWNE of Section 21, Township 13 North, Range 19 West.

### 4.3.3 Irrigation Ground Water Certificates

The City of Missoula has 12 ground water certificates for the beneficial use of irrigation or lawn and garden purposes. These ground water certificates are associated with wells that are utilized to irrigate seven city parks. Table 4-8 summarizes each of the irrigation ground water certificates. A detailed discussion of each water right is provided in the following sections. A map illustrating the locations of each well is provided as Figure 4-8.

**Table 4-8. Irrigation Ground Water Certificates Associated with Wells**

| Water Right | Priority Date | Facility / Park | Well ID / GWIC | Flow Rate (gpm) | Volume (AF) | Acres |
|---|---|---|---|---|---|---|
| 76M 30046393 | 7/7/2009 | 44 Ranch Ph 1 & 2 | 241774 | 35 | 1.9 | 1 |

**Table 4-8. Irrigation Ground Water Certificates Associated with Wells**

| Water Right | Priority Date | Facility / Park | Well ID / GWIC | Flow Rate (gpm) | Volume (AF) | Acres |
|---|---|---|---|---|---|---|
| 76M 30046394 | 7/7/2009 | 45 Ranch Ph 1 & 2 | 241771 | 35 | 1.9 | 1 |
| 76M 30051555 | 8/3/2011 | Silver Park Phase III | 261918 | 35 | 8.74 | 4.6 |
| 76M 30051556 | 8/3/2011 | Silver Park Phase III | 261917 | 35 | 8.36 | 4.4 |
| 76H 30006192 | 5/16/2003 | Rainbow Park (Linda Vista) | 180939 | <35 | <10 | 7.64 |
| 76M 110800 00 | 4/13/2000 | Milwaukee Trail ROW | 176505 | 33 | 7.75 | 3.1 |
| 76M 110801 00 | 4/13/2000 | Milwaukee Trail ROW | 176506 | 33 | 7.75 | 3.1 |
| 76M 30047618 | 12/2/2009 | White Pines Park | 252559 | 35 | 7.5 | 3 |
| 76M 30047619 | 12/2/2009 | White Pines Park | 252560 | 35 | 7.5 | 3 |
| 76M 30067673 | 10/23/2013 | Silver Park (Phase IV) | 275207 | 35 | 9.45 | 3.78 |
| 76M 30067675 | 10/23/2013 | Silver Park (Phase IV) | 275206 | 35 | 9.18 | 3.67 |
| *76M 75662 00 | 8/14/1990 | Pineview Park | 68520 | 25 | 6.43 | 2.5 |

*Also includes recreational use associated with ice skating rink.

GROUND WATER CERTIFICATE 76M 30046393

Ground Water Certificate 76M 30046393 was filed by The Grass Valley Project LLC on June 10, 2009; DNRC issued the water right on July 7, 2009. The water right was transferred to the City of Missoula on June 23, 2017. The certificate allows for diversion of water from a 170 foot deep well at the 44 Ranch Phases 1 and 2 at a rate of 35 gpm and volume of up to 1.9 acre-feet per year to irrigate a total of 1.0 acres. A copy of the well log associated with the water right (GWIC 241774) is provided as Attachment IW. Water is diverted in the E2SESW of Section 12, Township 13 North, Range 20 West and utilized to irrigate a total of 1.0 acres in the E2SESW of Section 12, Township 13 North, Range 20 West.

GROUND WATER CERTIFICATE 76M 30046394

Ground Water Certificate 76M 30046394 was also filed by The Grass Valley Project LLC on June 10, 2009; DNRC issued the water right on July 7, 2009. Water right ownership was transferred to the City of Missoula on June 23, 2017. The certificate allows for diversion of water from a 125 foot deep well at the 44 Ranch Phases 1 and 2 at a rate of 35 gpm and volume of up to 1.9 acre-feet per year to irrigate a total of 1.0 acres. A copy of the well log associated with the water right (GWIC 241771) is provided as Attachment IW. Water is diverted in the E2SESW of Section 12, Township 13 North, Range 20 West and

utilized to irrigate a total of 1.0 acres in the E2SESW of Section 12, Township 13 North, Range 20 West.

### GROUND WATER CERTIFICATE 76M 30051555

Ground Water Certificate 76M 30051555 was filed by City of Missoula Parks and Recreation on August 3, 2011. The certificate allows for diversion of water from a 95 foot deep well located at 930 Cregg Lane at a rate of 35 gpm, volume of 8.74 acre-feet per year to irrigate a total of 4.6 acres at Silver Park Phase III. A copy of the well log associated with the water right (GWIC 261918) is provided as Attachment IW. Water is diverted in the NENW of Section 21, Township 13 North, Range 19 West and utilized to irrigate a total of 4.6 acres in the NENW of Section 21, Township 13 North, Range 19 West.

### GROUND WATER CERTIFICATE 76M 30051556

Ground Water Certificate 76M 30051556 was filed by Missoula Parks and Recreation on August 3, 2011. The certificate allows for the diversion of water from a 77 foot deep well located at 900 Cregg Lane at a pumping rate of 35 gpm and volume of 8.74 acre-feet per year to irrigate a total of 4.4 acres at Silver Park Phase III. A copy of the well log associated with the water right (GWIC 261917) is provided as Attachment IW. Water is diverted in the NENW of Section 21, Township 13 North, Range 19 West and utilized to irrigate a total of 4.4 acres in the NENW of Section 21, Township 13 North, Range 19 West.

### GROUND WATER CERTIFICATE 76H 30006192

Ground Water Certificate 76H 30006192 was filed by Upper Linda Vista HOA Homeowners Association, Inc. on May 16, 2003. The water right was transferred to the City of Missoula on June 8, 2006. The certificate allows for diversion of water from a 180-foot deep well located at the Rainbow Park in the Linda Vista subdivision at a rate of up to 35 gpm and volume of up to 10.0 acre-feet per year to irrigate a total of 7.64 acres. A copy of the well log associated with the water right (GWIC 180939) is provided as Attachment IW. Water is diverted in the NESW of Section 12, Township 12 North, Range 20 West and utilized to irrigate a total of 7.64 acres in the NESW of Section 12, Township 12 North, Range 20 West.

### GROUND WATER CERTIFICATE 76M 110800 00

Ground Water Certificate 76M 110800 00 was filed by Missoula on April 13, 2000. The certificate allows for diversion of water from a 77-foot deep well located near the Milwaukee Trail bike path/park between North California Street and Hickory Street. Water is diverted at a rate of 33 gpm and volume of up to 7.75 acre-feet per year to irrigate a total of 3.1 acres along the path. A copy of the well log associated with the water right (GWIC 176505) is provided as Attachment IW. Water is diverted in the SWSWNE of Section 21, Township 13 North, Range 19 West and utilized to irrigate a total of 3.1 acres in the S2SENW of Section 21, Township 13 North, Range 19 West.

### GROUND WATER CERTIFICATE 76M 110801 00

Ground Water Certificate 76M 110800 00 was filed by Missoula on April 13, 2000. The certificate allows for diversion of water from a 92-foot deep well located near the Milwaukee Trail bike path/park between North California Street and Hickory Street. Water

is diverted at a rate of 33 gpm and volume of 7.75 acre-feet per year to irrigate a total of 3.1 acres along the path. A copy of the well log associated with the water right (GWIC 176506) is provided as Attachment IW. Water is diverted in the SWSWNW of Section 21, Township 13 North, Range 19 West and utilized to irrigate a total of 3.1 acres in the S2SWNW of Section 21, Township 13 North, Range 19 West.

#### GROUND WATER CERTIFICATE 76M 30047618

Ground Water Certificate 76M 30047618 was filed by Missoula Parks and Recreation on December 2, 2009. The certificate allows for diversion of water from a 96-foot deep well at White Pines Park at a rate of 35 gpm and volume of 7.5 acre-feet per year to irrigate a total of 3.0 acres. A copy of the well log associated with the water right (GWIC 252559) is provided as Attachment IW. Water is diverted in the SESENE of Section 16, Township 13 North, Range 19 West and utilized to irrigate a total of 3.0 acres in the SESENE of Section 16, Township 13 North, Range 19 West.

#### GROUND WATER CERTIFICATE 76M 30047619

Ground Water Certificate 76M 30047619 was filed by Missoula Parks and Recreation on December 2, 2009. The certificate allows for diversion of water from an 86-foot deep well at White Pines Park at a rate of 35 gpm and volume of 7.5 acre-feet per year to irrigate a total of 3.0 acres. A copy of the well log associated with the water right (GWIC 252560) is provided as Attachment IW. Water is diverted in the SESENE of Section 16, Township 13 North, Range 19 West and utilized to irrigate a total of 3.0 acres in the SESENE of Section 16, Township 13 North, Range 19 West.

#### GROUND WATER CERTIFICATE 76M 30067673

Ground Water Certificate 76M 30067673 was filed by Missoula Parks and Recreation on October 23, 2013. The certificate allows for diversion of water from an 80-foot deep well (Well #1/North Well) at Silver Park Phase IV at a rate of 35 gpm and volume of 9.45 acre-feet per year to irrigate a total of 3.78 acres. A copy of the well log associated with the water right (GWIC 275207) is provided as Attachment IW. Water is diverted in the SENW of Section 21, Township 13 North, Range 19 West and utilized to irrigate a total of 3.78 acres in the SENW of Section 21, Township 13 North, Range 19 West. Ground Water Certificate 76M 30067675 is utilized to irrigate the same irrigated acres.

#### GROUND WATER CERTIFICATE 76M 30067675

Ground Water Certificate 76M 30067675 was filed by Missoula Parks and Recreation on October 23, 2013. The certificate allows for diversion of water from an 80-foot deep well (Well #2/South Well) at Silver Park Phase IV at a rate of 35 gpm and volume of 9.18 acre-feet per year to irrigate a total of 3.67 acres. A copy of the well log associated with the water right (GWIC 275206) is provided as Attachment IW. Water is diverted in the SENW of Section 21, Township 13 North, Range 19 West and utilized to irrigate a total of 3.67 acres in the E2NW of Section 21, Township 13 North, Range 19 West.

#### GROUND WATER CERTIFICATE 76M 75662 00

Ground Water Certificate 76M 75662 00 was filed by the Pineview Park Development Association on August 14, 1990. The water right was transferred to the City of Missoula on May 18, 2007. The certificate allows for diversion of water from a 40-foot deep well at

Pineview Park for irrigation and recreation purposes. Water is diverted at a rate of 25 gpm and volume of 6.43 acre-feet per year for irrigation of 2.5 acres and filling/maintaining an ice hockey rink. A copy of the well log associated with the water right (GWIC 68520) is provided as Attachment IW. Water is diverted in the NWNENW of Section 14, Township 13 North, Range 19 West and utilized for irrigation and recreation purposes in the NWNENW of Section 21, Township 13 North, Range 19 West.

## 4.4 Non-Municipal/Non-Irrigation Water Rights

The City of Missoula also owns a number of water rights that are not for municipal or irrigation uses. The following sections provide a description of those water rights.

### 4.4.1 Non-Municipal/Non-Irrigation Statements of Claim

#### City of Missoula Claims

The City of Missoula filed five statements of claim for purposes other than municipal and irrigation use. The beneficial uses associated with these statements of claim include domestic, industrial, and recreational uses. Table 4-9 summarizes each of these claims. A detailed discussion of each water right is provided in the following sections.

**Table 4-9. Non-Municipal/Non-Irrigation Statements of Claim Filed by City of Missoula**

| Water Right | Priority Date | Version Type | Source | Diversion Means | Purpose | Flow Rate (gpm) | Volume (AF) |
|---|---|---|---|---|---|---|---|
| 76M 147279 00 | 3/12/2021 | Original Right | Groundwater | Well | Domestic | 40 | 1.5 |
| 76M 147286 00 | 5/17/1972 | Original Right | Clark Fork River | Headgate | Recreation | n/a | n/a |
| 76M 147287 00 | 12/31/1939 | Change Authorization | Groundwater | Well | Recreation | 50 | 5 |
| 76M 147288 00 | 1/31/1964 | Original Right | Waste & Seepage, UT of UT of Clark Fork River | Pipeline | Industrial | 600 | 485.15 |
| 76M 147289 00 | 12/30/1963 | Original Right | Groundwater | Well | Industrial | 280 | 200 |

**STATEMENT OF CLAIM 76M 147279 00**

Statement of Claim 76M 147279 00 was filed for a domestic well at the City Cemetery. Water is diverted from an old onsite well and utilized for the office, shop, and caretaker facilities. Per the claim, water is diverted in the NWNWNW of Section 16, Township 13 North, Range 19 West and utilized in the NWNWNW of Section 16, and the SWSWSW of Section 9 in Township 13 North, Range 19 West.

#### STATEMENT OF CLAIM 76M 147286 00

Statement of Claim 76M 147286 00 was filed for filling and maintaining the fish pond at McCormick Park and the purpose is recreation. Water is diverted from a ditch that flows through the park that derives water from the Clark Fork River. The pond was constructed in the early 1970's and was stocked with fish on May 17, 1972, which is the priority date claimed by the City. Per the claim, water is diverted in the SWNESE of Section 21, Township 13 North, Range 19 West, from an irrigation ditch utilized to convey water to the lumber mill. Affidavits from Mr. John McDonald, the Building and Grounds Superintendent at Missoula Parks and Recreation; indicate the pond had a capacity of 6.5 acre-feet and water was allowed to flow through the pond through 18-inch culverts. A review of aerial photography indicates that the place of use is listed incorrectly, and should match the location of the reservoir in the SWSWNE of Section 21, Township 13 North, Range 19 West.

#### STATEMENT OF CLAIM 76M 147287 00

Statement of Claim 76M 147287 00 was filed for recreation purposes at McCormick Park and has a priority date of December 31, 1939. The City filed a change application on January 1, 1987, which was granted by the DNRC on June 5, 1987. The change authorized the point of diversion to be moved to a replacement well constructed in April 1987. A copy of the well log associated with the development (GWIC ID 69015) is provided in Attachment OW. Per the change authorization, water is diverted in the NESWNE of Section 21, Township 13 North, Range 19 West and utilized for recreational purposes at McCormick Park in the SWNE of Section 21, Township 13 North, Range 19 West.

#### STATEMENT OF CLAIM 76M 147288 00

Statement of Claim 76M 147288 00 was filed for industrial use at the City Sewage Treatment Plant. This water right allows for water entering the plant to be used for plant processes including: the dissolved air-flotation process and the temperature regulation heat exchanger. The water discharged from the sewer treatment plant ultimately ends up in the Clark Fork River. Water is diverted in the NWSESE of Section 18, Township 13 North, Range 19 West and utilized for industrial uses in the NESESE of Section 18, Township 13 North, Range 19 West.

#### STATEMENT OF CLAIM 76M 147289 00

Statement of Claim 76M 147289 00 was filed for other industrial water use at the City Sewage Treatment Plant. A copy of the well log associated with the development (GWIC ID 68636) is provided in Attachment OW. Water is diverted in the NWSESE of Section 18, Township 13 North, Range 19 West and utilized for industrial uses in the NESESE of Section 18, Township 13 North, Range 19 West.

### Klapwyk Claims

The following Statements of Claim were filed by Mr. Albert Klapwyk and the water rights were subsequently obtained by the City of Missoula as part of a land transfer. The claims were filed for domestic, stock, and irrigation purposes on properties previously owned by

Mr. Klapwyk. Table 4-10 summarizes each of the claims filed by Mr. Klapwyk's. A detailed discussion of each water right is provided in the following sections.

**Table 4-10. Non-Municipal/Non-Irrigation Statements of Claim Filed by Albert Klapwyk**

| Water Right | Priority Date | Version Type | Source | Diversion Means | Purpose | Flow Rate (gpm) | Volume (AF) |
|---|---|---|---|---|---|---|---|
| 76M 149110 00 | 6/19/1940 | Original Right | Groundwater | Well | Domestic | 20 | 6 |
| 76M 149111 00 | 9/1/1895 | Original Right | Rattlesnake Creek | Headgate | Irrigation | 16.8 | - |
| 76M 149113 00 | 5/16/1895 | Original Right | Rattlesnake Creek | Headgate | Irrigation | 338.8 | - |
| 76M 149114 00 | 4/15/1872 | Original Right | Rattlesnake Creek | Headgate | Irrigation | 132.4 | - |
| 76M 149115 00 | 4/15/1872 | Original Right | Rattlesnake Creek | Ditch | Stock | - | - |
| 76M 149116 00 | 9/1/1895 | Original Right | Rattlesnake Creek | Ditch | Stock | - | - |
| 76M 149117 00 | 1/1/1940 | Original Right | Spring, UT Rattlesnake Creek | Livestock Direct | Stock | - | - |
| 76M 149118 00 | 1/1/1940 | Original Right | Spring, UT Rattlesnake Creek | Livestock Direct | Stock | - | - |
| 76M 149119 00 | 1/1/1940 | Original Right | Spring, UT Rattlesnake Creek | Livestock Direct | Stock | - | - |
| 76M 149120 00 | 1/1/1940 | Original Right | Spring, UT Rattlesnake Creek | Livestock Direct | Stock | - | - |
| 76M 149121 00 | 8/16/1895 | Original Right | Rattlesnake Creek | Ditch | Stock | - | - |
| 76M 157886 00 | 8/31/1919 | Original Right | UT of High Falls Creek | Dam | Stock | - | - |

#### STATEMENT OF CLAIM 76M 149110 00

Statement of Claim 76M 149110 00 was filed on April 28, 1982 by Albert Klapwyk. The claim has a priority date of June 19, 1940 and is for domestic uses associated with the Klapwyk "Home Place". The water right allows diversion at a rate of 20 gpm and up to 6.0 acre-feet from a well in the NWSWSE of Section 11, Township 13 North, Range 19 West for domestic uses including up to 3 acres of irrigation in the NWSWSE of Section 11, Township 13 North, Range 19 West. A copy of the well log associated with the development (GWIC ID 68636) is provided in Attachment OW. The City filed a Water Right Transfer Certificate Form on July 23, 1996.

#### STATEMENT OF CLAIM 76M 149111 00

Statement of Claim 76M 149111 00 was filed for irrigation use from Rattlesnake Creek with a priority date of September 1, 1895. Objections were filed against the claim as it was originally submitted and it has subsequently been modified by the Water Court. The water right allows diversion from Rattlesnake Creek in the NWSWSE of Section 11, Township 13 North, Range 19 West for irrigation of 1 acre in the NWSWSE of Section 11, Township 13 North, Range 19 West. Water can be diverted at a rate of 16.8 gpm between April 1 and October 31 and is conveyed via the Cobban Ditch. The City filed a Water Right Transfer Certificate Form on July 23, 1996.

#### STATEMENT OF CLAIM 76M 149113 00

Statement of Claim 76M 149113 00 was filed for irrigation use from Rattlesnake Creek with a priority date of August 16, 1895. However, objections were filed against the claim as it was originally submitted and it was modified by the Water Court. The water right has been severed from its historic place of use and is reserved for future use. As such, no irrigated acres have been decreed at this time. The City filed a Water Right Transfer Certificate Form on July 23, 1996.

There is presently no volume associated with this Statement of Claim. Without a verified place of use for irrigation or volume, this water right has limited application or value.

#### STATEMENT OF CLAIM 76M 149114 00

Statement of Claim 76M 149114 00 was filed for irrigation use from Rattlesnake Creek with a priority date of April 15, 1872. Objections were filed against the claim as it was originally submitted and it was modified by the Water Court. The water right allows diversion from Rattlesnake Creek in the SWNESE of Section 35, Township 14 North, Range 19 West for irrigation of 10 acres in the NESENW of Section 12, Township 13 North, Range 19 West. Water can be diverted at up to 132.4 gpm between April 1 and October 31 and is conveyed via the Quast Ditch. The City filed a Water Right Transfer Certificate Form on July 23, 1996. There is no map illustrating the appurtenant 10 acres of irrigation decreed in the DNRC files.

#### STATEMENT OF CLAIM 76M 149115 00

Statement of Claim 76M 149115 00 was filed for stock water use from Rattlesnake Creek with a priority date of April 15, 1872. Although objections were filed against the claim as it was originally submitted, no modifications were made by the Water Court. The water right allows diversion from Rattlesnake Creek in the SWNESE of Section 35, Township 14 North, Range 19 West and the NENWNE of Section 2, Township 13 North, Range 19 West for stock watering uses in the SWSW of Section 1 and the NWNW and NWSW of Section 12 Township 13 North, Range 19 West. Water can be utilized year-round for stock watering at this historic place of use. Mr. Klapwyk claimed a total of 230 animal units per year, an approximate volume 7.73 acre-feet. The City filed a Water Right Transfer Certificate Form on July 23, 1996.

#### STATEMENT OF CLAIM 76M 149116 00

Statement of Claim 76M 149116 00 was filed for stock water use from Rattlesnake Creek with a priority date of September 1, 1895. The water right allows diversion from

Rattlesnake Creek in the SWNWSE and the NENWNE of Section 2, Township 13 North, Range 19 West for stock watering in the SWSWSW of Section 1, NWSWSE, E2NENE, E2SENE of Section 11, W2W2NW of Section 12, Township 13 North, Range 19 West. Mr. Klapwyk filed the claim for up to 100 cattle and 10 horses, an approximate volume of approximately 3.86 acre-feet. The City filed a Water Right Transfer Certificate Form in on July 23, 1996.

#### STATEMENT OF CLAIM 76M 149117 00

Statement of Claim 76M 149117 00 was filed for stock water use from an Unnamed Tributary of Rattlesnake Creek with a priority date of January 1, 1940. The water right allows livestock to drink from spring discharge in the SWNESE of Section 12, Township 13 North, Range 19 West year-round. Mr. Klapwyk filed the claim for up to 200 cattle and 50 horses, an approximate volume of 9.24 acre-feet. The City filed a Water Right Transfer Certificate Form on July 23, 1996.

#### STATEMENT OF CLAIM 76M 149118 00

Statement of Claim 76M 149118 00 was filed for stock water use from an Unnamed Tributary of Rattlesnake Creek with a priority date of January 1, 1940. The water right allows livestock to drink from spring discharge in the SENESW of Section 12, Township 13 North, Range 19 West year-round. Mr. Klapwyk filed the claim for up to 200 cattle and 50 horses, an approximate volume of 9.24 acre-feet. The City filed a Water Right Transfer Certificate Form on July 23, 1996.

#### STATEMENT OF CLAIM 76M 149119 00

Statement of Claim 76M 149119 00 was filed for stock water use from an Unnamed Tributary of Danny O'Brien Gulch with a priority date of January 1, 1940. The water right allows livestock to drink from spring discharge in the NWNENW of Section 12, Township 13 North, Range 19 West year-round. Mr. Klapwyk filed the claim for up to 200 cattle and 50 horses, an approximate volume of 9.24 acre-feet. The City filed a Water Right Transfer Certificate Form in on July 23, 1996.

#### STATEMENT OF CLAIM 76M 149120 00

Statement of Claim 76M 149120 00 was filed for stock water use from an Unnamed Tributary of Rattlesnake Creek with a priority date of January 1, 1940. The water right allows livestock to drink from spring discharge in the SWNWNW of Section 13, Township 13 North, Range 19 West year-round. Mr. Klapwyk filed the claim for up to 50 cattle and 10 horses, an approximate volume of 2.18 acre-feet. The City filed a Water Right Transfer Certificate Form on July 23, 1996.

#### STATEMENT OF CLAIM 76M 149121 00

Statement of Claim 76M 149121 00 was filed for stock water use from Rattlesnake Creek with a priority date of August 16, 1895. Although objections were filed against the claim as it was originally submitted, the Water Court did not make any modifications to the original claim filing. The water right allows diversion from Rattlesnake Creek in the SWNESE of Section 35, Township 14 North, Range 19 West for stock watering in portions of Section 1, 11, 12, and 14 Township 13 North, Range 19 West. Water can be utilized year-round for stock watering at this historic place of use. Mr. Klapwyk claimed a total of 230 animal units

per year for a total volume approximately 7.73 acre-feet. The City filed a Water Right Transfer Certificate Form on July 23, 1996.

#### STATEMENT OF CLAIM 76M 157886 00

Statement of Claim 76M 157886 00 was filed for stock water use from an Unnamed Tributary of High Falls Creek with a priority date of August 31, 1919. Mr. Klapwyk claimed portions of water stored in four reservoirs located upstream in the Rattlesnake Creek Drainage (Twin Lake, East Lake, and Farmers Lakes). Per the claim, water is diverted from the reservoirs via High Falls Creek and Rattlesnake Creek until it is diverted in the Quast Ditch or Williams Ditch and conveyed to the place of use for stock watering. Water can be utilized year-round for stock watering at this historic place of use in portions of Section 1, 2, 11, 12, and 14, Township 13 North, Range 19 West. Mr. Klapwyk filed the claim for a total of 230 animal units per year (200 cattle and 20 horses) for a total volume approximately 3.91 acre-feet. The City filed a Water Right Transfer Certificate Form on July 23, 1996.

### Barmeyer Claims

The following statements of claim were filed by George and Dorothy Barmeyer and subsequently obtained by the City of Missoula as part of a land transfer. The claims were filed for fish and wildlife purposes on properties previously owned by Mr. and Mrs. Barmeyer. Table 4-11 summarizes the Barmeyer's claims. The validity of this claim has been brought into question as there is no diversion or appropriation of water. In the matter of the Dearborn Drainage Area, 243 Mont. 343 (1988) (i.e. The Bean Lake Case) the Montana Supreme Court ruled: *"It is clear therefore that under Montana Law before 1973, no appropriation right was recognized for recreation, fish and wildlife, except through a Murphy Right statute"*. Given the question of validity and the fact that no water was ever diverted from the source, the value of these statements of claim is nominal. A brief discussion of each water right is provided in the following sections.

**Table 4-11. Non-Municipal/Non-Irrigation Statements of Claim Filed by Mr. and Mrs. Barmeyer**

| Water Right | Priority Date | Version Type | Source | Diversion Means | Purpose | Flow Rate (gpm) | Volume (AF) |
|---|---|---|---|---|---|---|---|
| 76H 123848 00 | 7/1/1953 | Original Right | Spring, UT of Pattee Creek | Instream | Fish and Wildlife | - | - |
| 76H 123849 00 | 7/1/1953 | Original Right | Spring, UT of Pattee Creek | Instream | Fish and Wildlife | - | - |
| 76H 123847 00 | 7/1/1955 | Original Right | Spring, UT of Pattee Creek | Instream | Fish and Wildlife | - | - |

#### STATEMENT OF CLAIM 76H 123847 00

Statement of Claim 76H 123847 00 was filed for fish and wildlife use from a spring tributary to Pattee Creek and located in the NWSWNW of Section 3, Township 12 North, Range 19 West. The claimed priority date is July 1, 1953.

#### STATEMENT OF CLAIM 76H 123848 00

Statement of Claim 76H 123848 00 was filed for fish and wildlife use from a spring tributary to Pattee Creek located in the NWSWNW of Section 3, Township 12 North, Range 19 West. The claimed priority date is July 1, 1953.

#### STATEMENT OF CLAIM 76H 123849 00

Statement of Claim 76H 123849 00 was filed for fish and wildlife use from a spring tributary to Pattee Creek located in the SWSWNW of Section 3, Township 12 North, Range 19 West. The claimed priority date is July 1, 1955.

## Non-Municipal/Non-Irrigation Ground Water Certificates

## City of Missoula Ground Water Certificates

The City of Missoula filed two ground water certificates for purposes other than municipal or irrigation. The beneficial use associated with these certificates is domestic. Table 4-12 summarizes each of the City's certificates. A discussion of each water right is provided in the following of Sections.

**Table 4-12. Non-Municipal/Non-Irrigation Ground Water Certificates Filed by City of Missoula**

| Water Right | Priority Date | Version Type | Source | Diversion Means | Purpose | Flow Rate (gpm) | Volume (AF) |
|---|---|---|---|---|---|---|---|
| 76M 16421 00 | 11/30/1977 | ORIGINAL RIGHT | GROUNDWATER | WELL | DOMESTIC | 95 | 31.68 |
| 76M 30042652 | 6/18/2008 | ORIGINAL RIGHT | GROUNDWATER | WELL | DOMESTIC | <35 | <10 |

#### GROUND WATER CERTIFICATE 76M 16421 00

Ground Water Certificate 76M 16421 00 was filed by the City of Missoula on November 30, 1977. The certificate allows for diversion of water from a 119-foot deep well at the City's Wastewater Treatment Plant. Water can be diverted at a rate of 95 gpm for potable (domestic) and municipal purposes in the SESE of Section 18, Township 13 North, Range 19 West. A copy of the well log associated with the water right (GWIC 668368) is provided as Attachment OW. Water is utilized for potable/domestic (1.5 acre-feet) and municipal water (30.18 acre-feet) uses at the Sewage Treatment Plant in the SESE of Section 18, Township 13 North, Range 19 West.

#### GROUND WATER CERTIFICATE 76M 30042652

Ground Water Certificate 76M 30042652 was filed by Missoula Parks and Recreation on June 18, 2008. The certificate allows for diversion of water from an 80-foot deep well located at 630 Lafray Park at a rate of 35 gpm and volume of up to 10 acre-feet for potable (domestic) purposes. A copy of the well log associated with the water right (GWIC 244135) is provided as Attachment OW. Water is diverted for domestic purposes at Lafray Park in the SWNWNE of Section 20, Township 13 North, Range 19 West.

## EKO-Kompost Ground Water Certificates

The following Ground Water Certificates were filed by EKO-Kompost and subsequently obtained by the City of Missoula as part of a land transfer. Table 4-13 summarizes the EKO-Kompost certificates. A discussion of each water right is provided in the following of Sections.

**Table 4-13. Non-Municipal/Non-Irrigation Ground Water Certificates Filed by City of Missoula**

| Water Right | Priority Date | Version Type | Source | Diversion Means | Purpose | Flow Rate (gpm) | Volume (AF) |
|---|---|---|---|---|---|---|---|
| 76M 31658 00 | 2/11/1981 | Original Right | Groundwater | Well | Commercial, Domestic, Stock | 99 | 24.2 |
| 76M 31659 00 | 2/11/1981 | Original Right | Groundwater | Developed Spring | Stock, Fish and Wildlife | 99 | 9.41 |
| 76M 31660 00 | 2/11/1981 | Original Right | Groundwater | Developed Spring | Irrigation, Fish and Wildlife | 99 | 58 |

### GROUND WATER CERTIFICATE 76M 31658 00

Ground Water Certificate 76M 31658 00 was filed by EKO-KOMPOST, Inc on February 11, 1981. The water right was transferred to the City on August 18, 2011. The certificate allows for diversion of water from a well near the City's Wastewater Treatment Plant. Water can be diverted for commercial use (21 acre-feet), domestic (two households), and stock watering (0.2 acre-feet) purposes. The well is located in the NESWSE of Section 18, Township 13 North, Range 19 West. A copy of the well log associated with the water right (GWIC 254503) is provided as Attachment OW.

### GROUND WATER CERTIFICATE 76M 31659 00

Ground Water Certificate 76M 31659 00 was filed by EKO-KOMPOST, Inc on February 11, 1981. The certificate allows for diversion of water from a developed spring that forms Hot Dog Lake southwest of the City's Wastewater Treatment Plant. The lake is a former sewage lagoon and gravel pit that was reclaimed by EKO-KOMPOST Inc. Water can be diverted for fish and wildlife and stock purposes in the S2SWSE of Section 18, Township 13 North, Range 19 West. Fish and wildlife uses occur within "Hot Dog Lake" and water can be diverted for stock watering of up to 7 head of cattle in the S2SWSE of Section 18, 13 North, Range 19 West. The City of Missoula obtained the property and the water right ownership was updated on August 18, 2011.

### GROUND WATER CERTIFICATE 76M 31660 00

Ground Water Certificate 76M 31660 00 was filed by EKO-KOMPOST, Inc on February 11, 1981. The certificate allows for diversion of water from a developed spring that forms "White Rock Lake" southwest of the City's Wastewater Treatment Plant. White Rock Lake is a former sewage lagoon and gravel pit that was reclaimed by EKO-KOMPOST Inc. Water can be diverted for fish and wildlife and irrigation purposes in the SESWSE of Section 18, Township 13 North, Range 19 West. Fish and wildlife uses occur within "White

Rock Lake" and water can be diverted for irrigation of up to 4 acres in the SESWSE of Section 18, 13 North, Range 19 West. The City of Missoula obtained the property and the water right ownership was updated on August 18, 2011.

### Jacobsen and Sousa Ground Water Certificate

The following ground water certificates were filed by Clifford Jacobson and Michael and Jen Sousa and subsequently obtained by the City of Missoula as part of a land transfer. Table 4-14 summarizes these certificates. A discussion of the two water rights is provided in the following sections.

**Table 4-14. Non-Municipal/Non-Irrigation Ground Water Certificates Filed by Jacobsen and Sousa**

| Water Right | Priority Date | Version Type | Source | Diversion Means | Purpose | Flow Rate (gpm) | Volume (AF) |
|---|---|---|---|---|---|---|---|
| 76H 30049965 | 12/8/2010 | Original Right | GROUNDWATER | Well | Domestic | 15 | 2.4 |
| 76M 6774 00 | 10/31/1975 | Original Right | GROUNDWATER | Well | Domestic | 12 | |

#### GROUND WATER CERTIFICATE 76M 6774 00

Ground Water Certificate 76M 6774 00 was filed by Clifford Jacobsen on October 31, 1975. The water right was transferred to the City of Missoula on March 24, 2017. The certificate allows for diversion of water from a 56-foot deep well located in the SWSENE of Section 20, Township 13 North, Range 19 West for domestic water use. The well was originally utilized to serve City Electric on Catlin Street. A copy of the well log associated with the water right (GWIC 68902) is provided as Attachment OW. The certificate is for a flow rate of 12 gpm for potable (domestic) purposes in the SWSENE of Section 20, Township 13 North, Range 19 West.

#### GROUND WATER CERTIFICATE 76H 30049965

Ground Water Certificate 76H 30049965 was filed by Michael and Jen Sousa on December 8, 2010. The water right was transferred to the City of Missoula on December 2, 2016. The certificate allows for diversion of water from a 520 foot deep well located in the NENWSE of Section 4, Township 12 North, Range 19 West for domestic, lawn and garden, and stock water use. A copy of the well log associated with the water right (GWIC 66849) is provided as Attachment OW. Water can be diverted at a rate of 15 gpm and volume up to 2.4 acre-feet per year for domestic (1 acre-feet), lawn and garden (1.25 acre-feet on 0.5 acres), and stock (0.15 acre-feet) purposes in the NENWSE of Section 4, Township 12 North, Range 19 West.

## 4.5 Water Use Evaluation

### Diverted Volume Compared to Appropriated Volume

Water-use records from calendar years 2015 and 2016 were used to evaluate the City's net water use as compared to the permitted or claimed volume for the water rights

associated with each of the City's municipal wells. Table 4-15 summarizes the actual diverted volume to the appropriated volumes. Figure 4-9 is a histogram comparing the permitted or claimed volume to the amount of water actually diverted from each well in 2015 and 2016. The green bars represent the permitted or claimed volume listed on the water right and the blue and red bars are the amount of water the City pumped during 2015 and 2016, respectively. The salient observation is that the City has excess water right capacity relative the actual amount of water being used. Table 4-15 also identifies a number of existing wells that have pump capacities below the water right capacity. By replacing pumps, the City could increase its production capacity without making changes to water rights. For example, the following wells have excess water rights: 26th Street (950 gpm), Judi Drive (675 gpm), South Avenue (550 gpm), 23rd Street (476 gpm), and Great Northern (1,240 gpm). Prior to replacing pumps, the City should ensure that the wells are capable of pumping the higher capacities without issues of excessive draw down or water quality (sand, etc.).

A similar evaluation comparing the total volume diverted as a system to the total claimed or permitted volume of the system was performed. The total volume of water diverted in 2015 was 27,029 acre-feet. The water rights associated with the production wells allow for a diversion of up to 89,696 acre-feet per year (as described in Section 2.1.3 and Section 2.2). As shown, the City is using approximately one-third of their allocated volume.

Table 4-15 and Figure 4-9 do not include the direct-flow water rights from Rattlesnake Creek that can now be appropriated from eight of the City's municipal supply wells. These water rights allow for up to 40,352.87 acre-feet per year to be diverted from municipal well #30, #31, #32, #33, #34, #3A, #3B, and #21 as outlined in Section 4.2.1. Table 4-16 compares the volume of water diverted from the eight municipal wells authorized as points of diversion through Change Authorization 76M 40170-99 to the volume of water claimed. As shown, in 2015 and 2016, these wells were utilized to divert a total of 10,320 acre-feet per year or approximately one-quarter of the volume claimed under the City's historic Rattlesnake Creek water rights. These eight wells contribute approximately 40-percent of the groundwater diverted by the City's water system for municipal use in 2015 and 2016.

As noted in Section 4.2.1, the eight wells can be operated under the historic priority dates when water is available in Rattlesnake Creek at the historic point of diversion for the historic surface water rights (SWSWNE Section 2, Township 13 North, Range 19 West). During periods of drought, when water is not available in sufficient quantity to satisfy the full historic surface water rights on Rattlesnake Creek, water is diverted under the existing water rights with a junior priority date. The volume of water diverted from this group of wells in any year is likely a combination of historic Rattlesnake Creek water and junior groundwater water rights.

## Appropriated Flow Rates by Pressure Zone

The City's water distribution system consists of multiple pressure zones. Although the City has several storage tanks located throughout the distribution system, groundwater pumping directly to the water distribution system is relied upon to help maintain pressures and flow during periods of peak flow. Operation in this manner requires large contributions of flow from the wells. Table 4-17, documents the permitted flow rate of each well in addition to the pressure zone the well is located in. In total, the City's current municipal wells appropriate a maximum flow rate of 57,934 gpm. By comparison, the overall peak

hourly demand on the City water system is 42,136 gpm. Of the total flow rate appropriated, 30,764 gpm is associated with wells in the South pressure zone. Given the uneven distribution of wells throughout the water system, booster pumps are utilized to help move water across different pressure zones.

## Table 4-15. Diverted Volume versus Claimed or Permitted Volumes

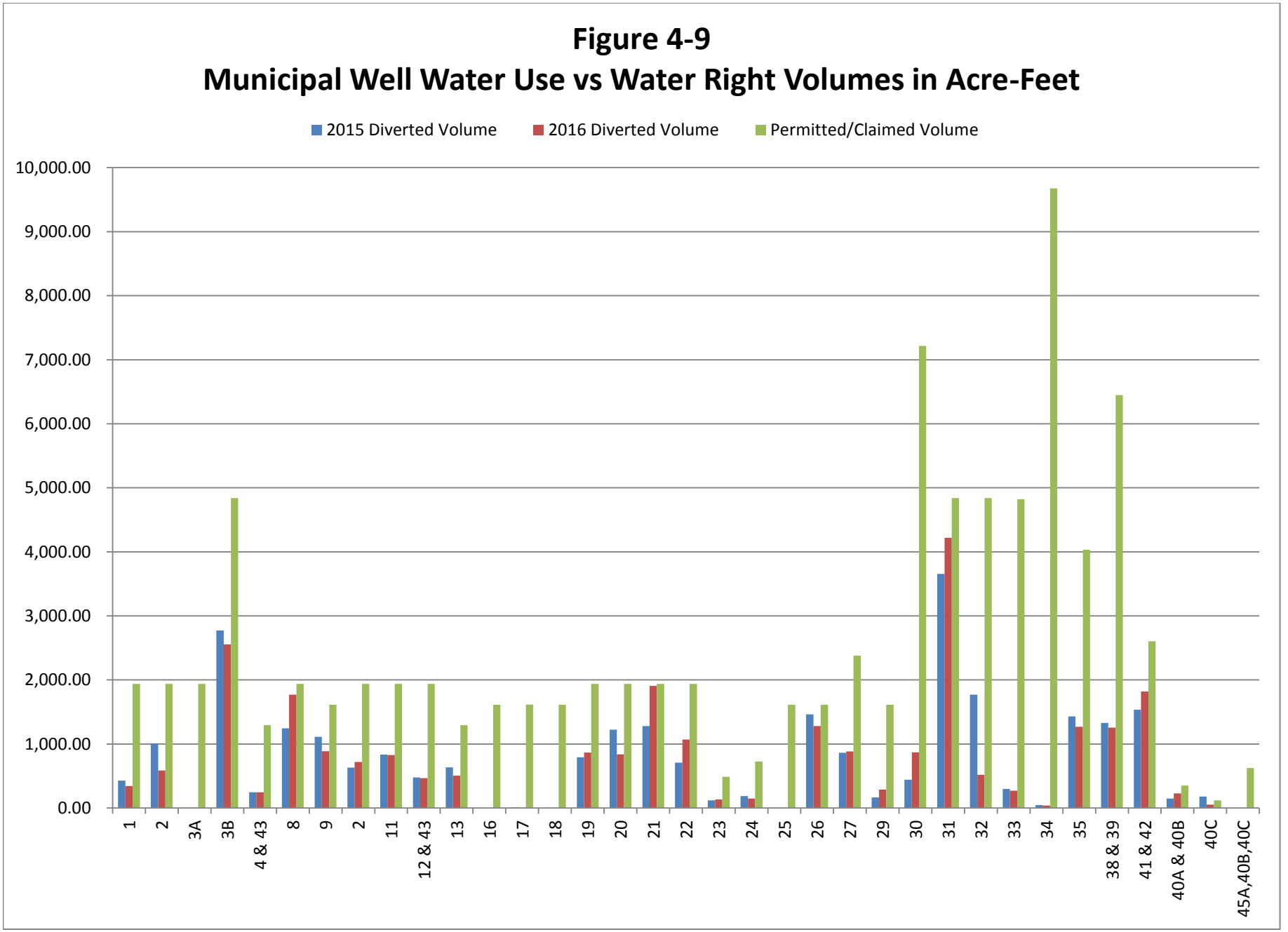
| Well No. | Well Location | Acre-Feet Diverted (2015) | Water Right Number | Water Right Type | Water Right Permitted (Acre-Feet) | Water Right Flow Rate (GPM) | Pump Capacity (GPM) | Excess Water Right (GPM) |
|---|---|---|---|---|---|---|---|---|
| 1 | S. 6th West | 427.80 | 76M 40143 00 | Claim | 1,938 | 1,200 | 1,125 | 75 |
| 2 | S. 14th West | 1,007.91 | 76M 40144 00 | Claim | 1,938 | 1,200 | 1,000 | 200 |
| 3A | South Ave. 100 hp | 0.14 | 76M 40145 00 | Claim | 1,938 | 1,200 | 1,250 | - |
| 3B | South Ave. 200 hp | 2,772.79 | 76M 53867 00 | Permit | 4,838 | 3,000 | 2,450 | 550 |
| 4 | Sommers Street | 227.57 | 76M 40146 00 | Claim | 1,292 | 800 | 500 | 300 |
| 8 | Schilling Street | 1,242.63 | 76M 40148 00 | Claim | 1,938 | 1,200 | 1,000 | 200 |
| 9 | Dixon Avenue | 1,109.55 | 76H 40149 00 | Claim | 1,613 | 1,000 | 1,000 | - |
| 10 | Hilda Avenue | 631.58 | 76M 40150 00 | Claim | 1,938 | 1,200 | 950 | 250 |
| 11 | Agnes Avenue | 833.06 | 76M 40151 00 | Claim | 1,938 | 1,200 | 1,350 | - |
| 12 | Judi Drive | 457.25 | 76M 40152 00 | Claim | 1,938 | 1,200 | 525 | 675 |
| 13 | Mountainview | 632.88 | 76M 40153 00 | Claim | 1,292 | 800 | 900 | - |
| 16 | 24th Street | 0.00 | 76H 40155 00 | Claim | 1,613 | 1,000 | | 1,000 |
| 17 | Momont | 9.87 | 76M 26368 00 | Claim | 1,617 | 1,000 | 1,000 | - |
| 18 | Willowood | 4.77 | 76H 40156 00 | Claim | 1,613 | 1,000 | 850 | 150 |
| 19 | North Russell | 792.81 | 76M 40157 00 | Claim | 1,938 | 1,200 | 1,100 | 100 |
| 20 | Catlin Street | 1,224.58 | 76M 40158 00 | Claim | 1,938 | 1,200 | 1,100 | 100 |
| 21 | East Central | 1,278.42 | 76M 40159 00 | Claim | 1,938 | 1,200 | 1,250 | - |
| 22 | Intermountain | 708.72 | 76M 40160 00 | Claim | 1,938 | 1,200 | 1,075 | 125 |
| 23 | Pattee Creek 25 hp | 119.30 | 76M 40161 00 | Claim | 487 | 305 | 185 | 120 |
| 24 | Pattee Creek 50 hp | 185.19 | 76M 40162 00 | Claim | 726 | 450 | 320 | 130 |
| 25 | Stephens Avenue | 0.41 | 76M 40163 00 | Claim | 1,611 | 1,000 | 825 | 175 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 26 | Benton Street | 1,461.38 | 76H 40164 00 | Claim | 1,613 | 1,000 | 950 | 50 |
| 27 | 26th Street | 863.43 | 76M 40165 00 | Claim | 2,381 | 1,475 | 525 | 950 |
| 29 | Orchard Avenue | 165.95 | 76H 40166 00 | Claim | 1,613 | 1,000 | 950 | 50 |
| 30 | Bank Street | 442.30 | 76M 706 00; 76M 53868 00 | Permit | 7,217 | 2,000 | 3,600 | - |
| 31 | Kiwanis Street | 3,655.61 | 76M 5452 00 | Permit | 4,839 | 3,000 | 3,400 | - |
| 32 | Arthur Avenue | 1,769.16 | 76M 5604 00 | Permit | 4,839 | 3,000 | 3,800 | - |
| 33 | Gerald Avenue | 298.97 | 76M 6616 00 | Permit | 4,821 | 2,989 | 3,800 | - |
| 34 | Maurice Avenue | 45.47 | 76M 10378 00; 76M 53872 00 | Permit | 9,677 | 3,000 | 5,700 | - |
| 35 | Southgate Mall | 1,430.90 | 76H 14489 00 | Permit | 4,032 | 2,500 | 2,425 | 75 |
| 38 | 23rd Avenue East | 837.07 | 76H 107536 00; 76H 70436 00 | Claim; Permit | 6,949 | 3,998 | 1,775 | |
| 39 | 23rd Avenue West | 492.92 | | | | | 1,750 | 473 |
| 41 | Great Northern | 734.81 | 76M 108816 00; 76M 23029 00; *76M 31907 00; 76M 91259 00 | Claim/Permit | 2604 | 2,440 | 1,200 | 1,240 |
| 42 | Palmer Street | 800.02 | | | | 1,150 | 1,140 | 10 |
| 40A | Linda Vista #1 East | 54.01 | 76H 67585 00 | Permit | 350 | 500 | 220 | |
| 40B | Linda Vista #2 North | 92.89 | | | | | 220 | 60 |
| 40C | Linda Vista #3 West | 178.08 | 76H 96947 00 | Permit | 120 | 175 | 250 | - |
| **43 | Canyon River | 38.36 | 76M 40146 00; 76M 40152 00 | Redundant Claim | 3,230 | 800 / 1200 | 555 | - |
| 45A | Haugan Drive #1 | 0.00 | 76H 30063539 | Permit | 623 | 2,000 | 1,000 | - |
| 45B | Haugan Drive #2 | 0.00 | | | | | 770 | - |
| 45C | Haugan Drive #3 | 0.00 | | | | | 1,000 | - |
| **Total** | | **27,028.59** | | | **89,696** | | | |

*Provisional Permit 76M 31907 00 is only associated with Well #42.

**Well #43 is redundant to both Statement of Claim 76M 40146 00 and 76M 40152 00; as such the flow rates and volume are shared with those two water rights.

# Figure 4-9
# Municipal Well Water Use vs Water Right Volumes in Acre-Feet



## Table 4-16. Rattlesnake Creek Claim Volume versus Diversions from Authorized Wells

| Well No. | Well Location | 2015 | | 2016 | | Water Right | | |
|---|---|---|---|---|---|---|---|---|
| | | Gallons | AF | Gallons | AF | Number | Type | AF |
| 3A | South Ave. 100 hp | 44,942 | 0.14 | 40,973 | 0.13 | 76M 40170-00 | Claim | 17,165 |
| 3B | South Ave. 200 hp | 903,517,632 | 2,772.79 | 832,214,307 | 2,553.97 | 76M 40171-00 | Claim | 2,903 |
| 21 | East Central | 416,575,064 | 1,278.42 | 621,621,640 | 1,907.69 | 76M 40172-00 | Claim | 246 |
| 30 | Bank Street | 144,125,511 | 442.30 | 283,091,578 | 868.78 | 76M 40173-00 | Claim | 1,176 |
| 31 | Kiwanis Street | 1,191,183,825 | 3,655.61 | 1,374,879,539 | 4,219.35 | 76M 40174-00 | Claim | 842 |
| 32 | Arthur Avenue | 576,483,909 | 1,769.16 | 169,549,941 | 520.33 | 76M 40175-00 | Claim | 6,314 |
| 33 | Gerald Avenue | 97,421,222 | 298.97 | 87,422,705 | 268.29 | 76M 40176-00 | Claim | 11,707 |
| 34 | Maurice Avenue | 14,816,105 | 45.47 | 12,732,596 | 39.07 | Total Claimed Volume | | 40,353 |
| TOTAL | | 3,344,168,209 | 10,263 | 3,381,553,279 | 10,378 | | | |

*All Statements of Claim include the eight wells as authorized points of diversion.

**Table 4-17. Appropriated Flow Rates by Pressure Zone**

| Well # | WR Number | Pressure Zone | Appropriated Flow (GPM) |
|---|---|---|---|
| 19 | 76M 40157 00 | North | 1,200 |
| 30 | 76M 706 00; 76M 53868 00 | | 4,500 |
| 31 | 76M 5452 00 | | 3,000 |
| 32 | 76M 5604 00 | | 3,000 |
| 17 | 76M 26368 00 | | 1,000 |
| 41 | 76M 108816 00; 76M 23029 00; *76M 31907 00; 76M 91259 00 | | 1,220 |
| 42 | | | 1,220 |
| **Total Appropriated Flow for Pressure Zone** | | | **15,140** |
| 4 | 76M 40146 00 | East Missoula | 800 |
| 12 | 76M 40152 00 | | 1,200 |
| 43 | 76M 40152 00; 76M 40146 00 | | Redundant |
| **Total Appropriated Flow for Pressure Zone** | | | **2,000** |
| 13 | 76M 40153 00 | Rattlesnake/PRV Richard St | 800 |
| **Total Appropriated Flow for Pressure Zone** | | | **800** |
| 1 | 76M 40143 00 | South/PRV FT Missoula | 1,200 |
| 2 | 76M 40144 00 | | 1,200 |
| 3A | 76M 40145 00 | | 1,200 |
| 3B | 76M 53867 00 | | 3,000 |
| 8 | 76M 40148 00 | | 1,200 |
| 9 | 76H 40149 00 | | 1,000 |
| 10 | 76M 40150 00 | | 1,200 |
| 33 | 76M 6616 00 | | 2,989 |
| 34 | 76M 10378 00; 76M 53872 00 | | 6,000 |
| 35 | 76H 14489 00 | | 2,500 |
| 11 | 76M 40151 00 | | 1,200 |

| Well # | WR Number | Pressure Zone | Appropriated Flow (GPM) |
|---|---|---|---|
| 16 | 76H 40155 00 | | 1,000 |
| 18 | 76H 40156 00 | | 1,000 |
| 20 | 76M 40158 00 | | 1,200 |
| 21 | 76M 40159 00 | | 1,200 |
| 22 | 76M 40160 00 | | 1,200 |
| 26 | 76H 40164 00 | | 1,000 |
| 27 | 76M 40165 00 | | 1,475 |
| **Total Appropriated Flow for Pressure Zone** | | | **30,764** |
| 23 | 76M 40161 00 | Lower Farviews/PRV Stephens | 305 |
| 24 | 76M 40162 00 | | 450 |
| 25 | 76M 40163 00 | | 1,000 |
| **Total Appropriated Flow for Pressure Zone** | | | **1,755** |
| 29 | 76H 40166 00 | Gharrett | 1,000 |
| **Total Appropriated Flow for Pressure Zone** | | | **1,000** |
| 38 | 76H 107536 00; 76H 70436 00 | Skyview/PRV Foothills/23rd System/PRV Pinewood/PRV St Thomas/St Francis System/PRV Paul Lane/Jack Dr System | 3,800 |
| 39 | | | |
| **Total Appropriated Flow for Pressure Zone** | | | **3,800** |
| 40A | 76H 67585 00 | Lower Linda Vista/PRV Helena Dr | 500 |
| 40B | | | |
| 40C | 76H 96947 00 | | 175 |
| **Total Appropriated Flow for Pressure Zone** | | | **675** |
| 45A | 76H 30063539 | Sophie | 2,000 |
| 45B | | | |
| 45C | | | |
| **Total Appropriated Flow for Pressure Zone** | | | **2,000** |
| **Total Appropriated Flow Rate of Active Municipal Wells** | | | **57,934** |

### 4.5.2 Impact of Leakage Reduction on Water Rights

The aging infrastructure of the City's water system results in considerable water losses via leaking water mains and service lines. Only a portion of the water diverted is delivered to the customers. At present, the City has water rights in excess of the volume of water diverted. As water mains are replaced and leakage reduced, the City will ultimately need to divert less water to serve the same number of users. The result will be that the City can serve more connections with the same volume of water permitted making it less likely that additional water rights will be needed.

The majority of water loss via leakage from the distribution system is returned to the Missoula Aquifer. Many of leaks within the distribution system are difficult to detect because of the permeable nature of the shallow sediments within the Missoula Valley. Water that is lost is ultimately returned to the same source aquifer it was pumped but is not consumed for beneficial use. Therefore, in terms of water rights, the primary benefit to reduced leakage is the ability to serve a greater number of connections with the same volume of water. In order to avoid the water right change application process, additional service connections must occur within the place of use authorized for each water right.

Figure 4-2 illustrates the place of use for the City's existing municipal water rights. Fortunately, most of the City's municipal water rights were included in Change Authorization 76M 26358-99, which expanded the place of use for the municipal water rights over a uniform area of the Missoula Valley.

### 4.5.3 Wilderness Dam Water Right Alternatives

Missoula has water rights associated with eight dams located within the upper portions of the Rattlesnake Creek drainage basin. These dams have traditionally been utilized to capture and store water during periods when water is available (i.e. spring runoff) and release water to augment flows of Rattlesnake Creek during periods of low flow (late summer and fall). Rattlesnake Creek has not been utilized as the primary source of water for the City of Missoula since 1983. Due to concerns of contamination associated with surface water, MWC transitioned to groundwater to supply the growing demands of the City's residents. We have identified three potential future uses for the wilderness dam water rights.

#### Protect Rattlesnake Creek Flow for Fisheries and Recreation Benefit

Even without the direct use of groundwater from Rattlesnake Creek, the dams have the potential to enhance Rattlesnake Creek flows for the benefit of fisheries and recreation. As described previously, MWC obtained Change Authorization 76M 40170-99 which allows the City to divert Rattlesnake Creek water via eight municipal wells. However, Rattlesnake Creek water can only be diverted from these wells during periods when the flow in Rattlesnake Creek is greater than the water rights being utilized. As such, the wilderness dams could be utilized to augment flows in Rattlesnake Creek if the water rights were successfully changed to instream flow rights.

### Mitigation of Future Groundwater Developments

The wilderness dams and water rights could potentially be utilized to mitigate depletions to the Clark Fork River associated with future groundwater developments. In order change these water rights for mitigation use, the City would be required to go through the water right change process with the DNRC. These water rights may be utilized to mitigate surface water depletions associated with future groundwater developments provided the consumptive use proposed is equal to the consumptive use associated with the wilderness dam water rights. This alternative requires that the historic water use associated with the wilderness dams be thoroughly documented.

### Aquifer Storage and Recovery

Water historically diverted under these water rights could potentially be utilized for aquifer storage and recovery (i.e. aquifer recharge). Aquifer storage and recovery is the injection of surface water for the later diversion (recovery) and use. This alternative may allow the wilderness dam water rights to be severed from the dams. Water could be diverted during periods of high stream flow, as it would have been historically, treated, and injected into the aquifer for later diversion. As with mitigation, the City would be required to go through the water right change process with the DNRC. As part of the change process, the City would need to document the historic use of these water rights, including the volume of water diverted, stored, and consumed. Further, the City would be required to document the impact aquifer recharge would have on local surface water bodies. These impacts would vary depending upon the location of an injection well and the rate and timing of injection. This alternative is highly complex and would require a feasibility assessment for both the water right portions and environmental implications associated with injection of surface water into the Missoula Aquifer.

## 4.6 Water Right Strategies

As noted in Section 4.5, the City has substantial water rights and previous change authorizations obtained by MWC allow a certain amount of flexibility in the operation of the City's water rights. However, the existing wells (and associated water rights) are likely not sited in locations that are ideal to meet the City's distribution demands moving forward. As the City continues to grow and the water system is expanded, additional water rights (and perhaps changes to existing water rights) may be warranted.

Ideally, the City could add additional points of diversion (wells) to some of the existing municipal water rights that are being underutilized. There are several advantages to changing existing water rights, including the ability to divert water under a senior priority date and avoid mitigating depletions that may occur in nearby surface water bodies. However, there are some uncertainties that exist when maneuvering the water right change application process (including the documentation of historic use and the potential changes in net depletion to local surface water bodies).

There are a number of instances wherein a new water right may be necessary. For instance, it is likely that the City will determine a new well must be sited in a certain location to most efficiently meet increased (or existing) flow demands spatially within the distribution system. The City may not have an existing water right with sufficient excess flow rate to accommodate an additional point of diversion (well). Further, depending upon

the location of the new well site, the City may not have an existing water right that could be changed to include the proposed point of diversion (well). Pumping of wells located at different geographic locations within the Missoula Valley may end up depleting the Bitterroot River or Clark Fork River at differing rates. If pumping of the proposed well results in an increased depletion to the Bitterroot River, a change will likely not be authorized. As such, a new water right would be required.

The following recommendations are afforded based on this understanding and our assessment of the City of Missoula's municipal water rights.

## Infill within Existing Place of Use

Both the Clark Fork River and the Bitterroot River have existing legal demands (water rights) that exceed stream flows during large portions of the year. Although groundwater is an abundant source that does not appear to be being depleted due to over-pumping, the Missoula Aquifer's interconnection with these surface water bodies will require mitigating depletions to surface water associated with any proposed groundwater development. Mitigation water, particularly on the Bitterroot River, is not easily achieved. Water is currently being marketed for mitigation on the Clark Fork River, but not on the Bitterroot River. Therefore, it behooves the City to continue service with the existing points of diversion (municipal wells) and within the existing place of use to the maximum extent practical.

As documented in Section 5.0, the City owns substantially more water rights than are currently being utilized. Change Authorization 76M 26358-99 expanded the place of use for municipal water rights to cover a large portion of the Missoula Valley. A notice of completion for Change Authorization 76M 26358-99 is due December 31, 2024. Prior to that date, the City will need to file a Form 618 (Project Completion Notice) with the DNRC and provide supplemental documentation detailing the expansion of the City's distribution system (place of use). Current DNRC policy is that only the aspects of the water rights that have been changed are subject to review by the DNRC once the Notice of Completion is filed. As such, the underlying water rights will remain intact; but the place of use will be modified to reflect the place of use being served at the time the notice of completion is filed. Alternatively, if the City has plans to continue expansion of the water system within the place of use authorized through Change Authorization 76M 26358-99 (and illustrated in Figure 4-2), the City may file an Application for Extension of Time (Form 607) instead of the notice of completion. If the City chooses this alternative, it is imperative that the City file an Application for Extension of Time before the December 31, 2024 deadline.

Provided the City's growth and expansion occurs within the place of use outlined in Figure 4-2, these water rights can continue to be utilized as permitted or claimed. This is especially important given the problems associated with obtaining new water rights from the Missoula Aquifer. As shown in Table 4-15, the city does have excess water rights at some existing wells. By replacing pumps, the City could increase its production capacity without making changes to water rights. For example, the following wells have excess water rights: 26$^{th}$ Street (950 gpm), Judi Drive (675 gpm), South Avenue (550 gpm), 23$^{rd}$ Street (476 gpm), and Great Northern (1,240 gpm). Prior to replacing pumps, the City should ensure that the wells are capable of pumping the higher capacities without issues of excessive draw down or water quality (sand, etc.).

## Change Point of Diversion for Unperfected Permits

Obtaining a new water right permit for a groundwater well within the Missoula Aquifer is challenging because the Bitterroot River and the Clark Fork River are over-appropriated. Impacts to each of these sources require mitigation of the consumed portion of the diverted volume. MWC obtained two provisional permits to increase the flow rates and diverted volume of Well #30 and Well #34, respectively. These water rights are unperfected and have a project completion deadline of December 31, 2024.

Provisional Permit 76M 53868 00 allows for diversion of groundwater from Well #30 at a rate of up to 2,500 gpm and volume of 4,031 acre-feet per year and in combination with the original water right allow a total diversion from Well #30 of up to 4,500 gpm and volume of 7,217acre-feet. Provisional Permit 76M 53872 00 allows for diversion of groundwater from Well #34 at a rate of up to 3,000 gpm and volume of 4,838.29 acre-feet per year and in combination with the original water right allows diversion from Well #34 of up to 6,000 gpm and 9,678 acre-feet.

Both permits were filed to increase the flow rate and volume of water associated each respective well. However, based on the water use information from 2015 and 2016 it appears that neither of these wells is being utilized at their full permitted flow rate or volume. As such, the unutilized portion of the flow rate (approximately 1,200 gpm) and volume could be moved to a new point of diversion (new or existing municipal well) in a more beneficial location to improve the hydraulics of the distribution system.

The City would be required to go through the water right change process with the DNRC to move these water rights to a new point of diversion. However, the historic use does not need to be documented because these are unperfected permits. Instead the originally permitted flow rate and volume of water can be brought forward to a new point (or points) of diversion. There are two caveats with this type of change: 1) water must be diverted from the same source aquifer as originally permitted (i.e. Missoula Aquifer); and 2) the impacts to hydraulically connected surface water bodies (i.e. Bitterroot River and Clark Fork River) needs to be the same as it would have been at the originally permitted points of diversion. Given that both wells are located near the Clark Fork River, the new point of diversion should be kept as near to the Clark Fork River as practical to achieve the same rate and timing of surface water depletions. As a first step in the change process, an evaluation of potential well locations meeting these requirements should be submitted to the DNRC for approval prior to selection of a new well site.

## Assess Point of Diversion Changes to Under-utilized Municipal Rights

As noted above, obtaining new water right permits for groundwater wells within the Missoula Aquifer is challenging. However, the City does hold a number of municipal water rights that appear to be either unutilized or under-utilized at this time. There are five statements of claim for municipal purposes that are associated with wells that are not currently connected to the City's water system. These wells include: Well #37, Well #28, Well #24, Well #7, and Well #15. If the City does not intend to connect these wells to the distribution system, the flow rate and volume could be moved to an alternate well (point of diversion).

A review of the 2015 and 2016 water use indicate there are several additional water rights for wells that are connected to the water system but do not appear to be utilized to their full potential. Well #16 was not pumped in either of those years. Additionally, the volume of water diverted from Well #17, Well #18, Well #25, and Well #34 was substantially less than the appropriated volumes associated with each well. These wells are likely required to meet peak demands but not relied upon as primary sources of water. In that instance, moving a portion of the diverted volume to an additional well and retaining the flow rate at the existing well may be possible.

The City would be required to go through the DNRC water right change process to modify the points of diversion associated with these water rights. With the exception of Well #34 all of the wells identified above are associated with statements of claim. The City will likely be able to move at least a portion of the water rights to alternate points of diversion. As noted above, there are two caveats with this type of change: 1) water must be diverted from the same source aquifer as originally permitted (i.e. Missoula Aquifer); and 2) the impacts to hydraulically connected surface water bodies (i.e. Bitterroot River and Clark Fork River) needs to be the same as it would have been at the originally permitted points of diversion. As shown in Figure 4-5, the wells identified above are located in various portions of the Missoula Valley. As a first step in the change process, an evaluation of historic use associated with each water right should be discussed with the DNRC and potential well locations meeting the caveats for a new well site should be submitted to the DNRC for approval prior to moving forward with a change application.

## Identify Potential Sources of Mitigation Water

The Missoula Aquifer is a prolific source of groundwater with well yields of up to 6,000 gpm in certain locations. Future groundwater development within the Missoula Valley is constrained by the limitation of legally available surface water. As previously noted, there are existing water rights with demands in excess of the normal monthly flow rate for both the Bitterroot River and Clark Fork River. Due the nature of the Missoula Aquifer, pumping of groundwater from the aquifer results in a depletion to one or both of these surface water sources depending upon the location of the pumping well.

In order to obtain new permits to increase the system's capacity or expand the distribution system beyond the place of use permitted, a new water right will be required. Permitting the new water right will require an existing water right be retired or repurposed to ensure that there is no net impact to either of the rivers. As such, identifying water rights that can be retired or repurposed should be a priority for the City.

At this time, mitigating depletions to the Clark Fork River can be achieved with relative ease. Downstream power generators have water rights in excess of the stream flow during portions of the year. However, because the power generation is associated with a small amount of storage, the rate and timing of depletions to the Clark Fork River are not a critical factor in a mitigation plan. Instead, the total volume of water consumed or prevented from reaching the Clark Fork River must be mitigated on an annual basis. The City has a number of water rights that could potentially be utilized to mitigate impacts to the Clark Fork River. Grass Valley French Ditch Company has gone through the process of changing their water right to the purpose of marketing for mitigation. They have been granted more than 3,700 acre-feet of water for mitigation purposes on the Clark Fork River.

As such, the Grass Valley French Ditch Company is a potential source of mitigation water to mitigate future impacts to the Clark Fork River.

Unfortunately, mitigating depletions to the Bitterroot River is not as easily achieved. The Bitterroot River is a closed basin per MCA 85-2-344 - Bitterroot River Subbasin Temporary Closure. The basin closure allows for new groundwater water rights to be appropriated provided there is no adverse effect to any existing surface water users. At this time, water appears to be physically available in excess of the existing legal demands in the Bitterroot River for only six months of the year. The existing water rights are in excess of the median stream flows in the other months. As such, all depletions to the Bitterroot River during months when water is not legally available must be mitigated. Further complicating the process of mitigating impacts to the Bitterroot River is that mitigation is required for three months that are outside of the irrigation season (January, February, and December). Retiring historic irrigation water rights and leaving the water in stream is insufficient to mitigate impacts occurring from year-round groundwater diversions. In these instances, there are two options: 1) retire a historic water right with a year-round consumptive use; or 2) construct an infiltration basin or aquifer recharge system that will allow water associated with a seasonal use (i.e. irrigation) to be diverted during the irrigation season, infiltrate the groundwater system and return to offset depletions occurring during the winter months. Future development of groundwater within the Missoula Valley appears tied to the ability to mitigate depletions to the Bitterroot River when necessary. We recommend identifying historic water rights that may be sufficient to offset future depletions and acquiring these water rights as they become available.

## Define Historic Use and Potential Impact of Growing Cities Doctrine

On paper, the City of Missoula has water rights far in excess of their existing demands. In addition, the DNRC has authorized changes to the City's municipal water rights that expand the place of use. Under current rules, the continued utilization of the City's existing municipal water rights up to the claimed or permitted limits is permissible. However, in the event that the City needs to change any of their existing water rights they would be required to undertake the DNRC change application process. As part of this process, the historic use of each water right being changed would need to be thoroughly examined and documented. The process requires the historic flow rate, diverted volume, volume of water consumed to be determined prior to July 1, 1973. Once those elements are defined, the change authorization is restricted to those historic limitations.

A similar defense of the City's water rights may be required in the event that the validity of one of the City's water rights were challenged. DNRC standards require the documented historic use for a statement of claim to occur prior to July 1, 1973. For provisional permits, the maximum historic use must occur prior to the filing of a notice of completion. Given that the majority of the City's statements of claim and provisional permits allow for year-round diversion at the claimed or permitted flow rate, it is likely that a water right would be reduced to the actual rate and volume historically diverted. This reduction would certainly reduce the excess of water rights currently held by the City. However, once the historic use of water has been defined, the water rights are secure from challenge. Defining each of the municipal water rights in this manner will provide City management the information necessary to plan for future development needs.

It should be noted that a number of recent court decisions have rejected the notion that a municipality or public utility in Montana is required to have put the full flow rate or volume of water appropriated under a statement of claim to use prior to July 1, 1973 (Helena v Skinner, MT Supreme Court DA 16-0320; Lockwood Area Yellowstone County Water and Sewer District, MT Water Court; and City of Billings v USA Bureau of Indian Affairs, USA Bureau of Reclamation, Crow Tribe of Indians, MT Water Court). These recent court cases discuss either specifically or allude to the "growing communities doctrine", wherein a municipality (or other public utility company) is able to acquire water rights sufficient to satisfy the needs of a growing city and need not put the full flow rate or volume to beneficial use to have legally appropriated it. The growing communities' doctrine creates a presumption of nonabandonment provided a municipality or water purveyor has utilized a portion of their water right and there is evidence that they have taken additional steps to provide water to meet future demands. Montana statutes do provide special privileges to municipal water utilities, but have yet to explicitly or completely adopt the growing communities' doctrine. At this time the application of the growing communities' doctrine is somewhat nebulous and will likely be refined through future court decisions.

# ATTACHMENTS W AND IW

# WELL LOGS

# Well #37 / 76M 26357 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/8/2009 10:17:57 AM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 37**
**GWIC Id: 68306**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
440 SOUTH AVE W.
MISSOULA MT N/A [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
N/A
MISSOULA MT N/A [06/25/1973]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 2 | SE¼ SW¼ SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.91453 | -113.963601 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3425.4 | | | |

**Addition** **Block** **Lot**

### Section 3: Proposed Use of Water

DOMESTIC (1)

### Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Monday, June 25, 1973

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.
There are no casing strings assigned to this well.
There are no completion records assigned to this well.

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 57
Static Water Level: 11
Water Temperature:

**Air Test** *

120 gpm with drill stem set at _ feet for 2 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 16 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

111ALVM - ALLUVIUM (HOLOCENE)

| From | To | Description |
|---|---|---|
| 0 | 14 | CLAY AND SANDY GRAVEL |
| 14 | 32 | BOULDERS AND GRAVEL |
| 32 | 55 | SANDY GRAVEL AND CLAY STREAKS WATER |
| 55 | 57 | GRAVEL (WATER) |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 6/25/1973

# Well #28 / 76M 26359 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View water quality for this site
View scanned well log (11/17/2008 1:36:57 PM)


**Site Name: MOUNTAIN WATER COMPANY * WELL 28**
**GWIC Id: 132890**

## Section 1: Well Owner(s)

1) MONTANA POWER CO (MAIL)
N/A
MISSOULA MT 59801 [09/21/1972]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 14N | 20W | 26 | NW¼ SW¼ SW¼ SW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.9374 | -114.1023 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3161.3 | | | |

**Addition**
C & M HOMES WELL

**Block**

**Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, September 21, 1972

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 365 | 6 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 138 | 141 | 6 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 365
Static Water Level: 78
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
33 gpm pump rate with _ feet of drawdown after 20 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 116 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

120SNGR - SAND AND GRAVEL (TERTIARY)

| From | To | Description |
|---|---|---|
| 0 | 5 | COBBLESTONES- GRAVEL & TAN CLAY |
| 5 | 31 | TAN CLAY |
| 31 | 39 | TAN CLAY AND GRAVEL |
| 39 | 68 | BROWN CLAY AND GRAVEL |
| 68 | 84 | LT BROWN CLAY & GRAVEL |
| 84 | 85 | CLAY GRAVEL & WATER |
| 85 | 98 | YELLOW CLAY AND GRAVEL |
| 98 | 110 | TAN CLAY |
| 110 | 122 | TAN CLAY AND GRAVEL |
| 122 | 123 | GRAVEL- CLAY AND WATER |
| 123 | 132 | YELLOW CLAY |
| 132 | 138 | TAN CLAY SOME GRAVEL |
| 138 | 141 | GRAVEL SAND AND WATER |
| 141 | 150 | YELLOW CLAY AND GRAVEL |
| 150 | 151 | SAND GRAVEL- WATER AND SILT |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 9/21/1972

**Site Name: MOUNTAIN WATER COMPANY * WELL 28**
**GWIC Id: 132890**
**Additional Lithology Records**

| From | To | Description |
|---|---|---|
| 151 | 169 | SAND CLAY AND GRAVEL |
| 169 | 171 | SAND SOME GRAVEL AND WATER |
| 171 | 187 | SANDY YELLOW CLAY |
| 187 | 246 | BROWN CLAY |
| 246 | 257 | BLUE AND TAN CLAY- SOME GRAVEL |
| 257 | 272 | BLUE CLAY |
| 272 | 285 | GREEN CLAY |
| 285 | 305 | BLUE CLAY |
| 305 | 350 | GRAY CLAY AND GRAVEL |
| 350 | 375 | GRAY CLAY |

# Well #14 / 76 H 26360 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View water quality for this site
View scanned well log (3/3/2009 12:19:10 PM)


**Site Name: MOUNTAIN WATER COMPANY * WELL 14**
**GWIC Id: 132030**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
N/A
N/A N/A N/A [09/01/1992]
2) THE MONTANA POWER COMPANY (MAIL)
RUSSELL ST
MISSOULA MT N/A [04/05/1976]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 32 | SE¼ SE¼ SE¼ SE¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.834651 | -114.019702 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3135.7 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: DEEPENED

## Section 5: Well Completion Date

Date well completed: Monday, April 05, 1976

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.
There are no casing strings assigned to this well.
There are no completion records assigned to this well.

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 146
Static Water Level:
Water Temperature:

**Unknown Test Method** *

Yield _ gpm.
Pumping water level _ feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 2 | TOPSOIL AND GRAVEL |
| 2 | 31 | CLAY- GRAVEL AND BOULDERS |
| 31 | 37 | SILTY SAND AND GRAVEL |
| 37 | 46 | CLAY AND GRAVEL |
| 46 | 59 | CLAY- GRAVEL AND BOULDERS |
| 59 | 68 | GRAVEL AND WATER |
| 68 | 80 | CLAY AND GRAVEL |
| 80 | 100 | SAND- GRAVEL AND WATER |
| 100 | 101 | CLAY AND GRAVEL ORIGINAL WELL COMPLETED 6-1-65 BY GLENN CAMP |
| 101 | 107 | SAND- GRAVEL AND WATER |
| 107 | 109 | SAND AND WATER |
| 109 | 121 | SAND- GRAVEL AND WATER |
| 121 | 123 | GRAVEL- WATER W/SEAMS OF CLAY |
| 123 | 133 | CLAY AND GRAVEL |
| 133 | 145 | SANDY CLAY |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-239
**Date Completed:** 4/5/1976

**Site Name: MOUNTAIN WATER COMPANY * WELL 14**
**GWIC Id: 132030**
**Additional Lithology Records**

| From | To | Description |
|---|---|---|
| 145 | 146 | SAND- GRAVEL AND WATER |

# Well #17 / 76M 26368 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View water quality for this site
View scanned well log (11/14/2008 12:37:16 PM)


**Site Name: MOUNTAIN WATER COMPANY - WELL 16**
**GWIC Id: 132891**
**DNRC Water Right: W026368-00**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [10/22/1999]
2) MONTANA POWER CO (MAIL)
DESMET
MISSOULA MT 59803 [10/30/1968]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 14N | 20W | 35 | NE¼ SE¼ NE¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.935 | -114.0966 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3171.8 | | | |

**Addition:** **Block:** **Lot:**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Wednesday, October 30, 1968

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 360 | 16 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 177 | 181 | 16 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 360
Static Water Level: 107
Water Temperature:

**Air Test ***

500 gpm with drill stem set at _ feet for 6.5 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 113 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 1 | TOPSOIL |
| 1 | 79 | GRAVEL AND CLAY |
| 79 | 85 | WATER SAND GRAVEL SOME CLAY |
| 85 | 90 | SAND GRAVEL & CLAY |
| 90 | 104 | CLAY |
| 104 | 106 | WATER SAND & GRAVEL |
| 106 | 130 | CLAY AND GRAVEL |
| 130 | 132 | WATER SAND & GRAVEL |
| 132 | 157 | GRAVEL & CLAY WATER SEEPAGE |
| 157 | 171 | CLAY |
| 171 | 179 | SAND GRAVEL WATER TRACES OF CLAY |
| 179 | 189 | CLAY SAND & GRAVEL |
| 189 | 201 | YELLOW CLAY |
| 201 | 212 | BLUE GRAY CLAY |
| 212 | 213 | GRAVEL & CLAY |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 10/30/1968

**Site Name: MOUNTAIN WATER COMPANY - WELL 16**
**GWIC Id: 132891**
**Additional Lithology Records**

| From | To | Description |
|---|---|---|
| 213 | 220 | BLUE AND YELLOW CLAY MARBELIZED |
| 220 | 236 | BLUE GRAY CLAY |
| 236 | 240 | GRAVEL AND CLAY |
| 240 | 252 | GRAY CLAY |
| 252 | 253 | SAND YELLOW CLAY SEEP OF WATER |
| 253 | 270 | CLAY |
| 270 | 281 | BROWN CLAY |
| 281 | 289 | BROWN SANDY CLAY |
| 289 | 291.5 | WATER SAND |
| 291.5 | 299 | SOME GRAVEL SAND WATER |
| 299 | 302 | CLAY AND GRAVEL |
| 302 | 311 | GRAVEL SAND SOME CLAY WATER |
| 311 | 317 | MORE CLAY SAND GRAVEL WATER |
| 317 | 327 | SAND GRAVEL WATER & CLAY |
| 327 | 335 | SAND GRAVEL LOOSE. A LITTLE CLAY WATER |
| 335 | 338 | TAN CLAY GRAVEL SAND NO WATER |
| 338 | 342 | GRAVEL SAND SOME CLAY SOME WATER |
| 342 | 346 | GRAVEL SAND SOME CLAY SOME WATER |
| 346 | 360 | GRAVEL SAND SOME CLAY |

# Well #1 / 76M 40143 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/1/2009 10:18:50 AM)

**Site Name: MOUNTAIN WATER COMPANY * WELL #38**
**GWIC Id: 151949**
**DNRC Water Right: W040143-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
E BROADWAY
MISSOULA MT 59803 [01/01/1936]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | SE¼ SE¼ SW¼ SW¼ |

**County** / **Geocode**
MISSOULA

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8642 | -114.0129 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3190 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method:
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, January 01, 1935

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 120 | 12 | | | | STEEL |

There are no completion records assigned to this well.

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 122
Static Water Level: 50
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after _ hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 70 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 22 | GRAVEL AND BOULDERS |
| 22 | 24 | GRAVEL AND FINE SAND |
| 24 | 40 | GRAVEL- BOULDERS AND VERY LITTLE CLAY |
| 40 | 45 | GRAVEL- BOULDERS AND CLAY |
| 45 | 47 | WATER- CLEAN GRAVEL AND SAND |
| 47 | 50 | SAND |
| 50 | 62 | SAND- GRAVEL AND A LITTLE CLAY |
| 65 | 69 | GRAVEL AND A LITTLE CLAY |
| 69 | 71.5 | SAND AND FINE GRAVEL |
| 71.5 | 73.5 | GRAVEL AND WATER |
| 73.5 | 75 | SAND AND FINE GRAVEL |
| 75 | 88 | GRAVEL- SAND- CLAY AND BOULDERS |
| 88 | 100.5 | GRAVEL- WATER AND A LITTLE CLAY |
| 100.5 | 102.5 | GRAVEL- BOULDERS AND CLAY |
| 102.5 | 114.3 | GRAVEL- SAND AND CLAY |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** ULRICH
**License No:** -
**Date Completed:** 1/1/1935

**Site Name: MOUNTAIN WATER COMPANY**
**GWIC Id: 151949**
**Additional Lithology Records**

| From | To | Description |
|---|---|---|
| 114.3 | 120 | GRAVEL AND SAND |

# Well #2 / 76M 40144 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View water quality for this site


**Site Name: MOUNTAIN WATER COMPANY * WELL #2**
**GWIC Id: 69155**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
N/A
MISSOULA MT N/A [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
40 E BROADWAY
MISSOULA MT N/A [11/19/1934]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 29 | SE¼ SW¼ SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8567 | -114.0261 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3143.7 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHRUN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Monday, November 19, 1934

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 90 | 12 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 40 | 90 | 12 | | | 1/2IN X1 1/2IN SLOT |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 116
Static Water Level: 50
Water Temperature:

**Unknown Test Method** *

Yield 1200 gpm.
Pumping water level _ feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 2 | CLAY AND TOP SOIL |
| 2 | 10 | SAND AND SOME GRAVEL |
| 10 | 21 | SAND GRAVEL AND BOULDERS |
| 21 | 35 | CLAY SAND AND BOULDERS |
| 35 | 55 | CLAY AND GRAVEL - SOME WATER |
| 55 | 62 | GRAVEL AND WATER |
| 62 | 68 | GRAVEL CLAY AND BOULDERS |
| 68 | 71 | GRAVEL |
| 71 | 72 | CLAY AND GRAVEL |
| 72 | 90 | LOOSE SANDY GRAVEL WITH FINE SEDIMENT SOME CLAY |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** ULRICH
**License No:** -
**Date Completed:** 11/19/1934

# Well #3A / 76M 40145 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 12:22:36 PM)

**Site Name: MOUNTAIN WATER COMPANY - WELL 2**
**GWIC Id: 151950**
**DNRC Water Right: W040145-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
E BROADWAY
MISSOULA MT 59803 [02/09/1935]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 28 | SW¼ SE¼ SW¼ SE¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8489 | -114.0026 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3161.7 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN DRILL
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, February 27, 1935

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 117.8 | 12 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 85 | 116 | 12 | | | |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 117.8
Static Water Level: 54
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after _ hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 90 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 30 | TOPSOIL; GRAVEL CLAY AND BOULDERS |
| 30 | 32 | CLAY |
| 32 | 43 | GRAVEL BOULDERS AND SOME CLAY |
| 43 | 45 | GRAVEL AND WATER |
| 45 | 78 | GRAVEL BOULDERS AND VERY LITTLE CLAY |
| 78 | 81 | GRAVEL WATER |
| 81 | 116 | GRAVEL SAND BOULDERS AND SOME CLAY |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** ULRICH
**License No:** -
**Date Completed:** 2/27/1935

# Well #4 / 76M 40146 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View scanned well log (3/19/2009 11:13:04 AM)


**Site Name: MOUNTAIN WATER COMPANY * WELL #3**
**GWIC Id: 132849**
**DNRC Water Right: W040146-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
E BROADWAY
MISSOULA MT 59803 [05/07/1937]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 24 | SE¼ SE¼ SW¼ NE¼ |

**County** / **Geocode**

MISSOULA

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8709 | -113.9393 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3173.1 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: UNKNOWN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, May 07, 1937

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 86 | 10 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 86 | 100 | 10 | | | 1/2X1 1/2 SLOT |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 86
Static Water Level: 65
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
_800_ gpm pump rate with _ feet of drawdown after _ hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _80_ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 35 | BOULDERS AND GRAVEL |
| 35 | 37 | WATER TIGHT GRAVEL AND CLAY |
| 37 | 38 | SAND |
| 38 | 40 | WATER TIGHT GRAVEL AND CLAY |
| 40 | 69 | GRAVEL AND BOULDERS |
| 69 | 75 | COARSE SAND |
| 75 | 86 | HEAVY GRAVEL AND SAND |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** ULRICH
**License No:** -
**Date Completed:** 5/7/1937

## MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View hydrograph for this site
View scanned update/correction (4/2/2012 10:22:33 AM)
View scanned aquifer test (6/27/2018 11:29:21 AM)

**Site Name: CANYON RIVER DEVELOPMENT * WELL HOUSE**
**GWIC Id: 240491**

### Section 1: Well Owner(s)

1) CANYON RIVER DEVELOPMENT (MAIL)
P.O. BOX 778
WHITEHALL MT 59759 [06/26/2007]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 18W | 18 | |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8853911248 | -113.923093018 | TRS-SEC | NAD83 |

**Ground Surface Altitude:** **Ground Surface Method:** **Datum:** **Date:**

**Addition:** **Block:** **Lot:**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Tuesday, June 26, 2007

### Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 25 | 14 |
| 25 | 132 | 10 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 100 | 10 | 0.25 | | WELDED | A53B STEEL |
| 111 | 122 | 10 | 0.25 | | WELDED | A53B STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 101 | 111 | 10 | | .125 | SCREEN-CONTINUOUS-STAINLESS |
| 122 | 132 | 10 | | .125 | SCREEN-CONTINUOUS-STAINLESS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 100 | K PACKER | |
| 0 | 20 | BENTONITE CHIPS | |

### Section 7: Well Test Data

Total Depth: 132
Static Water Level: 49.06
Water Temperature:

**Pump Test ***

Depth pump set for test 100 feet.
450 gpm pump rate with 16 feet of drawdown after 24 hours of pumping.
Time of recovery _ hours.
Recovery water level 49.06 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 2 | SOIL |
| 2 | 115 | GRAVELS |
| 115 | 124 | GRAVELS WITH LITTLE CLAY |
| 124 | 134 | GRAVELS |

### Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** LARRY GAGNON
**Company:** OKEEFE DRILLING CO
**License No:** WWD-126
**Date Completed:** 6/26/2007

# Well #7 / 76M 40147 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 12:48:39 PM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 7**
**GWIC Id: 132856**

## Section 1: Well Owner(s)

1) MONTANA POWER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [04/12/1958]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 29 | NE¼ SE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.853982 | -114.021679 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Saturday, April 12, 1958

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 110 | 14 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 95 | 109 | 14 | | 1/2X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 110
Static Water Level: 58
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after 24 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 85 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 5 | TOPSOIL AND BOULDERS |
| 5 | 58 | CLAY- GRAVEL AND BOULDERS |
| 58 | 60 | WATER- SAND- GRAVEL AND COBBLESTONES |
| 60 | 79 | CLAY- GRAVEL AND WATER |
| 79 | 80 | CLAY AND GRAVEL |
| 80 | 94 | WATER- CLAY AND BIG GRAVEL |
| 94 | 98 | WATER- SAND AND GRAVEL |
| 98 | 110 | WATER- SAND AND BIG GRAVEL |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** -
**Date Completed:** 4/12/1958

# Well #8 / 76M 40148 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/3/2009 11:58:04 AM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 08**
**GWIC Id: 132857**

## Section 1: Well Owner(s)

1) MONTANA POWER COMPANY (MAIL)
E BROADWAY
MISSOULA MT 59803 [07/10/1954]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 32 | NE¼ NW¼ |

**County**

MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.846879 | -114.032292 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, August 10, 1954

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 117 | 12 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 71 | 14 | 12 | | | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 117
Static Water Level: 50
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after 24 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 90 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 2 | FILL DIRT |
| 2 | 42 | GRAVEL AND SOME CLAY |
| 42 | 51 | GRAVEL-SOME WATER |
| 51 | 94 | GRAVEL AND CLAY-LOTS OF WATER |
| 94 | 100 | GRAVEL AND CLAY-LITTLE WATER |
| 100 | 109 | SAND AND GRAVEL LOTS OF WATER |
| 109 | 112 | GRAVEL W/CLAY |
| 112 | 117 | GRAVEL AND SAND-WATER |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 8/10/1954

# Well #9 / 76H 40149 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View water quality for this site
View scanned well log (3/3/2009 12:10:24 PM)


**Site Name: MOUNTAIN WATER COMPANY * WELL 09**
**GWIC Id: 69353**

### Section 1: Well Owner(s)

1) MISSOULA WATER (MAIL)
N/A
MISSOULA MT N/A [10/22/1999]
2) MOUNTAIN WATER CO (MAIL)
2301 DIXON AVE
MISSOULA MT N/A [01/01/1980]
3) THE MONTANA POWER COMPANY (MAIL)
40 E BROADWAY
BUTTE MT 59701 [09/02/1954]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 32 | NW¼ NE¼ NW¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.840992 | -114.036931 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3131.9 | | | |

**Addition:** **Block:** **Lot:**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Thursday, September 02, 1954

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 17 | 12 | | | | |
| 17 | 132 | 12 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 78 | 79 | 12 | | | MILLS KNIFE |
| 80 | 87 | 12 | | | MILLS KNIFE |
| 112 | 116 | 12 | | | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 132
Static Water Level: 44
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after 24 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 90 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 14 | GRAVEL AND CLAY |
| 14 | 16 | SAND |
| 16 | 44 | GRAVEL AND LCAY |
| 44 | 74 | SAND-GRAVEL W/CLAY-LITTLE WATER |
| 74 | 78 | GRAVEL W/CLAY-LITTLE WATER |
| 78 | 88 | GRAVEL W/LITTLE SAND & WATER |
| 88 | 111 | GRAVEL AND CLAY - LITTLE WATER |
| 111 | 115 | SAND-GRAVEL AND WATER |
| 115 | 128 | CLAY-GRAVEL AND BOULDERS |
| 128 | 132 | GRAVEL AND BOULDERS W/WATER |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-213
**Date Completed:** 9/2/1954

# Well #10 / 76M 40150 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 11:53:57 AM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 10**
**GWIC Id: 132850**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
1520 HILDA AVE
MISSOULA MT 59801 [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [06/18/1957]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 27 | NE¼ SE¼ SW¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.85751 | -113.9932 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3116.1 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, June 18, 1957

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 147.8 | 12 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 95 | 100 | 12 | | 3/8X3 | MILLS KNIFE |
| 110 | 120 | 12 | | 3/8X3 | MILLS KNIFE |
| 135 | 146 | 12 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 147.7
Static Water Level: 70
Water Temperature:

**Unknown Test Method** *

Yield 1200 gpm.
Pumping water level 90 feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 10 | SOIL- GRAVEL- SAND LOOSE FORMATION |
| 10 | 60 | CLAY- COARSE GRAVEL AND SAND- SOME SMALL BOULDERS WITH CLAY- TIGHT FORMATION |
| 60 | 70 | CLAY- MEDIUM TO COARSE GRAVEL AND SAND |
| 70 | 77 | FAIRLY LOOSE GRAVEL- SAND AND SOME CLAY |
| 77 | 95 | FINE TO MEDIUM GRAVEL AND SAND |
| 95 | 112 | THIN LAYERS OF CLAY- SAND AND LOOSE ROCK WITH H2O |
| 112 | 123 | SMALL BOULDERS SAND AND SOME CLAY WITH WATER |
| 123 | 130 | CLAY AND BOULDER |
| 130 | 132 | SAND |
| 132 | 147.8 | COARSE GRAVEL AND SAND WITH WATER |
| | | |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 6/18/1957

# Well #11 / 76M 40151 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/25/2009 10:13:20 AM)

**Site Name: MOUNTAIN WATER COMPANY - WELL 10**
**GWIC Id: 132860**
**DNRC Water Right: W040151-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [07/04/1957]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 33 | NE¼ SW¼ SW¼ NE¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8432 | -114.0048 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3149.5 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, July 04, 1957

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 118.5 | 12 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 90 | 115 | 12 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 118.5
Static Water Level: 56
Water Temperature:

**Unknown Test Method** *

Yield 1200 gpm.
Pumping water level 90 feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 8 | BLACK MUCK AND GRAVEL |
| 8 | 54 | YELLOW CLAY AND GRAVEL |
| 54 | 56 | SAND & SMALL GRAVEL-SOME WATER |
| 56 | 77 | CLAY AND GRAVEL |
| 77 | 86 | SAND & SMALL GRAVEL-SOME WATER |
| 86 | 115 | SAND & LARGE GRAVEL W/WATER |
| 115 | 117 | CLAY AND GRAVEL |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** -
**Date Completed:** 7/4/1957

# Well #12 / 76M 40152 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 11:08:22 AM)

**Site Name: MOUNTAIN WATER MISSOULA DIV. * WELL #12**
**GWIC Id: 132848**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER MISSOULA DIV (MAIL)
N/A
MISSOULA MT 59801 [10/22/1999]
2) MONTANA POWER CO (MAIL)
N/A
MISSOULA MT 59803 [04/27/1964]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 24 | NW¼ SW¼ NW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8758 | -113.9436 | UNKNOWN | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3280 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Monday, April 27, 1964

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.9 | 107.9 | 12 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 80 | 100 | 12 | | | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 107.8
Static Water Level: 69
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after 3 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 3 | TOPSOIL |
| 3 | 65 | CLAY AND GRAVEL |
| 65 | 77 | SAND- GRAVEL AND SOME WATER |
| 77 | 93 | SAND- GRAVEL AND WATER |
| 93 | 95 | SAND- GRAVEL- CLAY AND WATER |
| 95 | 106 | SAND- GRAVEL BROKEN ROCK AND WATER |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 4/27/1964

# Well #13 / 76M 40153 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/6/2009 1:40:44 PM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 13**
**GWIC Id: 68519**

## Section 1: Well Owner(s)

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 14 | NW¼ |

**County** MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.88896 | -113.971225 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method:
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, January 01, 1964

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 0 | 12 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 70 | 78 | 0 | | | |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 127
Static Water Level: 25
Water Temperature:

**Unknown Test Method** *

Yield 800 gpm.
Pumping water level 85 feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

Lithology Data

There are no lithologic details assigned to this well.

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:**
**License No:** -0
**Date Completed:** 1/1/1964

# Well #15 / 76M 40154 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/6/2009 12:38:34 PM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 15**
**GWIC Id: 68453**

## Section 1: Well Owner(s)

1) MONTANA POWER CO. (MAIL)
N/A
MISSOULA MT N/A [12/22/1965]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 12 | NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.903432 | -113.949685 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, December 22, 1965

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2.5 | 104 | 12 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 88 | 97 | 12 | | 6 IN | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 151
Static Water Level: 75
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
150 gpm pump rate with _ feet of drawdown after 4 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 86 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 59 | DIRT AND BOULDERS |
| 59 | 63 | TAN CLAY GRAVEL AND BOULDERS |
| 63 | 86 | CLAY AND GRAVEL |
| 86 | 87 | GRAVEL BOULDERS AND WATER |
| 87 | 97 | GRAVEL AND WATER |
| 97 | 99 | GRAVEL AND WATER |
| 99 | 103 | BLUE CLAY AND SMALL GRAVEL |
| 103 | 123 | TIGHT PURPLE CLAY AND GRAVEL |
| 123 | 137 | FRACTURED ROCK AND CLAY |
| 137 | 151 | MULTI-COLORED ROCK. |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 12/22/1965

# Well #16 / 76H 40155 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/13/2009 9:05:33 AM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 16**
**GWIC Id: 132828**

### Section 1: Well Owner(s)

1) MONTANA POWER CO (MAIL)
N/A
N/A N/A N/A [06/22/1966]
2) MOUNTAIN WATER COMPANY (MAIL)
4401 24TH ST
MISSOULA MT N/A [06/22/1966]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 19W | 6 | SE¼ SW¼ NE¼ NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8656 | -114.038 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3158.2 | | | |

**Addition** **Block** **Lot**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Wednesday, June 22, 1966

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 120 | 12 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 101 | 119 | 12 | | | PERFORATED CASING |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 120
Static Water Level:
Water Temperature:

**Unknown Test Method** *

Yield 1500 gpm.
Pumping water level _ feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 3 | TOPSOIL |
| 3 | 41 | GRAVEL AND YELLOW CLAY |
| 41 | 57 | WATER GRAVEL SAND AND CLAY |
| 57 | 62 | SAND AND WATER |
| 62 | 80 | GRAVEL SAND AND WATER |
| 80 | 87 | CLAY AND GRAVEL |
| 87 | 89 | WATER FINE SAND CLAY |
| 89 | 97 | HEAVY GRAVEL WATER FINE SAND SOME CLAY |
| 97 | 117 | GRAVEL SAND AND WATER |
| 117 | 120 | GRAVEL SAND WATER AND TRACE OF CLAY |
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### Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 6/22/1966

# Well #18 / 76H 40156 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/13/2009 9:06:49 AM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 18**
**GWIC Id: 66872**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
4101 GHARRETT ST
MISSOULA MT N/A [08/06/1968]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 19W | 6 | NW¼ NW¼ NW¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.833919 | -114.045254 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3093.7 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, August 06, 1968

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.5 | 105 | 16 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 95 | 103 | 16 | | | 3/8X4 MILLS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 105
Static Water Level: 31
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1000 gpm pump rate with _ feet of drawdown after 7.5 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 38 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 4 | TOPSOIL |
| 4 | 29 | CLAY & GRAVEL |
| 29 | 60 | WATER SAND GRAVEL |
| 60 | 64 | CLAY & GRAVEL |
| 64 | 80 | WATER SAND & GRAVEL |
| 80 | 83 | CLAY & GRAVEL |
| 83 | 87 | SAND & FINE GRAVEL WATER |
| 87 | 105 | SAND LARGE GRAVEL WATER |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 8/6/1968

# Well #19 / 76M 40157 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/6/2009 12:01:56 PM)

**Site Name: MOUNTAIN WATER COMPANY - WELL 18**
**GWIC Id: 151948**
**DNRC Water Right: W040157-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
1250 N RUSSELL
MISSOULA MT 59803 [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
E BROADWAY
MISSOULA MT 59803 [04/30/1969]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 16 | SW¼ NW¼ NW¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8836 | -114.0174 | MAP | NAD27 |

**Ground Surface Altitude:** **Ground Surface Method:** **Datum:** **Date:**

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN DRILL
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, April 30, 1969

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 109.5 | 16 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 85 | 105 | 16 | | | 3/8X4 MILLS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 109.5
Static Water Level: 48
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1000 gpm pump rate with _ feet of drawdown after 2 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 51.5 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 1 | TOPSOIL AND GRAVEL |
| 1 | 33 | GRAVEL AND CLAY |
| 33 | 41 | BOULDERS & GRAVEL |
| 41 | 55 | CLAY & GRAVEL |
| 55 | 65 | CLAY GRAVEL & WATER |
| 65 | 109.5 | GRAVEL WATER SAND |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 4/30/1969

# Well #21 / 76M 40159 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 11:55:14 AM)

**Site Name: MOUNTAIN WATER COMPANY - WELL 20**
**GWIC Id: 132851**
**DNRC Water Right: W040159-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
335 E CENTRAL
MISSOULA MT 59803 [10/22/1999]
2) MONTANA POWER CO (MAIL)
N/A
MISSOULA MT 59803 [06/17/1969]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 27 | SE¼ NE¼ SW¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8508 | -113.9925 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3114.2 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, June 17, 1969

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 137 | 16 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 90 | 96 | 16 | | 3/8X3 | MILLS KNIFE |
| 112 | 132 | 16 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 137
Static Water Level: 58
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
1000 gpm pump rate with _ feet of drawdown after 0.5 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 63.7 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 40 | GRAVEL AND CLAY |
| 40 | 47 | CLAY |
| 47 | 72 | GRAVEL AND CLAY |
| 72 | 83 | CLAY AND SAND |
| 83 | 101 | WATER- GRAVEL AND SAND |
| 101 | 108 | GRAVEL AND CLAY |
| 108 | 137 | GRAVEL- SAND- WATER |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 6/17/1969

# Well #22 / 76M 40160 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/31/2009 4:38:12 PM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 22**
**GWIC Id: 132841**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
720 CREGG LANE
MISSOULA MT N/A [10/22/1999]
2) MONTANA POWER (MAIL)
N/A
MISSOULA MT N/A [12/01/1949]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | NW¼ SW¼ SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8722 | -114.0077 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3118.6 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, December 01, 1949

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 92 | 12 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 62 | 72 | 12 | | 3/8X3 | MILLS KNIFE |
| 82 | 92 | 12 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 92
Static Water Level: 23
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after 5 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 23.5 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | TOPSOIL AND GRAVEL |
| 6 | 15 | CLAY |
| 15 | 29 | CLAY AND GRAVEL |
| 29 | 38 | SAND AND GRAVEL |
| 38 | 41 | GRAVEL- SAND AND WATER |
| 41 | 48 | GRAVEL AND WATER |
| 48 | 52 | TIGHT GRAVEL AND SAND SOME CLAY |
| 52 | 60 | CLAY AND GRAVEL |
| 60 | 72 | BOULDERS- GRAVEL AND WATER |
| 72 | 80 | CLAY AND GRAVEL |
| 80 | 92 | GRAVEL SAND AND WATER |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 12/1/1949

# Well #23 / 76M 40161 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View water quality for this site
View scanned well log (2/25/2009 10:25:55 AM)


**Site Name: MOUNTAIN WATER COMPANY - WELL 22**
**GWIC Id: 132025**
**DNRC Water Right: W040161-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
345 PATTEE CREEK
MISSOULA MT 59803 [10/22/1999]
2) MOSBYS INC (MAIL)
N/A
MISSOULA MT 59803 [09/24/1945]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 33 | NE¼ NE¼ NW¼ SE¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8415 | -114.0025 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3133.7 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: SCREW
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Monday, September 24, 1945

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 116.2 | 8 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 105 | 113 | 8 | | | 3/8X1 PERFS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 116.2
Static Water Level:
Water Temperature:

**Unknown Test Method** *

Yield 300 gpm.
Pumping water level _ feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 4 | TOPSOIL |
| 4 | 20 | GRAVEL AND SOIL |
| 20 | 30 | GRAVEL |
| 30 | 55 | CLAY |
| 55 | 76 | CLAY AND GRAVEL |
| 76 | 87 | SAND GRAVEL AND CLAY |
| 87 | 96 | MORE CLAY AND SAND |
| 96 | 98 | GRAVEL- CLAY- WATER |
| 98 | 100 | TIGHT GRAVEL |
| 100 | 116 | LITTLE WATER SAND GRAVEL |
| | | |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** ULRICH
**License No:** -
**Date Completed:** 9/24/1945

# Well #24 / 76M 40162 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View water quality for this site
View scanned well log (2/25/2009 10:22:51 AM)


**Site Name: MOUNTAIN WATER COMPANY - WELL 23**
**GWIC Id: 69412**
**DNRC Water Right: W040161-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
345 PATTEE CREEK
MISSOULA MT 59803 [10/22/1999]
2) FAIRVIEW DEV CO (MAIL)
340 WEST MAIN
MISSOULA MT 59803 [07/01/1948]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 33 | NW¼ NW¼ NW¼ NE¼ SE¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8364 | -114.0013 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3129.5 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method:
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, July 01, 1948

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 95 | 120 | 8 | | | | |

There are no completion records assigned to this well.

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 120
Static Water Level: 72
Water Temperature:

**Unknown Test Method** *

Yield 450 gpm.
Pumping water level _ feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 72 | CLAY GRAVEL |
| 72 | 94 | GRAVEL SAND WATER |
| 97 | 101 | CLAY AND WATER |
| 101 | 120 | GRAVEL WATER |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:**
**License No:** -
**Date Completed:** 7/1/1948

# Well #25 / 76M 40163 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View water quality for this site
View scanned well log (2/25/2009 10:21:27 AM)


**Site Name: MOUNTAIN WATER COMPANY - WELL 24**
**GWIC Id: 132861**
**DNRC Water Right: W040163-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
3800 STEPHENS AVE
MISSOULA MT 59803 [10/22/1999]
2) MOSBY, ARTHUR.J (MAIL)
N/A
MISSOULA MT 59803 [08/27/1966]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 33 | NE¼ NW¼ SE¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8378 | -114.011 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3154.9 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Saturday, August 27, 1966

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 146 | 14 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 90 | 127 | 14 | | | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 146
Static Water Level: 45.3
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1000 gpm pump rate with _ feet of drawdown after 28.5 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 73 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | SANDY SOIL |
| 6 | 13 | SAND & GRAVEL MIXED IN BROWN CLAY |
| 13 | 15 | CLEAN GRAVEL |
| 15 | 55 | GRAVEL IMBEDDED IN TAN CLAY |
| 55 | 78 | FINE GRAY SAND & GRAVEL.SOME WATER |
| 78 | 86 | RED TO TAN CLAY |
| 86 | 90 | GRAVEL IMBEDDED IN TAN CLAY |
| 90 | 99 | COARSE SAND & GRAVEL. WATER. |
| 99 | 101 | BOULDERS |
| 101 | 127 | FINE TO COARSE SAND & GRAVEL.WATER. |
| 127 | 137 | FINE TO COARSE SAND & GRAEL.SOME TAN CLAY.WATER. |
| 137 | 146 | SAND & GRAVEL MIXED IN GRAY CLAY. |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** LIBERTY DRILLING & PUMP CO
**License No:** WWC-52
**Date Completed:** 8/27/1966

# Well #26 / 76H 40164 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/3/2009 11:54:22 AM)


**Site Name: MOUNTAIN WATER COMPANY - WELL 25**
**GWIC Id: 132834**
**DNRC Water Right: W040164-00**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
1550 BENTON AVE
MISSOULA MT 59803 [10/22/1999]
2) MONTANA POWER CO. (MAIL)
BENTON AVE
MISSOULA MT 59803 [06/02/1971]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 32 | SE¼ NW¼ SE¼ NE¼ NE¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8463 | -114.0191 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3151.3 | | | |

**Addition:** **Block:** **Lot:**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Friday, July 02, 1971

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 125 | 16 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 100 | 120 | 16 | | | 5/8X4 IN HOLES |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 125
Static Water Level: 38
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1275 gpm pump rate with _ feet of drawdown after 8 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 40.5 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 24 | COBBLESTONES & GRAVEL & CLAY |
| 24 | 46 | BROWN CLAY & GRAVEL |
| 46 | 57 | GRAVEL- SAND & WATER |
| 57 | 70 | BIG GRAVEL- SAND- WATER |
| 70 | 84 | SAND- SMALL GRAVEL & WATER |
| 84 | 104 | GRAVEL- SOME SAND- WATER |
| 104 | 108 | SAND- GRAVEL- WATER |
| 108 | 125 | BIG GRAVEL- SAND- WATER |
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### Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 7/2/1971

# Well #27 / 76M 40165 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/11/2009 12:45:44 PM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 27**
**GWIC Id: 132844**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
1315 26TH AVE
MISSOULA MT 59801 [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [04/10/1972]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 30 | NE¼ NW¼ SE¼ NE¼ |

**County**: MISSOULA
**Geocode**:

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8587 | -114.0424 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3142.1 | | | |

**Addition**: **Block**: **Lot**:

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: UNKNOWN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Monday, April 10, 1972

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -3 | 125 | 16 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 92 | 118 | 16 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 125
Static Water Level:
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
_1475_ gpm pump rate with _ feet of drawdown after _ hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 2 | BROWN TOPSOIL AND GRAVEL |
| 2 | 53 | BROWN CLAY AND GRAVEL |
| 53 | 62 | GRAVEL SAND AND WATER |
| 62 | 75 | TAN CLAY AND GRAVEL |
| 75 | 98 | GRAVEL SAND AND WATER |
| 98 | 109 | BIG GRAVEL CLAY AND WATER |
| 109 | 119 | SAND GRAVEL AND WATER |
| 119 | 125 | CLAY- GRAVEL- SAND AND WATER |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 4/10/1972

# Well #29 / 76H 40166 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/23/2009 10:04:55 AM)

**Site Name: MOUNTAIN WATER COMPANY - WELL 28**
**GWIC Id: 67046**
**DNRC Water Right: W040166-00**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
4701 ORCHARD AVE
MISSOULA MT N/A [06/20/1973]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 20W | 1 | SE¼ SW¼ SE¼ NE¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8278 | -114.0476 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3076 | | | |

**Addition:** **Block:** **Lot:**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Wednesday, June 20, 1973

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.7 | 136 | 16 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 100 | 125 | 16 | | | 3/8X3 MILLS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 136
Static Water Level: 24
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1000 gpm pump rate with _ feet of drawdown after 4 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 35 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 1 | BLACK DIRT |
| 1 | 5 | SANDY CLAY |
| 5 | 15 | SAND AND GRAVEL |
| 15 | 24 | SAND GRAVEL & SEEPS OF WATER |
| 24 | 33 | CLAY AND GRAVEL |
| 33 | 35 | SAND AND WATER |
| 35 | 49 | SAND GRAVEL AND WATER |
| 49 | 64 | SAND AND CLAY |
| 64 | 68 | SAND SMALL GRAVEL & WATER |
| 68 | 75 | CLAY AND GRAVEL |
| 75 | 78 | SAND WATER |
| 78 | 84 | SAND GRAVEL & WATER |
| 84 | 90 | SAND GRAVEL WATER WITH SEAMS OF CLAY |
| 90 | 125 | SAND GRAVEL & WATER |
| 125 | 136 | GRAY CLAY & GRAVEL |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 6/20/1973

# Well #38 / 76H 107536 00 and 76H 70436 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

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**Site Name: MOUNTAIN WATER COMPANY - WELL 39**
**GWIC Id: 66867**
**DNRC Water Right: P070436-00**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
P.O. BOX 4826
MISSOULA MT 59806 [01/11/1995]
2) CURAN CONSTRUCTION (MAIL)
BOX 1206
MISSOULA MT 59801 [06/16/1971]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 19W | 6 | NE¼ NE¼ SE¼ NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8304 | -114.0348 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3190 | | | |

| Addition | Block | Lot |
|---|---|---|
| HILLVIEW HEIGHTS | 3 | 1 |

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Wednesday, June 16, 1971

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -3 | 90 | 18 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 90 | 125.5 | 18 | | | JOHNSON WIRE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 125.5
Static Water Level: 26
Water Temperature:

**Air Test** *

2000 gpm with drill stem set at _ feet for 40 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 66 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | BROWN TOPSOIL |
| 6 | 11 | COBBLESTONES GRAVEL |
| 11 | 31 | COBBLESTONES GRAVEL & BOULDERS |
| 31 | 53 | SAND & GRAVEL MIXED IN TAN SILTY CLAY |
| 53 | 61 | SAND GRAVEL & COBBLESTONES EMBEDDED IN TAN CLAY |
| 61 | 89 | SAND & GRAVEL |
| 89 | 109 | COARSE SAND & GRAVEL |
| 109 | 119 | SAND GRAVEL & LARGE COBBLESTONES |
| 119 | 125 | SAND & GRAVEL EMBEDDED IN CLAY |
| 125 | 125.5 | CLAY |
| | | |
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### Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** OSBORNE
**License No:** WWC-52
**Date Completed:** 6/16/1971

# Well #39 / 76H 107536 00 and 76H 70436 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps

**Site Name: MOUNTAIN WATER COMPANY**
**GWIC Id: 154873**

## Section 1: Well Owner(s)

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 19W | 6 | SW¼ SW¼ NW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8309 | -114.0394 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3190 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water
PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work
Drilling Method: CABLE AND ROTARY
Status: NEW WELL

## Section 5: Well Completion Date
Date well completed: Wednesday, June 16, 1971

## Section 6: Well Construction Details
There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.3 | 90 | 18 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 90 | 120 | 18 | | | 0.1 JOHNSON WIR |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 125.5
Static Water Level: 25.75
Water Temperature:

**Air Test** *

2000 gpm with drill stem set at _ feet for 40 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 66 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | BROWN TOPSOIL |
| 6 | 11 | COBBLESTONES AND GRAVEL |
| 11 | 31 | COBBLESTONES GRAVEL AND BOULDERS |
| 31 | 53 | SAND AND GRAVEL MIXED IN TAN SILTY CLAY |
| 53 | 61 | SAND GRAVEL AND COBBLESTONES EMBEDDED IN TAN CLAY |
| 61 | 89 | SAND AND GRAVEL |
| 89 | 109 | COARSE SAND AND GRAVEL |
| 109 | 119 | SAND GRAVEL AND LARGE COBBLESTONES |
| 119 | 125 | SAND AND GRAVEL EMBEDDED IN CLAY |
| 125 | 125.5 | CLAY |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** LIBERTY DRILLING & PUMP CO
**License No:** -0
**Date Completed:** 6/16/1971

# Well #41 / 76M 108816 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


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View field visits for this site
View scanned well log (4/6/2009 12:28:27 PM)


**Site Name: MISSOULA WATER WORKS - EAST WELL 1**
**GWIC Id: 68413**
**DNRC Water Right: P091259-00**

## Section 1: Well Owner(s)

1) MISSOULA WATER WORKS (MAIL)
3333 E CLARK RD
MISSOULA MT N/A [11/15/2000]
2) AMERICAN CRYSTAL SUGAR CO. (MAIL)
N/A
MISSOULA MT N/A [09/26/1962]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 17 | SE¼ NE¼ SW¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8872 | -114.0347 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3174 | | | 11/15/2000 |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE TOOLS
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, September 26, 1962

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 218 | 16 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 8 | 213 | 16 | | | | 63 LB STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 107 | 115 | 16 | | 3/8X3 | MILLS KNIFE |
| 121 | 147 | 16 | | 3/8X3 | MILLS KNIFE |
| 192 | 208 | 16 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 218
Static Water Level: 29.5
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
4120 gpm pump rate with _ feet of drawdown after 144 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 36 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

WELL CONSTRUCTED IN 8 FT DEEP PIT. CASING STRING STARTS AT 8 FT BELOW LAND SURFACE

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 8 | PIT |
| 8 | 36 | SAND GRAVEL AND COBBLESTONES SOME DIRT MIXED IN |
| 36 | 39 | GRAVEL MIXED IN TAN CLAY |
| 39 | 64 | SAND AND GRAVEL |
| 64 | 76 | FINE TO COARSE SAND FEW SCATTERED GRAVELS IN TAN SILT |
| 76 | 79 | GRAVEL IMBEDDED IN TAN SILT |
| 79 | 83 | COARSE GRAVEL AND COBBLESTONES MIXED IN FINE SAND |
| 83 | 88 | FINE TO COARSE SAND |
| 88 | 107 | SAND AND GRAVEL IMBEDDED IN TAN SILT |
| 107 | 115 | CLEAN COARSE SAND AND GRAVEL |
| 115 | 121 | SAND AND GRAVEL MIXED IN TAN SILT |
| 121 | 147 | CLEAN COARSE SAND AND GRAVEL |
| 147 | 156 | SAND AND GRAVEL IMBEDDED IN TAN SILT |
| 156 | 167 | TAN STICKY CLAY |
| 167 | 191 | GREEN STICKY CLAY FEW STRAY GRAVELS IMBEDDED |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** LIBERTY DRILLING & PUMP CO
**License No:** WWC-52
**Date Completed:** 9/26/1962

**Site Name: MISSOULA WATER WORKS - EAST WELL 1**
**GWIC Id: 68413**
**Additional Lithology Records**

| From | To | Description |
|---|---|---|
| 191 | 208 | CLEAN COARSE SAND AND GRAVEL |
| 208 | 218 | GRAY CLAY |

# Well #42 / 76M 108816 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


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View field visits for this site
View scanned well log (4/6/2009 12:24:51 PM)


**Site Name: MISSOULA WATER WORKS - WEST WELL 2**
**GWIC Id: 68599**
**DNRC Water Right: P031907-00**

### Section 1: Well Owner(s)

1) MISSOULA WATER WORKS (MAIL)
3333 E CLARK RD
MISSOULA MT N/A [11/15/2000]
2) VALLEY WEST WATER COMPANY (MAIL)
SUITE D - 2806 GARFIELD
MISSOULA MT N/A [06/01/1981]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 17 | SW¼ NE¼ SW¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8872 | -114.0367 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3172 | | | 11/15/2000 |

**Addition:** **Block:** **Lot:**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Monday, June 01, 1981

### Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 171 | 16 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.5 | 170 | 16 | | | | 62.5 LB STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 127 | 147 | 16 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 15 | CEMENT | |

### Section 7: Well Test Data

Total Depth: 171
Static Water Level: 35
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1500 gpm pump rate with _ feet of drawdown after 2 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 37 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

TOTAL OF 240 HOLES IN PERFORATIONS.

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 26 | CLAY GRAVEL AND COBBLESTONES |
| 26 | 44 | SANDY CLAY AND GRAVEL |
| 44 | 70 | SILTY CLAY SAND GRAVEL AND WATER |
| 70 | 87 | TAN CLAY SAND GRAVEL AND WATER |
| 87 | 93 | SAND AND WATER |
| 93 | 159 | SAND GRAVEL AND WATER |
| 159 | 171 | YELLOW CLAY AND GRAVEL |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 6/1/1981

# Well #30 / 76M 706 00 and 76M 53868 00

**MONTANA WELL LOG REPORT**

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**Other Options**

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**Site Name: MOUNTAIN WATER COMPANY - WELL 29**
**GWIC Id: 132845**
**DNRC Water Right: P000706-00**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
101 BANK ST
MISSOULA MT 59801 [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [01/25/1974]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | NE¼ NW¼ SW¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8661 | -113.9945 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3129.5 | | | |

**Addition:** **Block:** **Lot:**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Friday, January 25, 1974

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 160.5 | 18 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 80 | 96 | 18 | | | 3/8X3 SLOT PERF |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 176
Static Water Level: 31.3
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after 4 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 41.5 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | FILL |
| 6 | 16 | ROCK AND GRAVEL |
| 16 | 40 | CLAY AND GRAVEL |
| 40 | 50 | SAND- GRAVEL SOME CLAY W/WATER |
| 50 | 55 | CLAY- GRAVEL |
| 55 | 73 | GRAVEL- SAND & WITH CLAY BALLS WATER |
| 73 | 78 | SAND AND CLAY |
| 78 | 98 | CLAY- GRAVEL- BOULDERS & WATER |
| 98 | 108 | CLAY |
| 108 | 115 | CLAY AND GRAVEL |
| 115 | 150 | TIGHT CLAY- SAND & GRAVEL |
| 150 | 152 | CLAY AND GRAVEL |
| 152 | 158 | GRAY CLAY AND SAND |
| 158 | 176 | CLAY AND SHARP ROCK |
| | | |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 1/25/1974

# Well #31 / 76M 5452 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

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Plot this site in State Library Digital Atlas
Plot this site in Google Maps
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**Site Name: MOUNTAIN WATER COMPANY * WELL #30**
**GWIC Id: 69073**
**DNRC Water Right: P005452-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER SUPPLY (MAIL)
311 KIWANIS ST
MISSOULA MT N/A [10/22/1999]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | NW¼ NE¼ SW¼ SW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8666 | -113.9934 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3122.6 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, December 10, 1976

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.5 | 135 | 18 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 101 | 117 | 18 | | | 3/8X3 SLOTS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 135
Static Water Level: 32
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
4100 gpm pump rate with _ feet of drawdown after 2 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 47 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 15 | FILL |
| 15 | 51 | GRAVEL AND CLAY |
| 51 | 80 | GRAVEL SAND AND WATER |
| 80 | 92 | CLAY AND SILT |
| 92 | 118 | GRAVEL AND WATER |
| 118 | 135 | CLAY AND GRAVEL SILT |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-239
**Date Completed:** 12/10/1976

# Well #32 / 76M 5604 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
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Plot this site in Google Maps
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**Site Name: MOUNTAIN WATER COMPANY * WELL 32**
**GWIC Id: 69078**
**DNRC Water Right: C005604-00**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER SUPPLY (MAIL)
540 S. 5TH E.
MISSOULA MT N/A [08/17/1976]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | SW¼ NE¼ SE¼ SW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8657 | -113.9892 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3133.7 | | | |

**Addition** **Block** **Lot**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Tuesday, August 17, 1976

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 139.5 | 18 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 100 | 125 | 18 | | | 3/8X3 SLOTS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 139.5
Static Water Level: 43.8
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1500 gpm pump rate with _ feet of drawdown after 3 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 44.3 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 21 | CLAY GRAVEL BOULDERS AND FILL |
| 21 | 40 | CLAY GRAVEL AND BOULDERS |
| 40 | 129 | GRAVEL BOULDERS AND WATER |
| 129 | 139.5 | CLAY |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-239
**Date Completed:** 8/17/1976

# Well #33 / 76M 6616 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/26/2009 12:04:49 PM)

**Site Name: MOUNTAIN WATER COMPANY - WELL 32**
**GWIC Id: 69077**
**DNRC Water Right: P010378-00**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
500 GERALD
MISSOULA MT 59801 [08/17/1977]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | NE¼ NW¼ SW¼ SW¼ |

**County**

MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8663 | -113.995 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3127.7 | | | |

**Addition** **Block** **Lot**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Wednesday, August 17, 1977

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -4 | 147 | 18 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 118 | 138 | 18 | | | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 147
Static Water Level: 51.5
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
2000 gpm pump rate with _ feet of drawdown after 1 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 52.4 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | BLACK DIRT AND GRAVEL |
| 6 | 15 | CLAY GRAVEL AND COBBLESTONES |
| 15 | 58 | CLAY AND GRAVEL |
| 58 | 65 | SAND GRAVEL AND WATER |
| 65 | 80 | GRAVEL BOULDERS AND WATER |
| 80 | 88 | SAND SMALL GRAVEL AND WATER |
| 88 | 92 | SAND GRAVEL AND WATER |
| 92 | 96 | SMALL GRAVEL AND WATER |
| 96 | 100 | CLAY AND GRAVEL |
| 100 | 104 | SILTY CLAY |
| 104 | 113 | TIGHT CLAY AND BOULDERS |
| 113 | 116 | SAND GRAVEL AND WATER |
| 116 | 147 | GRAVEL AND WATER |
| | | |
| | | |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-239
**Date Completed:** 8/17/1977

# Well #34 / 76M 10378 00 and 76M 53872 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/26/2009 12:07:16 PM)

**Site Name: MOUNTAIN WATER COMPANY - WELL 33**
**GWIC Id: 69063**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
1903 RUSSELL
MISSOULA MT 59801 [02/10/1978]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | SE¼ NE¼ SE¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8657 | -113.9864 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3119.6 | | | |

| Addition | Block | Lot |
|---|---|---|
| MONTANA | 16 | 15 |

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, February 10, 1978

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -3 | 196 | 18 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 80 | 104 | 18 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 196
Static Water Level: 40.8
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1400 gpm pump rate with _ feet of drawdown after 2 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 41.9 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 2 | TOPSOI |
| 2 | 43 | SAND GRAVEL AND CLAY |
| 15 | 186 | SAND GRAVEL AND WATER |
| 43 | 78 | GRAVEL AND WATER |
| 78 | 104 | SAND GRAVEL AND WATER |
| 104 | 110 | FINE BROWN SAND GRAVEL AND WATER |
| 110 | 118 | FINE BROWN SAND AND CLAY |
| 118 | 151 | FINE BROWN SAND CLAY AND GRAVEL |
| 186 | 196 | TAN CLAY |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-239
**Date Completed:** 2/10/1978

# Well #35 / 76H 14489 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/3/2009 11:59:53 AM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 35**
**GWIC Id: 132858**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
2650 KEMP
MISSOULA MT 59803 [10/22/1999]
2) THE MONTANA POWER COMPANY (MAIL)
1903 RUSSELL
MISSOULA MT 59803 [07/18/1978]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 32 | SE¼ NE¼ NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.845973 | -114.030967 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, July 18, 1978

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -4 | 145 | 18 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 104 | 129 | 18 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 145
Static Water Level: 32.5
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
2000 gpm pump rate with _ feet of drawdown after 1 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 36.5 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | GRAVEL- SAND AND CLAY |
| 6 | 25 | GRAVEL AND BOULDERS |
| 25 | 38 | GRAVEL- BOULDERS & CLAY |
| 38 | 42 | GRAVEL- CLAY SOME WATER |
| 42 | 57 | GRAVEL- SAND & WATER |
| 57 | 70 | GRAVEL- SAND- LOTS OF WATER |
| 70 | 85 | GRAVEL AND WATER |
| 85 | 94 | GRAVEL- SEAMS OF CLAY AND WATER |
| 94 | 99 | CLAY AND GRAVEL |
| 99 | 102 | SAND- SMALL GRAVEL & WATER |
| 102 | 127 | SAND- LARGE GRAVEL & WATER |
| 127 | 134.5 | CLAY- GRAVEL & BOULDERS |
| 134.5 | 145 | GRAVEL- SAND & WATER |
| | | |
| | | |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 7/18/1978

# Well #36 / 76M 23029 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/6/2009 12:02:37 PM)

**Site Name: MOUNTAIN WATER COMPANY - WELL 35**
**GWIC Id: 68567**
**DNRC Water Right: P023029-00**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
1250 DICKENS
MISSOULA MT N/A [10/22/1999]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 16 | NW¼ SE¼ NE¼ SE¼ |

**County** MISSOULA **Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8818 | -114.0013 | MAP | NAD27 |

**Ground Surface Altitude** 3099 **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method:
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Tuesday, January 01, 1980

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 0 | 16 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 100 | 120 | 0 | | | |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 131
Static Water Level: 51
Water Temperature:

**Unknown Test Method** *

Yield 200 gpm.
Pumping water level 51 feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

Lithology Data

There are no lithologic details assigned to this well.

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:**
**License No:** -0
**Date Completed:** 1/1/1980

# Well #41 / 76M 23029 00 and 76M 91259 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View scanned well log (4/6/2009 12:28:27 PM)


**Site Name: MISSOULA WATER WORKS - EAST WELL 1**
**GWIC Id: 68413**
**DNRC Water Right: P091259-00**

## Section 1: Well Owner(s)

1) MISSOULA WATER WORKS (MAIL)
3333 E CLARK RD
MISSOULA MT N/A [11/15/2000]
2) AMERICAN CRYSTAL SUGAR CO. (MAIL)
N/A
MISSOULA MT N/A [09/26/1962]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 17 | SE¼ NE¼ SW¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8872 | -114.0347 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3174 | | | 11/15/2000 |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE TOOLS
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, September 26, 1962

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 218 | 16 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 8 | 213 | 16 | | | | 63 LB STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 107 | 115 | 16 | | 3/8X3 | MILLS KNIFE |
| 121 | 147 | 16 | | 3/8X3 | MILLS KNIFE |
| 192 | 208 | 16 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 218
Static Water Level: 29.5
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
4120 gpm pump rate with _ feet of drawdown after 144 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 36 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

WELL CONSTRUCTED IN 8 FT DEEP PIT. CASING STRING STARTS AT 8 FT BELOW LAND SURFACE

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 8 | PIT |
| 8 | 36 | SAND GRAVEL AND COBBLESTONES SOME DIRT MIXED IN |
| 36 | 39 | GRAVEL MIXED IN TAN CLAY |
| 39 | 64 | SAND AND GRAVEL |
| 64 | 76 | FINE TO COARSE SAND FEW SCATTERED GRAVELS IN TAN SILT |
| 76 | 79 | GRAVEL IMBEDDED IN TAN SILT |
| 79 | 83 | COARSE GRAVEL AND COBBLESTONES MIXED IN FINE SAND |
| 83 | 88 | FINE TO COARSE SAND |
| 88 | 107 | SAND AND GRAVEL IMBEDDED IN TAN SILT |
| 107 | 115 | CLEAN COARSE SAND AND GRAVEL |
| 115 | 121 | SAND AND GRAVEL MIXED IN TAN SILT |
| 121 | 147 | CLEAN COARSE SAND AND GRAVEL |
| 147 | 156 | SAND AND GRAVEL IMBEDDED IN TAN SILT |
| 156 | 167 | TAN STICKY CLAY |
| 167 | 191 | GREEN STICKY CLAY FEW STRAY GRAVELS IMBEDDED |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** LIBERTY DRILLING & PUMP CO
**License No:** WWC-52
**Date Completed:** 9/26/1962

**Site Name: MISSOULA WATER WORKS - EAST WELL 1**
**GWIC Id: 68413**
**Additional Lithology Records**

| From | To | Description |
|---|---|---|
| 191 | 208 | CLEAN COARSE SAND AND GRAVEL |
| 208 | 218 | GRAY CLAY |

# Well #42 / 76M 23029 00 and 76M 31907 00 and 76M 91259 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View scanned well log (4/6/2009 12:24:51 PM)


**Site Name: MISSOULA WATER WORKS - WEST WELL 2**
**GWIC Id: 68599**
**DNRC Water Right: P031907-00**

## Section 1: Well Owner(s)

1) MISSOULA WATER WORKS (MAIL)
3333 E CLARK RD
MISSOULA MT N/A [11/15/2000]
2) VALLEY WEST WATER COMPANY (MAIL)
SUITE D - 2806 GARFIELD
MISSOULA MT N/A [06/01/1981]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 17 | SW¼ NE¼ SW¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8872 | -114.0367 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3172 | | | 11/15/2000 |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Monday, June 01, 1981

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 171 | 16 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.5 | 170 | 16 | | | | 62.5 LB STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 127 | 147 | 16 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 15 | CEMENT | |

## Section 7: Well Test Data

Total Depth: 171
Static Water Level: 35
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1500 gpm pump rate with _ feet of drawdown after 2 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 37 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

TOTAL OF 240 HOLES IN PERFORATIONS.

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 26 | CLAY GRAVEL AND COBBLESTONES |
| 26 | 44 | SANDY CLAY AND GRAVEL |
| 44 | 70 | SILTY CLAY SAND GRAVEL AND WATER |
| 70 | 87 | TAN CLAY SAND GRAVEL AND WATER |
| 87 | 93 | SAND AND WATER |
| 93 | 159 | SAND GRAVEL AND WATER |
| 159 | 171 | YELLOW CLAY AND GRAVEL |
| | | |
| | | |
| | | |
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| | | |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 6/1/1981

# Well #3B / 76M 53867 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 12:25:50 PM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 36**
**GWIC Id: 132854**
**DNRC Water Right: P053867-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
BOX 4826
MISSOULA MT 59806 [07/03/1984]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 28 | SE¼ SE¼ SW¼ SE¼ |

**County**: MISSOULA
**Geocode**:

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8489 | -114.0025 | MAP | NAD27 |

**Ground Surface Altitude**: **Ground Surface Method**: **Datum**: **Date**:

| Addition | Block | Lot |
|---|---|---|
| HOMEVALE ADDITION | 42 | 15 |

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, July 03, 1984

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 192 | 18 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 80 | 104 | 18 | | 3/8X3 | MILLS KNIFE |
| 149 | 152 | 18 | | 3/8X3 | MILLS KNIFE |
| 177 | 180 | 18 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | CEMENT | |

## Section 7: Well Test Data

Total Depth: 192
Static Water Level: 51
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
_2400_ gpm pump rate with _ feet of drawdown after _4_ hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _55_ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 2 | TOPSOIL |
| 2 | 25 | GRAVEL |
| 25 | 53 | CLAY- SAND AND GRAVEL |
| 53 | 104 | CLAY- SAND- GRAVEL AND WATER |
| 104 | 130 | CLAY- GRAVEL AND BOULDERS |
| 130 | 133 | CLAY- SAND- GRAVEL AND WATER |
| 133 | 148 | CLAY- GRAVEL AND BOULDERS |
| 148 | 149 | CLAY- GRAVEL- BOULDERS AND WATER |
| 149 | 151 | SAND- GRAVEL- BOULDERS AND WATER |
| 151 | 152 | SAND- GRAVEL- BOULDERS AND WATER |
| 152 | 176 | CLAY- SAND- GRAVEL AND BOULDERS |
| 176 | 179 | SAND- GRAVEL- BOULDERS AND WATER |
| 179 | 192 | CLAY- SAND AND GRAVEL |
| | | |
| | | |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 7/3/1984

# Well #40A / 76H 67585 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/25/2009 10:01:58 AM)

**Site Name: LINDA VISTA WATER CO. N. WELL 01**
**GWIC Id: 67309**

## Section 1: Well Owner(s)

1) LINDA VISTA WATER CO (MAIL)
C/O LLOYD TWITE 3000 ELDORA
MISSOULA MT 59803 [03/03/1988]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 20W | 12 | NE¼ SW¼ SE¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8217 | -114.0588 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3040 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, March 03, 1988

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -5 | 100 | 8 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 85 | 100 | 8 | | | 8 INCH |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 100
Static Water Level: 14
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
370 gpm pump rate with _ feet of drawdown after 6.5 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

JEROMES FILE NO: 1988

## Section 9: Well Log

**Geologic Source**

120SDMS - SEDIMENTS (TERTIARY)

| From | To | Description |
|---|---|---|
| 0 | 2 | SOIL |
| 2 | 12 | SAND GRVEL |
| 12 | 20 | CLAY |
| 20 | 55 | SATURATED SAND |
| 55 | 70 | SAND GRAVEL |
| 70 | 80 | SANDY GRAY CLAY |
| 80 | 100 | GRAVEL WITH WATER |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** JEROMES DRILLING CO
**License No:** WWC-249
**Date Completed:** 3/3/1988

# Well #40B / 76H 67585 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/25/2009 10:02:10 AM)

**Site Name: LINDA VISTA WATER CO. WELL 03**
**GWIC Id: 67310**

## Section 1: Well Owner(s)

1) LINDA VISTA WATER CO (MAIL)
C/O LLOYD TWITE 3000 ELDORA
MISSOULA MT 59803 [03/02/1988]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 20W | 12 | NW¼ SW¼ SE¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8213 | -114.0588 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3040 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, March 22, 1988

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -4 | 110 | 8 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 85 | 100 | 8 | | | 8INCH |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 110
Static Water Level: 14
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
370 gpm pump rate with _ feet of drawdown after 6.5 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

JEROMES FILE NO: 1987

## Section 9: Well Log

**Geologic Source**

120SNGR - SAND AND GRAVEL (TERTIARY)

| From | To | Description |
|---|---|---|
| 0 | 5 | MULTICOLORED GRAVEL AND SOIL |
| 5 | 20 | CLAY AND SAND |
| 20 | 62 | SAND SATURATED |
| 62 | 71 | SAND AND GRAVEL |
| 71 | 82 | GRAY SANDY CLAY |
| 82 | 110 | GRAVEL WITH WATER |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** JEROMES DRILLING CO
**License No:** WWC-249
**Date Completed:** 3/22/1988

# Well #40C / 76H 96947 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/23/2009 10:20:43 AM)

**Site Name: LINDA VISTA WATER CO. S. WELL 02**
**GWIC Id: 127528**

## Section 1: Well Owner(s)

1) TWITE, LLOYD (MAIL)
3000 ELDORA LN
MISSOULA MT 59803 [03/25/1992]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 20W | 1 | NE¼ SW¼ SE¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8212 | -114.0597 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3040 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, March 25, 1992

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 113 | 8 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 85 | 100 | 8 | | 3/16X1 | HOLTE PERFORATOR SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 20 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 113
Static Water Level: 10
Water Temperature:

**Air Test** *

_350_ gpm with drill stem set at _ feet for _2_ hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _14_ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

JEROMES FILE NO: 3443

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 3 | SOIL |
| 3 | 11 | SILTY SAND |
| 11 | 18 | SAND- GRAVEL- SILT |
| 18 | 43 | CLAY- GRAVEL |
| 43 | 62 | GRAVEL- SAND |
| 62 | 70 | CLAY- GRAVEL |
| 70 | 78 | GRAY CLAY |
| 78 | 103 | COARSE GRAVEL |
| 103 | 106 | SAND |
| 106 | 113 | GRAVEL- SAND- SILT |
| | | |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** JEROMES DRILLING CO
**License No:** WWC-249
**Date Completed:** 3/25/1992

# 76M 147281 00 / City Cemetary

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/6/2009 12:01:06 PM)

**Site Name: CITY OF MISSOULA * CEMETERY**
**GWIC Id: 68561**

## Section 1: Well Owner(s)

1) MISSOULA CITY CEMETARY-DOUG WATERS
SUPERINDENDANT (MAIL)
1820 RODGERS STREET
MISSOULA MT 59802 [09/23/1999]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 16 | NW¼ NE¼ NW¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.892238 | -114.015711 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3185 | | | |

| Addition | Block | Lot |
|---|---|---|
| SCHOOL 5 ACRE TRACTS | 33-49 | |

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, January 22, 1969

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 152 | 12 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 94 | 99 | 12 | | | 3X3/8IN MILLS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 152
Static Water Level: 45
Water Temperature:

**Air Test** *

800 gpm with drill stem set at _ feet for 6 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 60 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 12 | COBBLESTONES AND CLAY |
| 12 | 25 | GRAVEL AND CLAY |
| 25 | 30 | CLAY AND SAND |
| 30 | 40 | CLYA |
| 40 | 52 | SAND AND CLAY |
| 52 | 60 | SAND CLAY AND WATER |
| 60 | 88 | SILT SAND AND WATER |
| 88 | 99 | GRAVEL AND WATER |
| 99 | 106 | CLAY AND GRAVEL |
| 106 | 126 | CLAY |
| 126 | 129 | GRAVEL SAND AND WATER |
| 129 | 152 | GRAVEL AND WATER |
| | | |
| | | |
| | | |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 1/22/1969

# 76M 147283 00 / McCormick Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (1/12/2007 1:35:06 PM)

**NOTICE >>** **This well has been marked as ABANDONED in the GWIC database.** **<< NOTICE**

**Site Name: CITY OF MISSOULA**
**GWIC Id: 69015**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
201 W SPRUCE
MISSOULA MT 59802 [04/27/1987]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | NE¼ SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.873533 | -114.004429 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**
MCCORMICK PARK

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: ABANDONED

## Section 5: Well Completion Date

Date well completed: Monday, April 27, 1987

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 8 | 10 | 118 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 10 | 118 | 8 | | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 100 | 118 | 8 | | 1/8X1 | SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 20 | CEMENT | |

## Section 7: Well Test Data

Total Depth: 118
Static Water Level: 32.4
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
600 gpm pump rate with _ feet of drawdown after 8 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 38.3 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 8 | 49 | CLAY GRAVEL AND BOULDERS |
| 49 | 90 | CLAY SAND GRAVEL AND WATER |
| 90 | 118 | SAND GRAVEL AND WATER |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** JIM FOLEY
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 4/27/1987

# 76M 147284 00 / City Sewer

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/6/2009 10:10:11 AM)

**Site Name: CITY OF MISSOULA**
**GWIC Id: 68636**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
N/A
MISSOULA MT N/A [06/29/1962]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 18 | NW¼ SE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.883366 | -114.047817 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3130 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, June 29, 1962

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -3 | 79.8 | 8 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 79.8 | 79.8 | 8 | | | OPEN BOTTOM * |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 79.8
Static Water Level: 12
Water Temperature:

**Air Test** *

280 gpm with drill stem set at _ feet for 6 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 41 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | LOOSE GRAVEL FILL |
| 6 | 13 | DIRT & GRAVEL WATER |
| 13 | 29 | SAND & GRAVEL |
| 29 | 36 | GRAVEL WITH SOME CLAY MIXED IN |
| 36 | 39 | SILT SAND & GRAVEL SEEPS WATER |
| 39 | 44 | GRAVEL MIXED IN CLAY |
| 44 | 55 | GRAVEL & COBBLES IMBEDDED IN CLAY |
| 55 | 61 | COARSE SAND & GRAVEL WATER |
| 61 | 65 | VERY COARSE GRAVEL LITTLE SAND CLEAN WATER |
| 65 | 69 | TAN TO BROWN CLAY |
| 69 | 78.5 | SAND & GRAVEL WATER |
| | | |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** LIBERTY DRILLING & PUMP CO
**License No:** WWC-52
**Date Completed:** 6/29/1962

# 76H 147285 00 / Play Fair Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View hydrograph for this site
View field visits for this site
View scanned well log (2/25/2009 10:17:57 AM)


**Site Name: CITY OF MISSOULA**
**GWIC Id: 69404**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
N/A
MISSOULA MT N/A [12/04/1962]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 33 | SW¼ SW¼ SE¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8419 | -114.0105 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3185 | | | 11/17/1999 |

| Measuring Point Altitude | MP Method | Datum | Date Applies |
|---|---|---|---|
| 3186.1 | | | 11/17/1999 1:11:00 PM |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, December 04, 1962

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1 | 116 | 10 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 104 | 115 | 10 | | | 3/8X2.5 MILLS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 116
Static Water Level: 45
Water Temperature:

**Air Test** *

400 gpm with drill stem set at _ feet for 4 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 62 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

MAIN VALVE IS BEING WORKED ON WELL IS OUT OF USE UNTIL SPRING

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 44 | GRAVEL AND COBBLESTONES IMBEDDED IN TAN CLAY |
| 44 | 66 | SILTY SAND AND GRAVEL. SOME WATER |
| 66 | 69 | TAN CLAY SOME GRAVEL IMBEDDED |
| 69 | 87 | SAND & GRAVEL MIXED IN TAN CLAY. SOME WATER |
| 87 | 89 | TAN CLAY. SOME GRAVEL IMBEDDED |
| 89 | 94 | TAN SANDY SILTY CLAY |
| 94 | 98 | TIGHT SAND & GRAVEL SOME WATER |
| 98 | 104 | SAND & GRAVEL. WATER |
| 104 | 116 | CLEAN COARSE SAND & GRAVEL. WATER |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** LIBERTY DRILLING & PUMP CO
**License No:** WWC-52
**Date Completed:** 12/4/1962

# 76H 4927 00 / Fort Missoula Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/3/2009 10:40:04 AM)

**Site Name: MISSOULA COUNTY**
**GWIC Id: 69338**

## Section 1: Well Owner(s)

1) MISSOULA COUNTY (MAIL)
N/A
MISSOULA MT 59801 [12/11/1974]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 31 | SE¼ NE¼ NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.845946 | -114.051957 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3155 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, December 11, 1974

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 117 | 12 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 95 | 100 | 12 | | | 3/8X3 SLOTS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 117
Static Water Level: 32
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after 8 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 38 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 3 | BROWN TOPSOIL |
| 3 | 25 | GRAVEL AND TAN CLAY |
| 25 | 45 | SANDY CLAY AND GRAVEL |
| 45 | 70 | GRAVEL SAND AND WATER |
| 70 | 78 | TAN CLAY AND GRAVEL |
| 78 | 85 | GRAVEL SAND AND WATER |
| 85 | 87 | TAN CLAY GRAVEL AND WATER |
| 87 | 117 | GRAVEL WATER AND SAND |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 12/11/1974

# 76M 12163 00 / Jacobs Island Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/26/2009 12:10:29 PM)

**Site Name: CITY OF MISSOULA**
**GWIC Id: 69081**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
201 W SPRUCE
MISSOULA MT 59801 [12/20/1977]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | NW¼ NE¼ SW¼ SE¼ |

**County**: MISSOULA
**Geocode**:

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.866432 | -113.983879 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3200 | | | |

**Addition**: **Block**: **Lot**:

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, December 20, 1977

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.5 | 56.8 | 6 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 55 | 63 | 6 | | | TORCH CUTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 39 | PUDDLE CLAY | |

## Section 7: Well Test Data

Total Depth: 56.8
Static Water Level: 38
Water Temperature:

**Air Test** *

_100_ gpm with drill stem set at _ feet for _6_ hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _50_ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 20 | RED RIVER GRAVEL FILL |
| 20 | 24 | BOULDERS GRAVELS & COBBLESTONES IN BROWN MUD |
| 24 | 39.5 | DARK BROWN SILTY CLAY GRAVEL AND COBBLES |
| 39.5 | 42 | SILTY SAND AND GRAVEL |
| 42 | 48 | GRAVEL AND COBBLES MIXED IN REDDISH SHAD. 2 GPM |
| 48 | 51 | CLEAN GRAVELS & COBBLES 5 GPM AT 49 FEET |
| 51 | 57 | CLEAN GRAVEL AND COARSE SAND 24 GPM AT 54 FEET |
| 57 | 63 | CLEAN GRAVELS AND LOOSE COARSE SAND 30 GPM |
| 63 | 63 | LARGE CLEAN GRAVEL AND COBBLES 100 GPM |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** LIBERTY DRILLING & PUMP CO
**License No:** WWC-52
**Date Completed:** 12/20/1977

# 76M 12164 00 / Greenough Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/26/2009 11:56:36 AM)

**Site Name: CITY OF MISSOULA**
**GWIC Id: 69068**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
201 W SPRUCE
MISSOULA MT 59801 [11/04/1977]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | NE¼ SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.873408 | -113.98321 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, November 04, 1977

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.5 | 50 | 6 | | | | STEEL |
| 9 | 70 | 4 | | | | PVC |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 70 | 70 | 4 | | | OPEN BOTTOM * |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 70
Static Water Level: 30
Water Temperature:

**Air Test** *

40 gpm with drill stem set at _ feet for 1 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 40 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

JEROMES FILE NO: 504

## Section 9: Well Log

**Geologic Source**

400BELT - BELT SUPERGROUP

| From | To | Description |
|---|---|---|
| 0 | 50 | GRAVEL AND BOULDERS |
| 50 | 70 | HARD ROCK |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** JEROMES DRILLING CO
**License No:** WWC-249
**Date Completed:** 11/4/1977

# 76M 12164 00 / Greenough Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/26/2009 11:56:48 AM)

**Site Name: CITY PARKS & RECREATION**
**GWIC Id: 69069**

## Section 1: Well Owner(s)

1) CITY PARKS & RECREATION (MAIL)
201 W SPRUCE
MISSOULA MT 59801 [03/29/1978]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | NE¼ SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.873408 | -113.98321 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, March 29, 1978

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1 | 60 | 6 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 30 | 40 | 6 | | | .5 HOLES |
| 50 | 60 | 6 | | | .5 HOLES |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 60
Static Water Level: 11
Water Temperature:

**Air Test** *

30 gpm with drill stem set at _ feet for 1 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 25 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

JEROMES FILE NO: 570

## Section 9: Well Log

**Geologic Source**

111ALVM - ALLUVIUM (HOLOCENE)

| From | To | Description |
|---|---|---|
| 0 | 60 | SAND GRAVEL AND BOULDERS |
| 60 | 70 | MED ROCK |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** JEROMES DRILLING CO
**License No:** WWC-249
**Date Completed:** 3/29/1978

# 76M 20380 00 / Play Fair Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/25/2009 10:23:30 AM)

**Site Name: CITY OF MISSOULA**
**GWIC Id: 69413**
**DNRC Water Right: 20380**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
201 W SPRUCE
MISSOULA MT 59801 [05/30/1979]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 33 | NW¼ SE¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.839721 | -114.00554 | TRS-SEC | NAD83 |

**Ground Surface Altitude:** **Ground Surface Method:** **Datum:** **Date:**

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

IRRIGATION (1)
PUBLIC WATER SUPPLY (2)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, May 30, 1979

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.3 | 117 | 8 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 100 | 110 | 8 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 10 | CEMENT | |

## Section 7: Well Test Data

Total Depth: 117
Static Water Level: 45
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
_200_ gpm pump rate with _ feet of drawdown after _1_ hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _46_ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 19 | CLAY GRAVEL AND BOULDERS |
| 19 | 26 | SAND GRAVEL AND COBBLESTONES |
| 26 | 58 | CLAY SAND AND GRAVEL |
| 58 | 65 | CLAY SAND GRAVEL AND SEEPS OF WATER |
| 65 | 73 | CLAY SAND GRAVEL AND WATER |
| 73 | 78 | SAND GRAVEL AND WATER |
| 78 | 86 | TAN CLAY |
| 86 | 95 | SAND GRAVEL AND WATER |
| 95 | 117 | GRAVEL COBBLESTONES VERY LIGTTLE SAND & WATER |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 5/30/1979

# 76M 55276 00 / John Toole Riverside Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/26/2009 12:02:47 PM)

**Site Name: CITY OF MISSOULA**
**GWIC Id: 69075**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
201 W SPRUCE
MISSOULA MT 59802 [04/23/1987]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | NE¼ SW¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.865967 | -113.993919 | TRS-SEC | NAD83 |

**Ground Surface Altitude:** **Ground Surface Method:** **Datum:** **Date:**

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, April 23, 1987

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2.7 | 138 | 8 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 123 | 138 | 8 | | 1/8X1 | PULL DOWN SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 20 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 138
Static Water Level: 40.4
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
600 gpm pump rate with _ feet of drawdown after 8 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 44.1 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | FILL |
| 6 | 65 | CLAY GRAVEL AND BOULDERS |
| 65 | 80 | CLAY GRAVEL SAND AND WATER |
| 80 | 98 | SAND GRAVEL AND WATER |
| 98 | 117 | SILTY SAND AND WATER |
| 117 | 135 | SAND GRAVEL AND WATER |
| 135 | 138 | CLAY GRAVEL BOULDERS AND WATER |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 4/23/1987

# 76M 99723 00 / Bonner Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 11:52:44 AM)

**Site Name: CITY OF MISSOULA * BONNER PARK**
**GWIC Id: 165173**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
435 RYMAN
MISSOULA MT 59802 [11/06/1997]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 27 | NW¼ SW¼ |

**County**: MISSOULA
**Geocode**:

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.854322 | -113.99523 | TRS-SEC | NAD83 |

**Ground Surface Altitude**: **Ground Surface Method**: **Datum**: **Date**:

**Addition**: **Block**: **Lot**:

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, November 06, 1997

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 138 | 8 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 127 | 137 | 8 | | | 1/8X1.5 SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 20 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 138
Static Water Level: 69.7
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
235 gpm pump rate with _ feet of drawdown after 8 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 120 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 2 | TOPSOIL |
| 2 | 71.5 | CLAY & GRAVEL & BOULDERS |
| 71.5 | 138 | CLAY & GRAVEL & BOULDERS & WATER |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 11/6/1997

# 76M 99724 00 / Franklin Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 12:42:35 PM)

**Site Name: CITY OF MISSOULA * FRANKLIN PARK**
**GWIC Id: 165180**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
435 RYMAN
MISSOULA MT 59802 [11/18/1997]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 29 | NE¼ NW¼ |

**County**

MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.861231 | -114.032237 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, November 18, 1997

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2.5 | 98 | 8 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 98 | 98 | 8 | | | OPEN BOTTOM * |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 20 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 98
Static Water Level: 42
Water Temperature:

**Air Test** *

200 gpm with drill stem set at _ feet for 1 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 52 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 2 | TOPSOIL |
| 2 | 60 | BROWN CLAY & GRAVEL |
| 60 | 98 | BROWN CLAY & GRAVEL & WATER & SAND |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 11/18/1997

# 76M 99725 00 / Sunset Memorial Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 12:05:26 PM)

**Site Name: CITY OF MISSOULA * ROSE PARK**
**GWIC Id: 165179**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
435 RYMAN
MISSOULA MT 59802 [11/13/1997]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 28 | SW¼ NE¼ |

**County** MISSOULA **Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.857744 | -114.005556 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, November 13, 1997

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 119 | 8 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 119 | 119 | 8 | | | OPEN BOTTOM * |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 20 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 119
Static Water Level: 66.2
Water Temperature:

**Air Test** *

250 gpm with drill stem set at _ feet for 1 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 80 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 1 | TOPSOIL |
| 1 | 78 | SAND & GRAVEL |
| 78 | 119 | SAND & GRAVEL & CLAY & WATER & BOULDERS |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 11/13/1997

# 76M 30000964 / Ogren Park - Allegiance Field

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/31/2009 4:36:50 PM)

**Site Name: MISSOULA CIVIC STADIUM**
**GWIC Id: 210074**

## Section 1: Well Owner(s)

1) BENCHWALL, STEVE (MAIL)
P.O. BOX 790
MISSOULA MT 59806 [04/19/2004]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.872579 | -114.005766 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

DOMESTIC (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Monday, April 19, 2004

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 80 | 8 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 80 | 8 | | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 65 | 80 | 8 | 300 | 1/4X1.25 | HOLTE PERFORATOR SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 80
Static Water Level: 38.9
Water Temperature:

**Pump Test** *

Depth pump set for test 70 feet.
280 gpm pump rate with 8 feet of drawdown after 8 hours of pumping.
Time of recovery 1 hours.
Recovery water level 38.9 feet.
Pumping water level 46.9 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 39 | GRAVEL, SAND AND TRACE OF CLAY |
| 39 | 80 | GRAVEL, SAND, TRACE OF CLAY AND WATER |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 4/19/2004

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/27/2008 4:23:47 PM)

**Site Name: GRASS VALLEY PROJECT LLC**
**GWIC Id: 241774**

## Section 1: Well Owner(s)

1) GRASS VALLEY PROJECT LLC (MAIL)
BOX 4746
MISSOULA MT 59806 [12/11/2007]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 20W | 12 | NW¼ SW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.897884 | -114.07932 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**
44 RANCH PARK

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, December 11, 2007

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 120 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 120 | 6 | 0.25 | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 100 | 115 | 6 | 15 | 3/16X1 | HOLTE PERFORATOR SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 0 | BENTONITE | Y |

## Section 7: Well Test Data

Total Depth: 120
Static Water Level: 30
Water Temperature:

**Air Test** *

100 gpm with drill stem set at 115 feet for 3 hours.
Time of recovery 0.03 hours.
Recovery water level 30 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 10 | SILT, SAND, GRAVEL |
| 10 | 32 | SAND, GRAVEL |
| 32 | 75 | TAN CLAY |
| 75 | 115 | GRAVEL, SAND, W/ WATER |
| 115 | 120 | FRACTURED ROCK, CLAY |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** RANDAL KOTECKI
**Company:** JEROMES DRILLING CO
**License No:** WWC-600
**Date Completed:** 12/11/2007

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/27/2008 4:23:35 PM)

**Site Name: GRASS VALLEY PROJECT LLC**
**GWIC Id: 241771**

## Section 1: Well Owner(s)

1) GRASS VALLEY PROJECT LLC (MAIL)
BOX 4746
MISSOULA MT 59806 [12/14/2007]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 20W | 12 | NW¼ SW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.897884 | -114.07932 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**
44 RANCH PARK

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, December 14, 2007

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 125 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 125 | 6 | 0.25 | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 107 | 117 | 6 | 10 | 3/16X1 | HOLTE PERFORATOR SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 0 | BENTONITE | Y |

## Section 7: Well Test Data

Total Depth: 125
Static Water Level: 30
Water Temperature:

**Air Test** *

100 gpm with drill stem set at 115 feet for 3 hours.
Time of recovery 0.03 hours.
Recovery water level 30 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 10 | SILT, SAND, CLAY |
| 10 | 30 | SAND, GRAVEL |
| 30 | 78 | TAN CLAY |
| 78 | 107 | SAND |
| 107 | 125 | GRAVEL, SAND, W/ WATER |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** RANDAL KOTECKI
**Company:** JEROMES DRILLING CO
**License No:** WWC-600
**Date Completed:** 12/14/2007

# 76M 30051555 / Silver Park Phase III

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (6/27/2011 9:50:35 AM)

**Site Name: CITY OF MISSOULA - SILVER PARK PHASE 3 * 11-220**
**GWIC Id: 261918**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA - SILVER PARK PHASE 3 (MAIL)
435 RYMAN ST
MISSOULA MT 59802 [04/26/2011]
2) CITY OF MISSOULA - SILVER PARK PHASE 3 (WELL)
900 CREGG ST
MISSOULA MT 59801 [04/26/2011]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | NE¼ NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.874566666667 | -114.010933333333 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|

| Addition | Block | Lot |
|---|---|---|
| SILVER PARK PHASE 3 | | |

## Section 3: Proposed Use of Water

DOMESTIC (1)
IRRIGATION (2)
PUBLIC WATER SUPPLY (3)

## Section 4: Type of Work

Drilling Method:
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, April 26, 2011

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 60 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 58 | 6 | | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 75 | 90 | 0 | | | PERFORATED CASING |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 90
Static Water Level: 38.5
Water Temperature:

**Air Test** *

60 gpm with drill stem set at 92 feet for 4 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 2 | TOPSOIL, GRAVEL MIX |
| 2 | 7 | BOULDER, COBBLES |
| 7 | 8 | VOID |
| 8 | 9 | WOOD PRODUCTS |
| 9 | 17 | WOOD PRODUCTS |
| 17 | 19 | CONCRETE |
| 19 | 20.5 | VOID |
| 20.5 | 22 | CONCRETE |
| 22 | 25 | WOOD, GRAVEL |
| 25 | 30.5 | GRAVEL - CLEAN |
| 30.5 | 36 | BOULDER |
| 36 | 42 | CLAY, GRAVEL, SAND |
| 42 | 45 | BOULDER |
| 45 | 58 | CLAY, GRAVEL, SAND |
| 58 | 65 | CLAY, COBBLES, SAND |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** JON NORCROSS
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 4/26/2011

**Site Name: CITY OF MISSOULA - SILVER PARK PHASE 3**
**GWIC Id: 261918**
**Additional Lithology Records**

| From | To | Description |
|---|---|---|
| 65 | 77 | SAND, CLAY, GRAVEL |
| 77 | 95 | GRAVEL |

# 76M 30051556 / Siver Park Phase III

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (6/27/2011 9:50:03 AM)

**Site Name: CITY OF MISSOULA -SILVER PARK PHASE 3 * 11-218**
**GWIC Id: 261917**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA - SILVER PARK PHASE 3 (MAIL)
435 RYMAN ST
MISSOULA MT 59802 [03/25/2011]
2) CITY OF MISSOULA - SILVER PARK PHASE 3 (WELL)
900 CREGG
MISSOULA MT 59801 [03/25/2011]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | NE¼ NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.87465 | -114.011833333333 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|

| Addition | Block | Lot |
|---|---|---|
| SILVER PARK PHASE 3 | | |

## Section 3: Proposed Use of Water

IRRIGATION (1)
PUBLIC WATER SUPPLY (2)

## Section 4: Type of Work

Drilling Method:
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, March 25, 2011

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 38 | 10 |
| 0 | 77 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 75 | 6 | | | WELDED | STEEL |
| 3 | 38 | 10 | | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 60 | 77 | 6 | 122 | 1/4 X 1 | HOLTE PERFORATOR SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 77
Static Water Level: 36
Water Temperature:

**Air Test** *

40 gpm with drill stem set at 72 feet for 3 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 4 | TOPSOIL |
| 4 | 11 | BOULDER |
| 11 | 14 | WOOD MIX |
| 14 | 23 | WOOD MIX |
| 23 | 26 | CONCRETE |
| 26 | 28 | WOOD MIX |
| 28 | 29 | VOID |
| 29 | 30 | CONCRETE |
| 30 | 34 | WOOD MIX |
| 34 | 36 | SAND, GRAVEL |
| 36 | 44 | CLAY, GRAVEL, SAND |
| 44 | 50 | SAND, GRAVEL |
| 50 | 77 | GRAVEL, SAND |
| | | |
| | | |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** JON NORCROSS
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 3/25/2011

# 76H 30006192 / Rainbow Park (Linda Vista)

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/25/2009 10:02:42 AM)

**Site Name: LINDA VISTA HOMEOWNERS A**
**GWIC Id: 180939**

## Section 1: Well Owner(s)

1) LINDA VISTA HOMEOWNERS ASS (MAIL)
3000 ELDORA
MISSOULA MT 59803 [01/27/2000]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 20W | 1 | NE¼ SW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.825267 | -114.059144 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**
LINDA VISTA SUPPLEMENT

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, January 27, 2000

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 180 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 180 | 6 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 160 | 175 | 6 | | 3/16X1 | HOLTE PERFORATOR SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 0 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 180
Static Water Level: 55
Water Temperature:

**Air Test** *

100 gpm with drill stem set at 175 feet for 2 hours.
Time of recovery 0.5 hours.
Recovery water level 55 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
120SDMS - SEDIMENTS (TERTIARY)
Lithology Data

There are no lithologic details assigned to this well.

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** JEROMES DRILLING CO
**License No:** WWC-2
**Date Completed:** 1/27/2000

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/1/2009 10:09:43 AM)

**Site Name: CITY OF MISSOULA-MILWAUK**
**GWIC Id: 176505**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA-MILWAUKEE RAILROAD #3 C/O DAVE YUHAS (MAIL)
531 ONE HORSE CREEK RD.
FLORENCE MT 59833 [09/07/1999]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | NW¼ SW¼ |

**County**

MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.868764 | -114.016468 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| | | | |

| Addition | Block | Lot |
|---|---|---|
| | | |

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, September 07, 1999

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 72 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -3.5 | 70.5 | 6 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 70.5 | 70.5 | 6 | | | OPEN BOTTOM * |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 0 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 70.5
Static Water Level: 30
Water Temperature:

**Air Test** *

45 gpm with drill stem set at 60 feet for 1 hours.
Time of recovery 0 hours.
Recovery water level 30 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 30 | SAND LOAM GRAVEL |
| 30 | 75 | GRAVEL SAND CLAY WATER |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 9/7/1999

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/1/2009 10:09:52 AM)

**Site Name: CITY OF MISSOULA-MILWAUK**
**GWIC Id: 176506**

**Section 1: Well Owner(s)**

1) CITY OF MISSOULA-MILWAUKEE RAILROAD #2 C/O DAVE YUHAS (MAIL)
531 ONE HORSE CREEK RD.
FLORENCE MT 59833 [09/07/1999]

**Section 2: Location**

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | NW¼ SW¼ |

**County**

MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.868764 | -114.016468 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| | | | |

| Addition | Block | Lot |
|---|---|---|
| | | |

**Section 3: Proposed Use of Water**

IRRIGATION (1)

**Section 4: Type of Work**

Drilling Method: ROTARY
Status: NEW WELL

**Section 5: Well Completion Date**

Date well completed: Tuesday, September 07, 1999

**Section 6: Well Construction Details**

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 92 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 90 | 6 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 90 | 90 | 6 | | | OPEN BOTTOM * |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 0 | BENTONITE | |

**Section 7: Well Test Data**

Total Depth: 90
Static Water Level: 30
Water Temperature:

**Air Test** *

150 gpm with drill stem set at 75 feet for 1 hours.
Time of recovery 0 hours.
Recovery water level 30 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

**Section 8: Remarks**

**Section 9: Well Log**

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | FILL DIRT COBBLES |
| 6 | 20 | GRAVEL COBBLES SANDY LOAM |
| 20 | 35 | GRAVEL SAND CLAY |
| 35 | 92 | GRAVEL SAND CLAY WATER |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 9/7/1999

# 76M 30047618 / White Pines Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (10/21/2009 4:11:52 PM)

**Site Name: CITY OF MISSOULA - WHITE PINES PARK**
**GWIC Id: 252559**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA - WHITE PINES PARK (MAIL)
100 HICKORY STREET
MISSOULA MT 59801 [09/18/2009]
2) CITY OF MISSOULA - WHITE PINES PARK (WELL)
1309 SCOTT STREET
MISSOULA MT 59602 [09/18/2009]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 16 | SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.887207 | -114.005727 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, September 18, 2009

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 40 | 10 |
| 40 | 96 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 96 | 6 | | | WELDED | STEEL |
| 0 | 40 | 10 | | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 96 | 96 | 6 | | | OPEN BOTTOM |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 96
Static Water Level: 54
Water Temperature:

**Air Test** *

80 gpm with drill stem set at 80 feet for 2 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 1 | TOPSOIL |
| 1 | 21 | SAND AND GRAVEL |
| 21 | 40 | CLAY SOFT BROWN WITH GRAVEL |
| 40 | 43 | CLAY SOFT BROWN WITH GRAVEL |
| 43 | 51 | COARSE SAND |
| 51 | 66 | GRAVEL AND SAND |
| 66 | 81 | GRAVEL AND SAND |
| 81 | 85 | CLAY SOFT BROWN |
| 85 | 96 | GRAVEL |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** JON NORCROSS
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 9/18/2009

# 76M 30047619 / White Pines Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (10/21/2009 4:11:39 PM)

**Site Name: CITY OF MISSOULA - WHITE PINES PARK**
**GWIC Id: 252560**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA - WHITE PINES PARK (MAIL)
100 HICKORY STREET
MISSOULA MT 59801 [09/20/2009]
2) CITY OF MISSOULA - WHITE PINES PARK (WELL)
1309 SCOTT STREET
MISSOULA MT 59802 [09/20/2009]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 16 | SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.887207 | -114.005727 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| | | | |

| Addition | Block | Lot |
|---|---|---|
| | | |

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Sunday, September 20, 2009

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 32 | 10 |
| 32 | 86 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 86 | 6 | | | WELDED | STEEL |
| 0 | 32 | 10 | | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 86 | 86 | 6 | | | OPEN BOTTOM |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 86
Static Water Level: 54
Water Temperature:

**Air Test** *

60 gpm with drill stem set at 80 feet for 2.5 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 6 | TOPSOIL |
| 6 | 22 | GRAVEL AND SAND |
| 22 | 26 | SAND |
| 26 | 38 | SOFT BROWN CLAY |
| 38 | 86 | GRAVEL |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** JON NORCROSS
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 9/20/2009

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (10/7/2013 9:22:35 AM)

**Site Name: CITY OF MISSOULA - MISSOULA REDEVELOPMENT * WELL # 1**
**GWIC Id: 275207**

### Section 1: Well Owner(s)

1) CITY OF MISSOULA - MISSOULA REDEVELOPMENT (MAIL)
435 RYMAN ST
MISSOULA MT 59802 [07/17/2013]
2) CITY OF MISSOULA - MISSOULA REDEVELOPMENT (WELL)
900 CREGG LN
MISSOULA MT 59801 [07/17/2013]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | SE¼ NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.87415 | -114.008766666667 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| | | | |

| Addition | Block | Lot |
|---|---|---|
| | C | |

### Section 3: Proposed Use of Water

IRRIGATION (1)

### Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Wednesday, July 17, 2013

### Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 26 | 10 |
| 0 | 80 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 78 | 6 | | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 65 | 75 | 6 | 180 | 1/4 X 1 1/4 | HOLTE PERFORATOR SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

### Section 7: Well Test Data

Total Depth: 80
Static Water Level: 30
Water Temperature:

**Air Test** *

75 gpm with drill stem set at 75 feet for 6 hours.
Time of recovery 0.03 hours.
Recovery water level 30 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 15 | SAND AND GRAVEL / FILL AND SAW DUST |
| 15 | 30 | SAND AND GRAVEL AND SMALL BOULDERS |
| 30 | 45 | SAND AND GRAVEL WITH WATER, CLAY BOUND AND TIGHTLY PACKED DRY LAYERS |
| 45 | 65 | SAND WITH WATER, SOME GRAVEL |
| 65 | 80 | SAND AND GRAVEL WITH WATER |
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### Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** JON NORCROSS
**Company:** CAMP WELL DRILLING & PUMP SUPPLY
**License No:** WWC-7
**Date Completed:** 7/17/2013

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (10/7/2013 9:21:32 AM)

**Site Name: CITY OF MISSOULA - MISSOULA REDEVELOPMENT * WELL # 2**
**GWIC Id: 275206**

### Section 1: Well Owner(s)

1) CITY OF MISSOULA - MISSOULA REDEVELOPMENT (MAIL)
435 RYMAN ST
MISSOULA MT 59802 [07/18/2013]
2) CITY OF MISSOULA - MISSOULA REDEVELOPMENT (WELL)
900 CREGG LANE
MISSOULA MT 59801 [07/18/2013]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | SE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.873433333333 | -114.009216666667 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| | | | |

| Addition | Block | Lot |
|---|---|---|
| | C | |

### Section 3: Proposed Use of Water

IRRIGATION (1)

### Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Thursday, July 18, 2013

### Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 26 | 10 |
| 0 | 80 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 78 | 6 | | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 65 | 75 | 6 | 180 | 1/4 X 1 1/4 | HOLTE PERFORATOR SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

### Section 7: Well Test Data

Total Depth: 80
Static Water Level: 26
Water Temperature:

**Air Test** *

75 gpm with drill stem set at 75 feet for 6 hours.
Time of recovery 0.03 hours.
Recovery water level 26 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 7 | SAND AND GRAVEL / FILL |
| 7 | 25 | BROKEN CONCRETE FILL |
| 25 | 60 | SAND AND GRAVEL WITH WATER, CLAYBOUND AND TIGHTLY PACKED LAYERS |
| 60 | 80 | SAND AND GRAVEL WITH WATER |

### Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** JON NORCROSS
**Company:** CAMP WELL DRILLING & PUMP SUPPLY
**License No:** WWC-7
**Date Completed:** 7/18/2013

# *76M 75662 00 / Pineview Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/6/2009 1:41:42 PM)

**Site Name: PINEVIEW PARK DEVELOPMENT**
**GWIC Id: 68520**

## Section 1: Well Owner(s)

1) PINEVIEW PARK DEVELOPMENT (MAIL)
N/A
MISSOULA MT N/A [05/21/1971]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 14 | NE¼ NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.890796 | -113.968517 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, May 21, 1971

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.5 | 40.5 | 6 | | | | STEEL |

There are no completion records assigned to this well.

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 41
Static Water Level: 19
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
50 gpm pump rate with _ feet of drawdown after 1 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 33 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

111ALVM - ALLUVIUM (HOLOCENE)

| From | To | Description |
|---|---|---|
| 0 | 18 | BOULDERS AND BROWN CLAY |
| 18 | 40.5 | GRAVEL AND WATER AND BOULDERS |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 5/21/1971

# 76M 147281 00 / City Cemetary

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/6/2009 12:01:06 PM)

**Site Name: CITY OF MISSOULA * CEMETERY**
**GWIC Id: 68561**

## Section 1: Well Owner(s)

1) MISSOULA CITY CEMETARY-DOUG WATERS
SUPERINDENDANT (MAIL)
1820 RODGERS STREET
MISSOULA MT 59802 [09/23/1999]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 16 | NW¼ NE¼ NW¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.892238 | -114.015711 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3185 | | | |

| Addition | Block | Lot |
|---|---|---|
| SCHOOL 5 ACRE TRACTS | 33-49 | |

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, January 22, 1969

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 152 | 12 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 94 | 99 | 12 | | | 3X3/8IN MILLS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 152
Static Water Level: 45
Water Temperature:

**Air Test** *

800 gpm with drill stem set at _ feet for 6 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 60 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 12 | COBBLESTONES AND CLAY |
| 12 | 25 | GRAVEL AND CLAY |
| 25 | 30 | CLAY AND SAND |
| 30 | 40 | CLYA |
| 40 | 52 | SAND AND CLAY |
| 52 | 60 | SAND CLAY AND WATER |
| 60 | 88 | SILT SAND AND WATER |
| 88 | 99 | GRAVEL AND WATER |
| 99 | 106 | CLAY AND GRAVEL |
| 106 | 126 | CLAY |
| 126 | 129 | GRAVEL SAND AND WATER |
| 129 | 152 | GRAVEL AND WATER |
| | | |
| | | |
| | | |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 1/22/1969

# 76M 147283 00 / McCormick Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (1/12/2007 1:35:06 PM)

**NOTICE >>** **This well has been marked as ABANDONED in the GWIC database.** **<< NOTICE**

**Site Name: CITY OF MISSOULA**
**GWIC Id: 69015**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
201 W SPRUCE
MISSOULA MT 59802 [04/27/1987]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | NE¼ SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.873533 | -114.004429 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**
MCCORMICK PARK

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: ABANDONED

## Section 5: Well Completion Date

Date well completed: Monday, April 27, 1987

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 8 | 10 | 118 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 10 | 118 | 8 | | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 100 | 118 | 8 | | 1/8X1 | SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 20 | CEMENT | |

## Section 7: Well Test Data

Total Depth: 118
Static Water Level: 32.4
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
600 gpm pump rate with _ feet of drawdown after 8 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 38.3 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 8 | 49 | CLAY GRAVEL AND BOULDERS |
| 49 | 90 | CLAY SAND GRAVEL AND WATER |
| 90 | 118 | SAND GRAVEL AND WATER |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** JIM FOLEY
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 4/27/1987

# 76M 147284 00 / City Sewer

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/6/2009 10:10:11 AM)

**Site Name: CITY OF MISSOULA**
**GWIC Id: 68636**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
N/A
MISSOULA MT N/A [06/29/1962]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 18 | NW¼ SE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.883366 | -114.047817 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3130 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, June 29, 1962

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -3 | 79.8 | 8 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 79.8 | 79.8 | 8 | | | OPEN BOTTOM * |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 79.8
Static Water Level: 12
Water Temperature:

**Air Test** *

280 gpm with drill stem set at _ feet for 6 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 41 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | LOOSE GRAVEL FILL |
| 6 | 13 | DIRT & GRAVEL WATER |
| 13 | 29 | SAND & GRAVEL |
| 29 | 36 | GRAVEL WITH SOME CLAY MIXED IN |
| 36 | 39 | SILT SAND & GRAVEL SEEPS WATER |
| 39 | 44 | GRAVEL MIXED IN CLAY |
| 44 | 55 | GRAVEL & COBBLES IMBEDDED IN CLAY |
| 55 | 61 | COARSE SAND & GRAVEL WATER |
| 61 | 65 | VERY COARSE GRAVEL LITTLE SAND CLEAN WATER |
| 65 | 69 | TAN TO BROWN CLAY |
| 69 | 78.5 | SAND & GRAVEL WATER |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** LIBERTY DRILLING & PUMP CO
**License No:** WWC-52
**Date Completed:** 6/29/1962

# 76H 147285 00 / Play Fair Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View hydrograph for this site
View field visits for this site
View scanned well log (2/25/2009 10:17:57 AM)


**Site Name: CITY OF MISSOULA**
**GWIC Id: 69404**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
N/A
MISSOULA MT N/A [12/04/1962]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 33 | SW¼ SW¼ SE¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8419 | -114.0105 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3185 | | | 11/17/1999 |

| Measuring Point Altitude | MP Method | Datum | Date Applies |
|---|---|---|---|
| 3186.1 | | | 11/17/1999 1:11:00 PM |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, December 04, 1962

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1 | 116 | 10 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 104 | 115 | 10 | | | 3/8X2.5 MILLS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 116
Static Water Level: 45
Water Temperature:

**Air Test** *

400 gpm with drill stem set at _ feet for 4 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 62 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

MAIN VALVE IS BEING WORKED ON WELL IS OUT OF USE UNTIL SPRING

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 44 | GRAVEL AND COBBLESTONES IMBEDDED IN TAN CLAY |
| 44 | 66 | SILTY SAND AND GRAVEL. SOME WATER |
| 66 | 69 | TAN CLAY SOME GRAVEL IMBEDDED |
| 69 | 87 | SAND & GRAVEL MIXED IN TAN CLAY. SOME WATER |
| 87 | 89 | TAN CLAY. SOME GRAVEL IMBEDDED |
| 89 | 94 | TAN SANDY SILTY CLAY |
| 94 | 98 | TIGHT SAND & GRAVEL SOME WATER |
| 98 | 104 | SAND & GRAVEL. WATER |
| 104 | 116 | CLEAN COARSE SAND & GRAVEL. WATER |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** LIBERTY DRILLING & PUMP CO
**License No:** WWC-52
**Date Completed:** 12/4/1962

# 76H 4927 00 / Fort Missoula Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/3/2009 10:40:04 AM)

**Site Name: MISSOULA COUNTY**
**GWIC Id: 69338**

## Section 1: Well Owner(s)

1) MISSOULA COUNTY (MAIL)
N/A
MISSOULA MT 59801 [12/11/1974]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 31 | SE¼ NE¼ NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.845946 | -114.051957 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3155 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, December 11, 1974

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 117 | 12 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 95 | 100 | 12 | | | 3/8X3 SLOTS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 117
Static Water Level: 32
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after 8 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 38 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 3 | BROWN TOPSOIL |
| 3 | 25 | GRAVEL AND TAN CLAY |
| 25 | 45 | SANDY CLAY AND GRAVEL |
| 45 | 70 | GRAVEL SAND AND WATER |
| 70 | 78 | TAN CLAY AND GRAVEL |
| 78 | 85 | GRAVEL SAND AND WATER |
| 85 | 87 | TAN CLAY GRAVEL AND WATER |
| 87 | 117 | GRAVEL WATER AND SAND |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 12/11/1974

# 76M 12163 00 / Jacobs Island Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/26/2009 12:10:29 PM)

**Site Name: CITY OF MISSOULA**
**GWIC Id: 69081**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
201 W SPRUCE
MISSOULA MT 59801 [12/20/1977]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | NW¼ NE¼ SW¼ SE¼ |

**County**: MISSOULA
**Geocode**:

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.866432 | -113.983879 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3200 | | | |

**Addition**: **Block**: **Lot**:

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, December 20, 1977

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.5 | 56.8 | 6 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 55 | 63 | 6 | | | TORCH CUTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 39 | PUDDLE CLAY | |

## Section 7: Well Test Data

Total Depth: 56.8
Static Water Level: 38
Water Temperature:

**Air Test** *

_100_ gpm with drill stem set at _ feet for _6_ hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _50_ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 20 | RED RIVER GRAVEL FILL |
| 20 | 24 | BOULDERS GRAVELS & COBBLESTONES IN BROWN MUD |
| 24 | 39.5 | DARK BROWN SILTY CLAY GRAVEL AND COBBLES |
| 39.5 | 42 | SILTY SAND AND GRAVEL |
| 42 | 48 | GRAVEL AND COBBLES MIXED IN REDDISH SHAD. 2 GPM |
| 48 | 51 | CLEAN GRAVELS & COBBLES 5 GPM AT 49 FEET |
| 51 | 57 | CLEAN GRAVEL AND COARSE SAND 24 GPM AT 54 FEET |
| 57 | 63 | CLEAN GRAVELS AND LOOSE COARSE SAND 30 GPM |
| 63 | 63 | LARGE CLEAN GRAVEL AND COBBLES 100 GPM |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** LIBERTY DRILLING & PUMP CO
**License No:** WWC-52
**Date Completed:** 12/20/1977

# 76M 12164 00 / Greenough Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/26/2009 11:56:36 AM)

**Site Name: CITY OF MISSOULA**
**GWIC Id: 69068**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
201 W SPRUCE
MISSOULA MT 59801 [11/04/1977]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | NE¼ SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.873408 | -113.98321 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, November 04, 1977

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.5 | 50 | 6 | | | | STEEL |
| 9 | 70 | 4 | | | | PVC |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 70 | 70 | 4 | | | OPEN BOTTOM * |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 70
Static Water Level: 30
Water Temperature:

**Air Test** *

40 gpm with drill stem set at _ feet for 1 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 40 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

JEROMES FILE NO: 504

## Section 9: Well Log

**Geologic Source**

400BELT - BELT SUPERGROUP

| From | To | Description |
|---|---|---|
| 0 | 50 | GRAVEL AND BOULDERS |
| 50 | 70 | HARD ROCK |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** JEROMES DRILLING CO
**License No:** WWC-249
**Date Completed:** 11/4/1977

# 76M 12164 00 / Greenough Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/26/2009 11:56:48 AM)

**Site Name: CITY PARKS & RECREATION**
**GWIC Id: 69069**

## Section 1: Well Owner(s)

1) CITY PARKS & RECREATION (MAIL)
201 W SPRUCE
MISSOULA MT 59801 [03/29/1978]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | NE¼ SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.873408 | -113.98321 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, March 29, 1978

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1 | 60 | 6 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 30 | 40 | 6 | | | .5 HOLES |
| 50 | 60 | 6 | | | .5 HOLES |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 60
Static Water Level: 11
Water Temperature:

**Air Test** *

30 gpm with drill stem set at _ feet for 1 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 25 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

JEROMES FILE NO: 570

## Section 9: Well Log

**Geologic Source**

111ALVM - ALLUVIUM (HOLOCENE)

| From | To | Description |
|---|---|---|
| 0 | 60 | SAND GRAVEL AND BOULDERS |
| 60 | 70 | MED ROCK |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** JEROMES DRILLING CO
**License No:** WWC-249
**Date Completed:** 3/29/1978

# 76M 20380 00 / Play Fair Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/25/2009 10:23:30 AM)

**Site Name: CITY OF MISSOULA**
**GWIC Id: 69413**
**DNRC Water Right: 20380**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
201 W SPRUCE
MISSOULA MT 59801 [05/30/1979]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 33 | NW¼ SE¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.839721 | -114.00554 | TRS-SEC | NAD83 |

**Ground Surface Altitude:** **Ground Surface Method:** **Datum:** **Date:**

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

IRRIGATION (1)
PUBLIC WATER SUPPLY (2)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, May 30, 1979

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.3 | 117 | 8 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 100 | 110 | 8 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 10 | CEMENT | |

## Section 7: Well Test Data

Total Depth: 117
Static Water Level: 45
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
_200_ gpm pump rate with _ feet of drawdown after _1_ hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _46_ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 19 | CLAY GRAVEL AND BOULDERS |
| 19 | 26 | SAND GRAVEL AND COBBLESTONES |
| 26 | 58 | CLAY SAND AND GRAVEL |
| 58 | 65 | CLAY SAND GRAVEL AND SEEPS OF WATER |
| 65 | 73 | CLAY SAND GRAVEL AND WATER |
| 73 | 78 | SAND GRAVEL AND WATER |
| 78 | 86 | TAN CLAY |
| 86 | 95 | SAND GRAVEL AND WATER |
| 95 | 117 | GRAVEL COBBLESTONES VERY LIGTTLE SAND & WATER |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 5/30/1979

# 76M 55276 00 / John Toole Riverside Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/26/2009 12:02:47 PM)

**Site Name: CITY OF MISSOULA**
**GWIC Id: 69075**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
201 W SPRUCE
MISSOULA MT 59802 [04/23/1987]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | NE¼ SW¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.865967 | -113.993919 | TRS-SEC | NAD83 |

**Ground Surface Altitude:** **Ground Surface Method:** **Datum:** **Date:**

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, April 23, 1987

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2.7 | 138 | 8 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 123 | 138 | 8 | | 1/8X1 | PULL DOWN SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 20 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 138
Static Water Level: 40.4
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
600 gpm pump rate with _ feet of drawdown after 8 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 44.1 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | FILL |
| 6 | 65 | CLAY GRAVEL AND BOULDERS |
| 65 | 80 | CLAY GRAVEL SAND AND WATER |
| 80 | 98 | SAND GRAVEL AND WATER |
| 98 | 117 | SILTY SAND AND WATER |
| 117 | 135 | SAND GRAVEL AND WATER |
| 135 | 138 | CLAY GRAVEL BOULDERS AND WATER |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 4/23/1987

# 76M 99723 00 / Bonner Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 11:52:44 AM)

**Site Name: CITY OF MISSOULA * BONNER PARK**
**GWIC Id: 165173**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
435 RYMAN
MISSOULA MT 59802 [11/06/1997]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 27 | NW¼ SW¼ |

**County**: MISSOULA
**Geocode**:

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.854322 | -113.99523 | TRS-SEC | NAD83 |

**Ground Surface Altitude**: **Ground Surface Method**: **Datum**: **Date**:

**Addition**: **Block**: **Lot**:

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, November 06, 1997

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 138 | 8 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 127 | 137 | 8 | | | 1/8X1.5 SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 20 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 138
Static Water Level: 69.7
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
235 gpm pump rate with _ feet of drawdown after 8 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 120 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 2 | TOPSOIL |
| 2 | 71.5 | CLAY & GRAVEL & BOULDERS |
| 71.5 | 138 | CLAY & GRAVEL & BOULDERS & WATER |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 11/6/1997

# 76M 99724 00 / Franklin Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 12:42:35 PM)

**Site Name: CITY OF MISSOULA * FRANKLIN PARK**
**GWIC Id: 165180**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
435 RYMAN
MISSOULA MT 59802 [11/18/1997]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 29 | NE¼ NW¼ |

**County**

MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.861231 | -114.032237 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, November 18, 1997

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2.5 | 98 | 8 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 98 | 98 | 8 | | | OPEN BOTTOM * |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 20 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 98
Static Water Level: 42
Water Temperature:

**Air Test** *

200 gpm with drill stem set at _ feet for 1 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 52 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 2 | TOPSOIL |
| 2 | 60 | BROWN CLAY & GRAVEL |
| 60 | 98 | BROWN CLAY & GRAVEL & WATER & SAND |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 11/18/1997

# 76M 99725 00 / Sunset Memorial Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 12:05:26 PM)

**Site Name: CITY OF MISSOULA * ROSE PARK**
**GWIC Id: 165179**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA (MAIL)
435 RYMAN
MISSOULA MT 59802 [11/13/1997]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 28 | SW¼ NE¼ |

**County** MISSOULA **Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.857744 | -114.005556 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, November 13, 1997

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 119 | 8 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 119 | 119 | 8 | | | OPEN BOTTOM * |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 20 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 119
Static Water Level: 66.2
Water Temperature:

**Air Test** *

250 gpm with drill stem set at _ feet for 1 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 80 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 1 | TOPSOIL |
| 1 | 78 | SAND & GRAVEL |
| 78 | 119 | SAND & GRAVEL & CLAY & WATER & BOULDERS |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 11/13/1997

# 76M 30000964 / Ogren Park - Allegiance Field

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/31/2009 4:36:50 PM)

**Site Name: MISSOULA CIVIC STADIUM**
**GWIC Id: 210074**

## Section 1: Well Owner(s)

1) BENCHWALL, STEVE (MAIL)
P.O. BOX 790
MISSOULA MT 59806 [04/19/2004]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.872579 | -114.005766 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

DOMESTIC (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Monday, April 19, 2004

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 80 | 8 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 80 | 8 | | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 65 | 80 | 8 | 300 | 1/4X1.25 | HOLTE PERFORATOR SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 80
Static Water Level: 38.9
Water Temperature:

**Pump Test** *

Depth pump set for test 70 feet.
280 gpm pump rate with 8 feet of drawdown after 8 hours of pumping.
Time of recovery 1 hours.
Recovery water level 38.9 feet.
Pumping water level 46.9 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 39 | GRAVEL, SAND AND TRACE OF CLAY |
| 39 | 80 | GRAVEL, SAND, TRACE OF CLAY AND WATER |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 4/19/2004

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/27/2008 4:23:47 PM)

**Site Name: GRASS VALLEY PROJECT LLC**
**GWIC Id: 241774**

## Section 1: Well Owner(s)

1) GRASS VALLEY PROJECT LLC (MAIL)
BOX 4746
MISSOULA MT 59806 [12/11/2007]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 20W | 12 | NW¼ SW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.897884 | -114.07932 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**
44 RANCH PARK

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, December 11, 2007

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 120 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 120 | 6 | 0.25 | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 100 | 115 | 6 | 15 | 3/16X1 | HOLTE PERFORATOR SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 0 | BENTONITE | Y |

## Section 7: Well Test Data

Total Depth: 120
Static Water Level: 30
Water Temperature:

**Air Test** *

100 gpm with drill stem set at 115 feet for 3 hours.
Time of recovery 0.03 hours.
Recovery water level 30 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 10 | SILT, SAND, GRAVEL |
| 10 | 32 | SAND, GRAVEL |
| 32 | 75 | TAN CLAY |
| 75 | 115 | GRAVEL, SAND, W/ WATER |
| 115 | 120 | FRACTURED ROCK, CLAY |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** RANDAL KOTECKI
**Company:** JEROMES DRILLING CO
**License No:** WWC-600
**Date Completed:** 12/11/2007

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/27/2008 4:23:35 PM)

**Site Name: GRASS VALLEY PROJECT LLC**
**GWIC Id: 241771**

## Section 1: Well Owner(s)

1) GRASS VALLEY PROJECT LLC (MAIL)
BOX 4746
MISSOULA MT 59806 [12/14/2007]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 20W | 12 | NW¼ SW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.897884 | -114.07932 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**
44 RANCH PARK

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, December 14, 2007

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 125 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 125 | 6 | 0.25 | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 107 | 117 | 6 | 10 | 3/16X1 | HOLTE PERFORATOR SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 0 | BENTONITE | Y |

## Section 7: Well Test Data

Total Depth: 125
Static Water Level: 30
Water Temperature:

**Air Test** *

100 gpm with drill stem set at 115 feet for 3 hours.
Time of recovery 0.03 hours.
Recovery water level 30 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 10 | SILT, SAND, CLAY |
| 10 | 30 | SAND, GRAVEL |
| 30 | 78 | TAN CLAY |
| 78 | 107 | SAND |
| 107 | 125 | GRAVEL, SAND, W/ WATER |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** RANDAL KOTECKI
**Company:** JEROMES DRILLING CO
**License No:** WWC-600
**Date Completed:** 12/14/2007

# 76M 30051555 / Silver Park Phase III

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (6/27/2011 9:50:35 AM)

**Site Name: CITY OF MISSOULA - SILVER PARK PHASE 3 * 11-220**
**GWIC Id: 261918**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA - SILVER PARK PHASE 3 (MAIL)
435 RYMAN ST
MISSOULA MT 59802 [04/26/2011]
2) CITY OF MISSOULA - SILVER PARK PHASE 3 (WELL)
900 CREGG ST
MISSOULA MT 59801 [04/26/2011]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | NE¼ NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.874566666667 | -114.010933333333 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|

| Addition | Block | Lot |
|---|---|---|
| SILVER PARK PHASE 3 | | |

## Section 3: Proposed Use of Water

DOMESTIC (1)
IRRIGATION (2)
PUBLIC WATER SUPPLY (3)

## Section 4: Type of Work

Drilling Method:
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, April 26, 2011

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 60 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 58 | 6 | | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 75 | 90 | 0 | | | PERFORATED CASING |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 90
Static Water Level: 38.5
Water Temperature:

**Air Test** *

60 gpm with drill stem set at 92 feet for 4 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 2 | TOPSOIL, GRAVEL MIX |
| 2 | 7 | BOULDER, COBBLES |
| 7 | 8 | VOID |
| 8 | 9 | WOOD PRODUCTS |
| 9 | 17 | WOOD PRODUCTS |
| 17 | 19 | CONCRETE |
| 19 | 20.5 | VOID |
| 20.5 | 22 | CONCRETE |
| 22 | 25 | WOOD, GRAVEL |
| 25 | 30.5 | GRAVEL - CLEAN |
| 30.5 | 36 | BOULDER |
| 36 | 42 | CLAY, GRAVEL, SAND |
| 42 | 45 | BOULDER |
| 45 | 58 | CLAY, GRAVEL, SAND |
| 58 | 65 | CLAY, COBBLES, SAND |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** JON NORCROSS
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 4/26/2011

**Site Name: CITY OF MISSOULA - SILVER PARK PHASE 3**
**GWIC Id: 261918**
**Additional Lithology Records**

| From | To | Description |
|---|---|---|
| 65 | 77 | SAND, CLAY, GRAVEL |
| 77 | 95 | GRAVEL |

# 76M 30051556 / Siver Park Phase III

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (6/27/2011 9:50:03 AM)

**Site Name: CITY OF MISSOULA -SILVER PARK PHASE 3 * 11-218**
**GWIC Id: 261917**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA - SILVER PARK PHASE 3 (MAIL)
435 RYMAN ST
MISSOULA MT 59802 [03/25/2011]
2) CITY OF MISSOULA - SILVER PARK PHASE 3 (WELL)
900 CREGG
MISSOULA MT 59801 [03/25/2011]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | NE¼ NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.87465 | -114.011833333333 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|

| Addition | Block | Lot |
|---|---|---|
| SILVER PARK PHASE 3 | | |

## Section 3: Proposed Use of Water

IRRIGATION (1)
PUBLIC WATER SUPPLY (2)

## Section 4: Type of Work

Drilling Method:
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, March 25, 2011

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 38 | 10 |
| 0 | 77 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 75 | 6 | | | WELDED | STEEL |
| 3 | 38 | 10 | | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 60 | 77 | 6 | 122 | 1/4 X 1 | HOLTE PERFORATOR SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 77
Static Water Level: 36
Water Temperature:

**Air Test** *

40 gpm with drill stem set at 72 feet for 3 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 4 | TOPSOIL |
| 4 | 11 | BOULDER |
| 11 | 14 | WOOD MIX |
| 14 | 23 | WOOD MIX |
| 23 | 26 | CONCRETE |
| 26 | 28 | WOOD MIX |
| 28 | 29 | VOID |
| 29 | 30 | CONCRETE |
| 30 | 34 | WOOD MIX |
| 34 | 36 | SAND, GRAVEL |
| 36 | 44 | CLAY, GRAVEL, SAND |
| 44 | 50 | SAND, GRAVEL |
| 50 | 77 | GRAVEL, SAND |
| | | |
| | | |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** JON NORCROSS
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 3/25/2011

# 76H 30006192 / Rainbow Park (Linda Vista)

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/25/2009 10:02:42 AM)

**Site Name: LINDA VISTA HOMEOWNERS A**
**GWIC Id: 180939**

## Section 1: Well Owner(s)

1) LINDA VISTA HOMEOWNERS ASS (MAIL)
3000 ELDORA
MISSOULA MT 59803 [01/27/2000]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 20W | 1 | NE¼ SW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.825267 | -114.059144 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**
LINDA VISTA SUPPLEMENT

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, January 27, 2000

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 180 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 180 | 6 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 160 | 175 | 6 | | 3/16X1 | HOLTE PERFORATOR SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 0 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 180
Static Water Level: 55
Water Temperature:

**Air Test** *

100 gpm with drill stem set at 175 feet for 2 hours.
Time of recovery 0.5 hours.
Recovery water level 55 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
120SDMS - SEDIMENTS (TERTIARY)
Lithology Data

There are no lithologic details assigned to this well.

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** JEROMES DRILLING CO
**License No:** WWC-2
**Date Completed:** 1/27/2000

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/1/2009 10:09:43 AM)

**Site Name: CITY OF MISSOULA-MILWAUK**
**GWIC Id: 176505**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA-MILWAUKEE RAILROAD #3 C/O DAVE YUHAS (MAIL)
531 ONE HORSE CREEK RD.
FLORENCE MT 59833 [09/07/1999]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | NW¼ SW¼ |

**County**

MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.868764 | -114.016468 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| | | | |

| Addition | Block | Lot |
|---|---|---|
| | | |

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, September 07, 1999

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 72 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -3.5 | 70.5 | 6 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 70.5 | 70.5 | 6 | | | OPEN BOTTOM * |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 0 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 70.5
Static Water Level: 30
Water Temperature:

**Air Test** *

45 gpm with drill stem set at 60 feet for 1 hours.
Time of recovery 0 hours.
Recovery water level 30 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 30 | SAND LOAM GRAVEL |
| 30 | 75 | GRAVEL SAND CLAY WATER |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 9/7/1999

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/1/2009 10:09:52 AM)

**Site Name: CITY OF MISSOULA-MILWAUK**
**GWIC Id: 176506**

**Section 1: Well Owner(s)**

1) CITY OF MISSOULA-MILWAUKEE RAILROAD #2 C/O DAVE YUHAS (MAIL)
531 ONE HORSE CREEK RD.
FLORENCE MT 59833 [09/07/1999]

**Section 2: Location**

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | NW¼ SW¼ |

**County**

MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.868764 | -114.016468 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| | | | |

| Addition | Block | Lot |
|---|---|---|
| | | |

**Section 3: Proposed Use of Water**

IRRIGATION (1)

**Section 4: Type of Work**

Drilling Method: ROTARY
Status: NEW WELL

**Section 5: Well Completion Date**

Date well completed: Tuesday, September 07, 1999

**Section 6: Well Construction Details**

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 92 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 90 | 6 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 90 | 90 | 6 | | | OPEN BOTTOM * |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 0 | BENTONITE | |

**Section 7: Well Test Data**

Total Depth: 90
Static Water Level: 30
Water Temperature:

**Air Test** *

150 gpm with drill stem set at 75 feet for 1 hours.
Time of recovery 0 hours.
Recovery water level 30 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

**Section 8: Remarks**

**Section 9: Well Log**

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | FILL DIRT COBBLES |
| 6 | 20 | GRAVEL COBBLES SANDY LOAM |
| 20 | 35 | GRAVEL SAND CLAY |
| 35 | 92 | GRAVEL SAND CLAY WATER |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 9/7/1999

# 76M 30047618 / White Pines Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (10/21/2009 4:11:52 PM)

**Site Name: CITY OF MISSOULA - WHITE PINES PARK**
**GWIC Id: 252559**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA - WHITE PINES PARK (MAIL)
100 HICKORY STREET
MISSOULA MT 59801 [09/18/2009]
2) CITY OF MISSOULA - WHITE PINES PARK (WELL)
1309 SCOTT STREET
MISSOULA MT 59602 [09/18/2009]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 16 | SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.887207 | -114.005727 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, September 18, 2009

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 40 | 10 |
| 40 | 96 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 96 | 6 | | | WELDED | STEEL |
| 0 | 40 | 10 | | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 96 | 96 | 6 | | | OPEN BOTTOM |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 96
Static Water Level: 54
Water Temperature:

**Air Test** *

80 gpm with drill stem set at 80 feet for 2 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 1 | TOPSOIL |
| 1 | 21 | SAND AND GRAVEL |
| 21 | 40 | CLAY SOFT BROWN WITH GRAVEL |
| 40 | 43 | CLAY SOFT BROWN WITH GRAVEL |
| 43 | 51 | COARSE SAND |
| 51 | 66 | GRAVEL AND SAND |
| 66 | 81 | GRAVEL AND SAND |
| 81 | 85 | CLAY SOFT BROWN |
| 85 | 96 | GRAVEL |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** JON NORCROSS
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 9/18/2009

# 76M 30047619 / White Pines Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (10/21/2009 4:11:39 PM)

**Site Name: CITY OF MISSOULA - WHITE PINES PARK**
**GWIC Id: 252560**

## Section 1: Well Owner(s)

1) CITY OF MISSOULA - WHITE PINES PARK (MAIL)
100 HICKORY STREET
MISSOULA MT 59801 [09/20/2009]
2) CITY OF MISSOULA - WHITE PINES PARK (WELL)
1309 SCOTT STREET
MISSOULA MT 59802 [09/20/2009]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 16 | SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.887207 | -114.005727 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| | | | |

| Addition | Block | Lot |
|---|---|---|
| | | |

## Section 3: Proposed Use of Water

IRRIGATION (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Sunday, September 20, 2009

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 32 | 10 |
| 32 | 86 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 86 | 6 | | | WELDED | STEEL |
| 0 | 32 | 10 | | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 86 | 86 | 6 | | | OPEN BOTTOM |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 86
Static Water Level: 54
Water Temperature:

**Air Test** *

60 gpm with drill stem set at 80 feet for 2.5 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 6 | TOPSOIL |
| 6 | 22 | GRAVEL AND SAND |
| 22 | 26 | SAND |
| 26 | 38 | SOFT BROWN CLAY |
| 38 | 86 | GRAVEL |
| | | |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** JON NORCROSS
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 9/20/2009

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (10/7/2013 9:22:35 AM)

**Site Name: CITY OF MISSOULA - MISSOULA REDEVELOPMENT * WELL # 1**
**GWIC Id: 275207**

### Section 1: Well Owner(s)

1) CITY OF MISSOULA - MISSOULA REDEVELOPMENT (MAIL)
435 RYMAN ST
MISSOULA MT 59802 [07/17/2013]
2) CITY OF MISSOULA - MISSOULA REDEVELOPMENT (WELL)
900 CREGG LN
MISSOULA MT 59801 [07/17/2013]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | SE¼ NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.87415 | -114.008766666667 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| | | | |

| Addition | Block | Lot |
|---|---|---|
| | C | |

### Section 3: Proposed Use of Water

IRRIGATION (1)

### Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Wednesday, July 17, 2013

### Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 26 | 10 |
| 0 | 80 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 78 | 6 | | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 65 | 75 | 6 | 180 | 1/4 X 1 1/4 | HOLTE PERFORATOR SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

### Section 7: Well Test Data

Total Depth: 80
Static Water Level: 30
Water Temperature:

**Air Test** *

75 gpm with drill stem set at 75 feet for 6 hours.
Time of recovery 0.03 hours.
Recovery water level 30 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 15 | SAND AND GRAVEL / FILL AND SAW DUST |
| 15 | 30 | SAND AND GRAVEL AND SMALL BOULDERS |
| 30 | 45 | SAND AND GRAVEL WITH WATER, CLAY BOUND AND TIGHTLY PACKED DRY LAYERS |
| 45 | 65 | SAND WITH WATER, SOME GRAVEL |
| 65 | 80 | SAND AND GRAVEL WITH WATER |
| | | |
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### Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** JON NORCROSS
**Company:** CAMP WELL DRILLING & PUMP SUPPLY
**License No:** WWC-7
**Date Completed:** 7/17/2013

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (10/7/2013 9:21:32 AM)

**Site Name: CITY OF MISSOULA - MISSOULA REDEVELOPMENT * WELL # 2**
**GWIC Id: 275206**

### Section 1: Well Owner(s)

1) CITY OF MISSOULA - MISSOULA REDEVELOPMENT (MAIL)
435 RYMAN ST
MISSOULA MT 59802 [07/18/2013]
2) CITY OF MISSOULA - MISSOULA REDEVELOPMENT (WELL)
900 CREGG LANE
MISSOULA MT 59801 [07/18/2013]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | SE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.873433333333 | -114.009216666667 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| | | | |

| Addition | Block | Lot |
|---|---|---|
| | C | |

### Section 3: Proposed Use of Water

IRRIGATION (1)

### Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Thursday, July 18, 2013

### Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 26 | 10 |
| 0 | 80 | 6 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 78 | 6 | | | WELDED | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 65 | 75 | 6 | 180 | 1/4 X 1 1/4 | HOLTE PERFORATOR SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

### Section 7: Well Test Data

Total Depth: 80
Static Water Level: 26
Water Temperature:

**Air Test** *

75 gpm with drill stem set at 75 feet for 6 hours.
Time of recovery 0.03 hours.
Recovery water level 26 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 7 | SAND AND GRAVEL / FILL |
| 7 | 25 | BROKEN CONCRETE FILL |
| 25 | 60 | SAND AND GRAVEL WITH WATER, CLAYBOUND AND TIGHTLY PACKED LAYERS |
| 60 | 80 | SAND AND GRAVEL WITH WATER |

### Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** JON NORCROSS
**Company:** CAMP WELL DRILLING & PUMP SUPPLY
**License No:** WWC-7
**Date Completed:** 7/18/2013

# *76M 75662 00 / Pineview Park

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/6/2009 1:41:42 PM)

**Site Name: PINEVIEW PARK DEVELOPMENT**
**GWIC Id: 68520**

## Section 1: Well Owner(s)

1) PINEVIEW PARK DEVELOPMENT (MAIL)
N/A
MISSOULA MT N/A [05/21/1971]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 14 | NE¼ NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.890796 | -113.968517 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, May 21, 1971

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.5 | 40.5 | 6 | | | | STEEL |

There are no completion records assigned to this well.

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 41
Static Water Level: 19
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
50 gpm pump rate with _ feet of drawdown after 1 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 33 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

111ALVM - ALLUVIUM (HOLOCENE)

| From | To | Description |
|---|---|---|
| 0 | 18 | BOULDERS AND BROWN CLAY |
| 18 | 40.5 | GRAVEL AND WATER AND BOULDERS |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 5/21/1971

# Well #37 / 76M 26357 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/8/2009 10:17:57 AM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 37**
**GWIC Id: 68306**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
440 SOUTH AVE W.
MISSOULA MT N/A [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
N/A
MISSOULA MT N/A [06/25/1973]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 2 | SE¼ SW¼ SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.91453 | -113.963601 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3425.4 | | | |

**Addition** **Block** **Lot**

### Section 3: Proposed Use of Water

DOMESTIC (1)

### Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Monday, June 25, 1973

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.
There are no casing strings assigned to this well.
There are no completion records assigned to this well.

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 57
Static Water Level: 11
Water Temperature:

**Air Test** *

120 gpm with drill stem set at _ feet for 2 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 16 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

111ALVM - ALLUVIUM (HOLOCENE)

| From | To | Description |
|---|---|---|
| 0 | 14 | CLAY AND SANDY GRAVEL |
| 14 | 32 | BOULDERS AND GRAVEL |
| 32 | 55 | SANDY GRAVEL AND CLAY STREAKS WATER |
| 55 | 57 | GRAVEL (WATER) |
| | | |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 6/25/1973

# Well #28 / 76M 26359 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View water quality for this site
View scanned well log (11/17/2008 1:36:57 PM)


**Site Name: MOUNTAIN WATER COMPANY * WELL 28**
**GWIC Id: 132890**

## Section 1: Well Owner(s)

1) MONTANA POWER CO (MAIL)
N/A
MISSOULA MT 59801 [09/21/1972]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 14N | 20W | 26 | NW¼ SW¼ SW¼ SW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.9374 | -114.1023 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3161.3 | | | |

**Addition**
C & M HOMES WELL

**Block**

**Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, September 21, 1972

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 365 | 6 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 138 | 141 | 6 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 365
Static Water Level: 78
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
33 gpm pump rate with _ feet of drawdown after 20 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 116 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

120SNGR - SAND AND GRAVEL (TERTIARY)

| From | To | Description |
|---|---|---|
| 0 | 5 | COBBLESTONES- GRAVEL & TAN CLAY |
| 5 | 31 | TAN CLAY |
| 31 | 39 | TAN CLAY AND GRAVEL |
| 39 | 68 | BROWN CLAY AND GRAVEL |
| 68 | 84 | LT BROWN CLAY & GRAVEL |
| 84 | 85 | CLAY GRAVEL & WATER |
| 85 | 98 | YELLOW CLAY AND GRAVEL |
| 98 | 110 | TAN CLAY |
| 110 | 122 | TAN CLAY AND GRAVEL |
| 122 | 123 | GRAVEL- CLAY AND WATER |
| 123 | 132 | YELLOW CLAY |
| 132 | 138 | TAN CLAY SOME GRAVEL |
| 138 | 141 | GRAVEL SAND AND WATER |
| 141 | 150 | YELLOW CLAY AND GRAVEL |
| 150 | 151 | SAND GRAVEL- WATER AND SILT |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 9/21/1972

**Site Name: MOUNTAIN WATER COMPANY * WELL 28**
**GWIC Id: 132890**
**Additional Lithology Records**

| From | To | Description |
|---|---|---|
| 151 | 169 | SAND CLAY AND GRAVEL |
| 169 | 171 | SAND SOME GRAVEL AND WATER |
| 171 | 187 | SANDY YELLOW CLAY |
| 187 | 246 | BROWN CLAY |
| 246 | 257 | BLUE AND TAN CLAY- SOME GRAVEL |
| 257 | 272 | BLUE CLAY |
| 272 | 285 | GREEN CLAY |
| 285 | 305 | BLUE CLAY |
| 305 | 350 | GRAY CLAY AND GRAVEL |
| 350 | 375 | GRAY CLAY |

# Well #14 / 76 H 26360 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View water quality for this site
View scanned well log (3/3/2009 12:19:10 PM)


**Site Name: MOUNTAIN WATER COMPANY * WELL 14**
**GWIC Id: 132030**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
N/A
N/A N/A N/A [09/01/1992]
2) THE MONTANA POWER COMPANY (MAIL)
RUSSELL ST
MISSOULA MT N/A [04/05/1976]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 32 | SE¼ SE¼ SE¼ SE¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.834651 | -114.019702 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3135.7 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: DEEPENED

## Section 5: Well Completion Date

Date well completed: Monday, April 05, 1976

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.
There are no casing strings assigned to this well.
There are no completion records assigned to this well.

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 146
Static Water Level:
Water Temperature:

**Unknown Test Method** *

Yield _ gpm.
Pumping water level _ feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 2 | TOPSOIL AND GRAVEL |
| 2 | 31 | CLAY- GRAVEL AND BOULDERS |
| 31 | 37 | SILTY SAND AND GRAVEL |
| 37 | 46 | CLAY AND GRAVEL |
| 46 | 59 | CLAY- GRAVEL AND BOULDERS |
| 59 | 68 | GRAVEL AND WATER |
| 68 | 80 | CLAY AND GRAVEL |
| 80 | 100 | SAND- GRAVEL AND WATER |
| 100 | 101 | CLAY AND GRAVEL ORIGINAL WELL COMPLETED 6-1-65 BY GLENN CAMP |
| 101 | 107 | SAND- GRAVEL AND WATER |
| 107 | 109 | SAND AND WATER |
| 109 | 121 | SAND- GRAVEL AND WATER |
| 121 | 123 | GRAVEL- WATER W/SEAMS OF CLAY |
| 123 | 133 | CLAY AND GRAVEL |
| 133 | 145 | SANDY CLAY |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-239
**Date Completed:** 4/5/1976

**Site Name: MOUNTAIN WATER COMPANY * WELL 14**
**GWIC Id: 132030**
**Additional Lithology Records**

| From | To | Description |
|---|---|---|
| 145 | 146 | SAND- GRAVEL AND WATER |

# Well #17 / 76M 26368 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View water quality for this site
View scanned well log (11/14/2008 12:37:16 PM)


**Site Name: MOUNTAIN WATER COMPANY - WELL 16**
**GWIC Id: 132891**
**DNRC Water Right: W026368-00**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [10/22/1999]
2) MONTANA POWER CO (MAIL)
DESMET
MISSOULA MT 59803 [10/30/1968]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 14N | 20W | 35 | NE¼ SE¼ NE¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.935 | -114.0966 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3171.8 | | | |

**Addition:** **Block:** **Lot:**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Wednesday, October 30, 1968

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 360 | 16 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 177 | 181 | 16 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 360
Static Water Level: 107
Water Temperature:

**Air Test ***

500 gpm with drill stem set at _ feet for 6.5 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 113 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 1 | TOPSOIL |
| 1 | 79 | GRAVEL AND CLAY |
| 79 | 85 | WATER SAND GRAVEL SOME CLAY |
| 85 | 90 | SAND GRAVEL & CLAY |
| 90 | 104 | CLAY |
| 104 | 106 | WATER SAND & GRAVEL |
| 106 | 130 | CLAY AND GRAVEL |
| 130 | 132 | WATER SAND & GRAVEL |
| 132 | 157 | GRAVEL & CLAY WATER SEEPAGE |
| 157 | 171 | CLAY |
| 171 | 179 | SAND GRAVEL WATER TRACES OF CLAY |
| 179 | 189 | CLAY SAND & GRAVEL |
| 189 | 201 | YELLOW CLAY |
| 201 | 212 | BLUE GRAY CLAY |
| 212 | 213 | GRAVEL & CLAY |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 10/30/1968

**Site Name: MOUNTAIN WATER COMPANY - WELL 16**
**GWIC Id: 132891**
**Additional Lithology Records**

| From | To | Description |
|---|---|---|
| 213 | 220 | BLUE AND YELLOW CLAY MARBELIZED |
| 220 | 236 | BLUE GRAY CLAY |
| 236 | 240 | GRAVEL AND CLAY |
| 240 | 252 | GRAY CLAY |
| 252 | 253 | SAND YELLOW CLAY SEEP OF WATER |
| 253 | 270 | CLAY |
| 270 | 281 | BROWN CLAY |
| 281 | 289 | BROWN SANDY CLAY |
| 289 | 291.5 | WATER SAND |
| 291.5 | 299 | SOME GRAVEL SAND WATER |
| 299 | 302 | CLAY AND GRAVEL |
| 302 | 311 | GRAVEL SAND SOME CLAY WATER |
| 311 | 317 | MORE CLAY SAND GRAVEL WATER |
| 317 | 327 | SAND GRAVEL WATER & CLAY |
| 327 | 335 | SAND GRAVEL LOOSE. A LITTLE CLAY WATER |
| 335 | 338 | TAN CLAY GRAVEL SAND NO WATER |
| 338 | 342 | GRAVEL SAND SOME CLAY SOME WATER |
| 342 | 346 | GRAVEL SAND SOME CLAY SOME WATER |
| 346 | 360 | GRAVEL SAND SOME CLAY |

# Well #1 / 76M 40143 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/1/2009 10:18:50 AM)

**Site Name: MOUNTAIN WATER COMPANY * WELL #38**
**GWIC Id: 151949**
**DNRC Water Right: W040143-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
E BROADWAY
MISSOULA MT 59803 [01/01/1936]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | SE¼ SE¼ SW¼ SW¼ |

**County** / **Geocode**
MISSOULA

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8642 | -114.0129 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3190 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method:
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, January 01, 1935

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 120 | 12 | | | | STEEL |

There are no completion records assigned to this well.

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 122
Static Water Level: 50
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after _ hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 70 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 22 | GRAVEL AND BOULDERS |
| 22 | 24 | GRAVEL AND FINE SAND |
| 24 | 40 | GRAVEL- BOULDERS AND VERY LITTLE CLAY |
| 40 | 45 | GRAVEL- BOULDERS AND CLAY |
| 45 | 47 | WATER- CLEAN GRAVEL AND SAND |
| 47 | 50 | SAND |
| 50 | 62 | SAND- GRAVEL AND A LITTLE CLAY |
| 65 | 69 | GRAVEL AND A LITTLE CLAY |
| 69 | 71.5 | SAND AND FINE GRAVEL |
| 71.5 | 73.5 | GRAVEL AND WATER |
| 73.5 | 75 | SAND AND FINE GRAVEL |
| 75 | 88 | GRAVEL- SAND- CLAY AND BOULDERS |
| 88 | 100.5 | GRAVEL- WATER AND A LITTLE CLAY |
| 100.5 | 102.5 | GRAVEL- BOULDERS AND CLAY |
| 102.5 | 114.3 | GRAVEL- SAND AND CLAY |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** ULRICH
**License No:** -
**Date Completed:** 1/1/1935

**Site Name: MOUNTAIN WATER COMPANY**
**GWIC Id: 151949**
**Additional Lithology Records**

| From | To | Description |
|---|---|---|
| 114.3 | 120 | GRAVEL AND SAND |

# Well #2 / 76M 40144 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View water quality for this site


**Site Name: MOUNTAIN WATER COMPANY * WELL #2**
**GWIC Id: 69155**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
N/A
MISSOULA MT N/A [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
40 E BROADWAY
MISSOULA MT N/A [11/19/1934]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 29 | SE¼ SW¼ SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8567 | -114.0261 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3143.7 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHRUN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Monday, November 19, 1934

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 90 | 12 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 40 | 90 | 12 | | | 1/2IN X1 1/2IN SLOT |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 116
Static Water Level: 50
Water Temperature:

**Unknown Test Method** *

Yield 1200 gpm.
Pumping water level _ feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 2 | CLAY AND TOP SOIL |
| 2 | 10 | SAND AND SOME GRAVEL |
| 10 | 21 | SAND GRAVEL AND BOULDERS |
| 21 | 35 | CLAY SAND AND BOULDERS |
| 35 | 55 | CLAY AND GRAVEL - SOME WATER |
| 55 | 62 | GRAVEL AND WATER |
| 62 | 68 | GRAVEL CLAY AND BOULDERS |
| 68 | 71 | GRAVEL |
| 71 | 72 | CLAY AND GRAVEL |
| 72 | 90 | LOOSE SANDY GRAVEL WITH FINE SEDIMENT SOME CLAY |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** ULRICH
**License No:** -
**Date Completed:** 11/19/1934

# Well #3A / 76M 40145 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 12:22:36 PM)

**Site Name: MOUNTAIN WATER COMPANY - WELL 2**
**GWIC Id: 151950**
**DNRC Water Right: W040145-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
E BROADWAY
MISSOULA MT 59803 [02/09/1935]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 28 | SW¼ SE¼ SW¼ SE¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8489 | -114.0026 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3161.7 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN DRILL
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, February 27, 1935

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 117.8 | 12 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 85 | 116 | 12 | | | |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 117.8
Static Water Level: 54
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after _ hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 90 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 30 | TOPSOIL; GRAVEL CLAY AND BOULDERS |
| 30 | 32 | CLAY |
| 32 | 43 | GRAVEL BOULDERS AND SOME CLAY |
| 43 | 45 | GRAVEL AND WATER |
| 45 | 78 | GRAVEL BOULDERS AND VERY LITTLE CLAY |
| 78 | 81 | GRAVEL WATER |
| 81 | 116 | GRAVEL SAND BOULDERS AND SOME CLAY |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** ULRICH
**License No:** -
**Date Completed:** 2/27/1935

# Well #4 / 76M 40146 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View scanned well log (3/19/2009 11:13:04 AM)


**Site Name: MOUNTAIN WATER COMPANY * WELL #3**
**GWIC Id: 132849**
**DNRC Water Right: W040146-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
E BROADWAY
MISSOULA MT 59803 [05/07/1937]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 24 | SE¼ SE¼ SW¼ NE¼ |

**County** / **Geocode**

MISSOULA

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8709 | -113.9393 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3173.1 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: UNKNOWN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, May 07, 1937

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 86 | 10 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 86 | 100 | 10 | | | 1/2X1 1/2 SLOT |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 86
Static Water Level: 65
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
_800_ gpm pump rate with _ feet of drawdown after _ hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _80_ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 35 | BOULDERS AND GRAVEL |
| 35 | 37 | WATER TIGHT GRAVEL AND CLAY |
| 37 | 38 | SAND |
| 38 | 40 | WATER TIGHT GRAVEL AND CLAY |
| 40 | 69 | GRAVEL AND BOULDERS |
| 69 | 75 | COARSE SAND |
| 75 | 86 | HEAVY GRAVEL AND SAND |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** ULRICH
**License No:** -
**Date Completed:** 5/7/1937

## MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View hydrograph for this site
View scanned update/correction (4/2/2012 10:22:33 AM)
View scanned aquifer test (6/27/2018 11:29:21 AM)

**Site Name: CANYON RIVER DEVELOPMENT * WELL HOUSE**
**GWIC Id: 240491**

### Section 1: Well Owner(s)

1) CANYON RIVER DEVELOPMENT (MAIL)
P.O. BOX 778
WHITEHALL MT 59759 [06/26/2007]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 18W | 18 | |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8853911248 | -113.923093018 | TRS-SEC | NAD83 |

**Ground Surface Altitude:** **Ground Surface Method:** **Datum:** **Date:**

**Addition:** **Block:** **Lot:**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Tuesday, June 26, 2007

### Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 25 | 14 |
| 25 | 132 | 10 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 100 | 10 | 0.25 | | WELDED | A53B STEEL |
| 111 | 122 | 10 | 0.25 | | WELDED | A53B STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 101 | 111 | 10 | | .125 | SCREEN-CONTINUOUS-STAINLESS |
| 122 | 132 | 10 | | .125 | SCREEN-CONTINUOUS-STAINLESS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 100 | K PACKER | |
| 0 | 20 | BENTONITE CHIPS | |

### Section 7: Well Test Data

Total Depth: 132
Static Water Level: 49.06
Water Temperature:

**Pump Test ***

Depth pump set for test 100 feet.
450 gpm pump rate with 16 feet of drawdown after 24 hours of pumping.
Time of recovery _ hours.
Recovery water level 49.06 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 2 | SOIL |
| 2 | 115 | GRAVELS |
| 115 | 124 | GRAVELS WITH LITTLE CLAY |
| 124 | 134 | GRAVELS |

### Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** LARRY GAGNON
**Company:** OKEEFE DRILLING CO
**License No:** WWD-126
**Date Completed:** 6/26/2007

# Well #7 / 76M 40147 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 12:48:39 PM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 7**
**GWIC Id: 132856**

## Section 1: Well Owner(s)

1) MONTANA POWER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [04/12/1958]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 29 | NE¼ SE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.853982 | -114.021679 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Saturday, April 12, 1958

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 110 | 14 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 95 | 109 | 14 | | 1/2X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 110
Static Water Level: 58
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after 24 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 85 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 5 | TOPSOIL AND BOULDERS |
| 5 | 58 | CLAY- GRAVEL AND BOULDERS |
| 58 | 60 | WATER- SAND- GRAVEL AND COBBLESTONES |
| 60 | 79 | CLAY- GRAVEL AND WATER |
| 79 | 80 | CLAY AND GRAVEL |
| 80 | 94 | WATER- CLAY AND BIG GRAVEL |
| 94 | 98 | WATER- SAND AND GRAVEL |
| 98 | 110 | WATER- SAND AND BIG GRAVEL |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** -
**Date Completed:** 4/12/1958

# Well #8 / 76M 40148 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/3/2009 11:58:04 AM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 08**
**GWIC Id: 132857**

## Section 1: Well Owner(s)

1) MONTANA POWER COMPANY (MAIL)
E BROADWAY
MISSOULA MT 59803 [07/10/1954]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 32 | NE¼ NW¼ |

**County**

MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.846879 | -114.032292 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, August 10, 1954

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 117 | 12 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 71 | 14 | 12 | | | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 117
Static Water Level: 50
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after 24 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 90 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 2 | FILL DIRT |
| 2 | 42 | GRAVEL AND SOME CLAY |
| 42 | 51 | GRAVEL-SOME WATER |
| 51 | 94 | GRAVEL AND CLAY-LOTS OF WATER |
| 94 | 100 | GRAVEL AND CLAY-LITTLE WATER |
| 100 | 109 | SAND AND GRAVEL LOTS OF WATER |
| 109 | 112 | GRAVEL W/CLAY |
| 112 | 117 | GRAVEL AND SAND-WATER |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 8/10/1954

# Well #9 / 76H 40149 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View water quality for this site
View scanned well log (3/3/2009 12:10:24 PM)


**Site Name: MOUNTAIN WATER COMPANY * WELL 09**
**GWIC Id: 69353**

### Section 1: Well Owner(s)

1) MISSOULA WATER (MAIL)
N/A
MISSOULA MT N/A [10/22/1999]
2) MOUNTAIN WATER CO (MAIL)
2301 DIXON AVE
MISSOULA MT N/A [01/01/1980]
3) THE MONTANA POWER COMPANY (MAIL)
40 E BROADWAY
BUTTE MT 59701 [09/02/1954]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 32 | NW¼ NE¼ NW¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.840992 | -114.036931 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3131.9 | | | |

**Addition:** **Block:** **Lot:**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Thursday, September 02, 1954

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 17 | 12 | | | | |
| 17 | 132 | 12 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 78 | 79 | 12 | | | MILLS KNIFE |
| 80 | 87 | 12 | | | MILLS KNIFE |
| 112 | 116 | 12 | | | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 132
Static Water Level: 44
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after 24 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 90 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 14 | GRAVEL AND CLAY |
| 14 | 16 | SAND |
| 16 | 44 | GRAVEL AND LCAY |
| 44 | 74 | SAND-GRAVEL W/CLAY-LITTLE WATER |
| 74 | 78 | GRAVEL W/CLAY-LITTLE WATER |
| 78 | 88 | GRAVEL W/LITTLE SAND & WATER |
| 88 | 111 | GRAVEL AND CLAY - LITTLE WATER |
| 111 | 115 | SAND-GRAVEL AND WATER |
| 115 | 128 | CLAY-GRAVEL AND BOULDERS |
| 128 | 132 | GRAVEL AND BOULDERS W/WATER |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-213
**Date Completed:** 9/2/1954

# Well #10 / 76M 40150 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 11:53:57 AM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 10**
**GWIC Id: 132850**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
1520 HILDA AVE
MISSOULA MT 59801 [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [06/18/1957]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 27 | NE¼ SE¼ SW¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.85751 | -113.9932 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3116.1 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, June 18, 1957

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 147.8 | 12 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 95 | 100 | 12 | | 3/8X3 | MILLS KNIFE |
| 110 | 120 | 12 | | 3/8X3 | MILLS KNIFE |
| 135 | 146 | 12 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 147.7
Static Water Level: 70
Water Temperature:

**Unknown Test Method** *

Yield 1200 gpm.
Pumping water level 90 feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 10 | SOIL- GRAVEL- SAND LOOSE FORMATION |
| 10 | 60 | CLAY- COARSE GRAVEL AND SAND- SOME SMALL BOULDERS WITH CLAY- TIGHT FORMATION |
| 60 | 70 | CLAY- MEDIUM TO COARSE GRAVEL AND SAND |
| 70 | 77 | FAIRLY LOOSE GRAVEL- SAND AND SOME CLAY |
| 77 | 95 | FINE TO MEDIUM GRAVEL AND SAND |
| 95 | 112 | THIN LAYERS OF CLAY- SAND AND LOOSE ROCK WITH H2O |
| 112 | 123 | SMALL BOULDERS SAND AND SOME CLAY WITH WATER |
| 123 | 130 | CLAY AND BOULDER |
| 130 | 132 | SAND |
| 132 | 147.8 | COARSE GRAVEL AND SAND WITH WATER |
| | | |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 6/18/1957

# Well #11 / 76M 40151 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/25/2009 10:13:20 AM)

**Site Name: MOUNTAIN WATER COMPANY - WELL 10**
**GWIC Id: 132860**
**DNRC Water Right: W040151-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [07/04/1957]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 33 | NE¼ SW¼ SW¼ NE¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8432 | -114.0048 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3149.5 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, July 04, 1957

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 118.5 | 12 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 90 | 115 | 12 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 118.5
Static Water Level: 56
Water Temperature:

**Unknown Test Method** *

Yield 1200 gpm.
Pumping water level 90 feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 8 | BLACK MUCK AND GRAVEL |
| 8 | 54 | YELLOW CLAY AND GRAVEL |
| 54 | 56 | SAND & SMALL GRAVEL-SOME WATER |
| 56 | 77 | CLAY AND GRAVEL |
| 77 | 86 | SAND & SMALL GRAVEL-SOME WATER |
| 86 | 115 | SAND & LARGE GRAVEL W/WATER |
| 115 | 117 | CLAY AND GRAVEL |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** -
**Date Completed:** 7/4/1957

# Well #12 / 76M 40152 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 11:08:22 AM)

**Site Name: MOUNTAIN WATER MISSOULA DIV. * WELL #12**
**GWIC Id: 132848**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER MISSOULA DIV (MAIL)
N/A
MISSOULA MT 59801 [10/22/1999]
2) MONTANA POWER CO (MAIL)
N/A
MISSOULA MT 59803 [04/27/1964]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 24 | NW¼ SW¼ NW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8758 | -113.9436 | UNKNOWN | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3280 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Monday, April 27, 1964

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.9 | 107.9 | 12 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 80 | 100 | 12 | | | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 107.8
Static Water Level: 69
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after 3 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 3 | TOPSOIL |
| 3 | 65 | CLAY AND GRAVEL |
| 65 | 77 | SAND- GRAVEL AND SOME WATER |
| 77 | 93 | SAND- GRAVEL AND WATER |
| 93 | 95 | SAND- GRAVEL- CLAY AND WATER |
| 95 | 106 | SAND- GRAVEL BROKEN ROCK AND WATER |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 4/27/1964

# Well #13 / 76M 40153 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/6/2009 1:40:44 PM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 13**
**GWIC Id: 68519**

## Section 1: Well Owner(s)

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 14 | NW¼ |

**County** MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.88896 | -113.971225 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method:
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, January 01, 1964

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 0 | 12 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 70 | 78 | 0 | | | |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 127
Static Water Level: 25
Water Temperature:

**Unknown Test Method** *

Yield 800 gpm.
Pumping water level 85 feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

Lithology Data

There are no lithologic details assigned to this well.

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:**
**License No:** -0
**Date Completed:** 1/1/1964

# Well #15 / 76M 40154 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/6/2009 12:38:34 PM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 15**
**GWIC Id: 68453**

## Section 1: Well Owner(s)

1) MONTANA POWER CO. (MAIL)
N/A
MISSOULA MT N/A [12/22/1965]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 12 | NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.903432 | -113.949685 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, December 22, 1965

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2.5 | 104 | 12 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 88 | 97 | 12 | | 6 IN | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 151
Static Water Level: 75
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
150 gpm pump rate with _ feet of drawdown after 4 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 86 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 59 | DIRT AND BOULDERS |
| 59 | 63 | TAN CLAY GRAVEL AND BOULDERS |
| 63 | 86 | CLAY AND GRAVEL |
| 86 | 87 | GRAVEL BOULDERS AND WATER |
| 87 | 97 | GRAVEL AND WATER |
| 97 | 99 | GRAVEL AND WATER |
| 99 | 103 | BLUE CLAY AND SMALL GRAVEL |
| 103 | 123 | TIGHT PURPLE CLAY AND GRAVEL |
| 123 | 137 | FRACTURED ROCK AND CLAY |
| 137 | 151 | MULTI-COLORED ROCK. |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 12/22/1965

# Well #16 / 76H 40155 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/13/2009 9:05:33 AM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 16**
**GWIC Id: 132828**

### Section 1: Well Owner(s)

1) MONTANA POWER CO (MAIL)
N/A
N/A N/A N/A [06/22/1966]
2) MOUNTAIN WATER COMPANY (MAIL)
4401 24TH ST
MISSOULA MT N/A [06/22/1966]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 19W | 6 | SE¼ SW¼ NE¼ NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8656 | -114.038 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3158.2 | | | |

**Addition** **Block** **Lot**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Wednesday, June 22, 1966

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 120 | 12 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 101 | 119 | 12 | | | PERFORATED CASING |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 120
Static Water Level:
Water Temperature:

**Unknown Test Method** *

Yield 1500 gpm.
Pumping water level _ feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 3 | TOPSOIL |
| 3 | 41 | GRAVEL AND YELLOW CLAY |
| 41 | 57 | WATER GRAVEL SAND AND CLAY |
| 57 | 62 | SAND AND WATER |
| 62 | 80 | GRAVEL SAND AND WATER |
| 80 | 87 | CLAY AND GRAVEL |
| 87 | 89 | WATER FINE SAND CLAY |
| 89 | 97 | HEAVY GRAVEL WATER FINE SAND SOME CLAY |
| 97 | 117 | GRAVEL SAND AND WATER |
| 117 | 120 | GRAVEL SAND WATER AND TRACE OF CLAY |
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### Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 6/22/1966

# Well #18 / 76H 40156 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/13/2009 9:06:49 AM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 18**
**GWIC Id: 66872**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
4101 GHARRETT ST
MISSOULA MT N/A [08/06/1968]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 19W | 6 | NW¼ NW¼ NW¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.833919 | -114.045254 | TRS-SEC | NAD83 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3093.7 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, August 06, 1968

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.5 | 105 | 16 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 95 | 103 | 16 | | | 3/8X4 MILLS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 105
Static Water Level: 31
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1000 gpm pump rate with _ feet of drawdown after 7.5 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 38 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 4 | TOPSOIL |
| 4 | 29 | CLAY & GRAVEL |
| 29 | 60 | WATER SAND GRAVEL |
| 60 | 64 | CLAY & GRAVEL |
| 64 | 80 | WATER SAND & GRAVEL |
| 80 | 83 | CLAY & GRAVEL |
| 83 | 87 | SAND & FINE GRAVEL WATER |
| 87 | 105 | SAND LARGE GRAVEL WATER |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 8/6/1968

# Well #19 / 76M 40157 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/6/2009 12:01:56 PM)

**Site Name: MOUNTAIN WATER COMPANY - WELL 18**
**GWIC Id: 151948**
**DNRC Water Right: W040157-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
1250 N RUSSELL
MISSOULA MT 59803 [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
E BROADWAY
MISSOULA MT 59803 [04/30/1969]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 16 | SW¼ NW¼ NW¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8836 | -114.0174 | MAP | NAD27 |

**Ground Surface Altitude:** **Ground Surface Method:** **Datum:** **Date:**

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN DRILL
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, April 30, 1969

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 109.5 | 16 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 85 | 105 | 16 | | | 3/8X4 MILLS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 109.5
Static Water Level: 48
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1000 gpm pump rate with _ feet of drawdown after 2 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 51.5 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 1 | TOPSOIL AND GRAVEL |
| 1 | 33 | GRAVEL AND CLAY |
| 33 | 41 | BOULDERS & GRAVEL |
| 41 | 55 | CLAY & GRAVEL |
| 55 | 65 | CLAY GRAVEL & WATER |
| 65 | 109.5 | GRAVEL WATER SAND |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 4/30/1969

# Well #21 / 76M 40159 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 11:55:14 AM)

**Site Name: MOUNTAIN WATER COMPANY - WELL 20**
**GWIC Id: 132851**
**DNRC Water Right: W040159-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
335 E CENTRAL
MISSOULA MT 59803 [10/22/1999]
2) MONTANA POWER CO (MAIL)
N/A
MISSOULA MT 59803 [06/17/1969]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 27 | SE¼ NE¼ SW¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8508 | -113.9925 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3114.2 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, June 17, 1969

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 137 | 16 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 90 | 96 | 16 | | 3/8X3 | MILLS KNIFE |
| 112 | 132 | 16 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 137
Static Water Level: 58
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
1000 gpm pump rate with _ feet of drawdown after 0.5 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 63.7 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 40 | GRAVEL AND CLAY |
| 40 | 47 | CLAY |
| 47 | 72 | GRAVEL AND CLAY |
| 72 | 83 | CLAY AND SAND |
| 83 | 101 | WATER- GRAVEL AND SAND |
| 101 | 108 | GRAVEL AND CLAY |
| 108 | 137 | GRAVEL- SAND- WATER |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 6/17/1969

# Well #22 / 76M 40160 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/31/2009 4:38:12 PM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 22**
**GWIC Id: 132841**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
720 CREGG LANE
MISSOULA MT N/A [10/22/1999]
2) MONTANA POWER (MAIL)
N/A
MISSOULA MT N/A [12/01/1949]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 21 | NW¼ SW¼ SW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8722 | -114.0077 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3118.6 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, December 01, 1949

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 92 | 12 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 62 | 72 | 12 | | 3/8X3 | MILLS KNIFE |
| 82 | 92 | 12 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 92
Static Water Level: 23
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after 5 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 23.5 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | TOPSOIL AND GRAVEL |
| 6 | 15 | CLAY |
| 15 | 29 | CLAY AND GRAVEL |
| 29 | 38 | SAND AND GRAVEL |
| 38 | 41 | GRAVEL- SAND AND WATER |
| 41 | 48 | GRAVEL AND WATER |
| 48 | 52 | TIGHT GRAVEL AND SAND SOME CLAY |
| 52 | 60 | CLAY AND GRAVEL |
| 60 | 72 | BOULDERS- GRAVEL AND WATER |
| 72 | 80 | CLAY AND GRAVEL |
| 80 | 92 | GRAVEL SAND AND WATER |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 12/1/1949

# Well #23 / 76M 40161 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View water quality for this site
View scanned well log (2/25/2009 10:25:55 AM)


**Site Name: MOUNTAIN WATER COMPANY - WELL 22**
**GWIC Id: 132025**
**DNRC Water Right: W040161-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
345 PATTEE CREEK
MISSOULA MT 59803 [10/22/1999]
2) MOSBYS INC (MAIL)
N/A
MISSOULA MT 59803 [09/24/1945]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 33 | NE¼ NE¼ NW¼ SE¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8415 | -114.0025 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3133.7 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: SCREW
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Monday, September 24, 1945

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 116.2 | 8 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 105 | 113 | 8 | | | 3/8X1 PERFS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 116.2
Static Water Level:
Water Temperature:

**Unknown Test Method** *

Yield 300 gpm.
Pumping water level _ feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 4 | TOPSOIL |
| 4 | 20 | GRAVEL AND SOIL |
| 20 | 30 | GRAVEL |
| 30 | 55 | CLAY |
| 55 | 76 | CLAY AND GRAVEL |
| 76 | 87 | SAND GRAVEL AND CLAY |
| 87 | 96 | MORE CLAY AND SAND |
| 96 | 98 | GRAVEL- CLAY- WATER |
| 98 | 100 | TIGHT GRAVEL |
| 100 | 116 | LITTLE WATER SAND GRAVEL |
| | | |
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## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** ULRICH
**License No:** -
**Date Completed:** 9/24/1945

# Well #24 / 76M 40162 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View water quality for this site
View scanned well log (2/25/2009 10:22:51 AM)


**Site Name: MOUNTAIN WATER COMPANY - WELL 23**
**GWIC Id: 69412**
**DNRC Water Right: W040161-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
345 PATTEE CREEK
MISSOULA MT 59803 [10/22/1999]
2) FAIRVIEW DEV CO (MAIL)
340 WEST MAIN
MISSOULA MT 59803 [07/01/1948]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 33 | NW¼ NW¼ NW¼ NE¼ SE¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8364 | -114.0013 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3129.5 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method:
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, July 01, 1948

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 95 | 120 | 8 | | | | |

There are no completion records assigned to this well.

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 120
Static Water Level: 72
Water Temperature:

**Unknown Test Method** *

Yield 450 gpm.
Pumping water level _ feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 72 | CLAY GRAVEL |
| 72 | 94 | GRAVEL SAND WATER |
| 97 | 101 | CLAY AND WATER |
| 101 | 120 | GRAVEL WATER |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:**
**License No:** -
**Date Completed:** 7/1/1948

# Well #25 / 76M 40163 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View water quality for this site
View scanned well log (2/25/2009 10:21:27 AM)


**Site Name: MOUNTAIN WATER COMPANY - WELL 24**
**GWIC Id: 132861**
**DNRC Water Right: W040163-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
3800 STEPHENS AVE
MISSOULA MT 59803 [10/22/1999]
2) MOSBY, ARTHUR.J (MAIL)
N/A
MISSOULA MT 59803 [08/27/1966]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 33 | NE¼ NW¼ SE¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8378 | -114.011 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3154.9 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Saturday, August 27, 1966

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 146 | 14 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 90 | 127 | 14 | | | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 146
Static Water Level: 45.3
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1000 gpm pump rate with _ feet of drawdown after 28.5 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 73 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | SANDY SOIL |
| 6 | 13 | SAND & GRAVEL MIXED IN BROWN CLAY |
| 13 | 15 | CLEAN GRAVEL |
| 15 | 55 | GRAVEL IMBEDDED IN TAN CLAY |
| 55 | 78 | FINE GRAY SAND & GRAVEL.SOME WATER |
| 78 | 86 | RED TO TAN CLAY |
| 86 | 90 | GRAVEL IMBEDDED IN TAN CLAY |
| 90 | 99 | COARSE SAND & GRAVEL. WATER. |
| 99 | 101 | BOULDERS |
| 101 | 127 | FINE TO COARSE SAND & GRAVEL.WATER. |
| 127 | 137 | FINE TO COARSE SAND & GRAEL.SOME TAN CLAY.WATER. |
| 137 | 146 | SAND & GRAVEL MIXED IN GRAY CLAY. |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** LIBERTY DRILLING & PUMP CO
**License No:** WWC-52
**Date Completed:** 8/27/1966

# Well #26 / 76H 40164 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/3/2009 11:54:22 AM)


**Site Name: MOUNTAIN WATER COMPANY - WELL 25**
**GWIC Id: 132834**
**DNRC Water Right: W040164-00**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
1550 BENTON AVE
MISSOULA MT 59803 [10/22/1999]
2) MONTANA POWER CO. (MAIL)
BENTON AVE
MISSOULA MT 59803 [06/02/1971]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 32 | SE¼ NW¼ SE¼ NE¼ NE¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8463 | -114.0191 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3151.3 | | | |

**Addition:** **Block:** **Lot:**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Friday, July 02, 1971

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 125 | 16 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 100 | 120 | 16 | | | 5/8X4 IN HOLES |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 125
Static Water Level: 38
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1275 gpm pump rate with _ feet of drawdown after 8 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 40.5 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 24 | COBBLESTONES & GRAVEL & CLAY |
| 24 | 46 | BROWN CLAY & GRAVEL |
| 46 | 57 | GRAVEL- SAND & WATER |
| 57 | 70 | BIG GRAVEL- SAND- WATER |
| 70 | 84 | SAND- SMALL GRAVEL & WATER |
| 84 | 104 | GRAVEL- SOME SAND- WATER |
| 104 | 108 | SAND- GRAVEL- WATER |
| 108 | 125 | BIG GRAVEL- SAND- WATER |
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### Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 7/2/1971

# Well #27 / 76M 40165 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/11/2009 12:45:44 PM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 27**
**GWIC Id: 132844**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
1315 26TH AVE
MISSOULA MT 59801 [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [04/10/1972]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 30 | NE¼ NW¼ SE¼ NE¼ |

**County**: MISSOULA
**Geocode**:

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8587 | -114.0424 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3142.1 | | | |

**Addition**: **Block**: **Lot**:

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: UNKNOWN
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Monday, April 10, 1972

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -3 | 125 | 16 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 92 | 118 | 16 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 125
Static Water Level:
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
_1475_ gpm pump rate with _ feet of drawdown after _ hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 2 | BROWN TOPSOIL AND GRAVEL |
| 2 | 53 | BROWN CLAY AND GRAVEL |
| 53 | 62 | GRAVEL SAND AND WATER |
| 62 | 75 | TAN CLAY AND GRAVEL |
| 75 | 98 | GRAVEL SAND AND WATER |
| 98 | 109 | BIG GRAVEL CLAY AND WATER |
| 109 | 119 | SAND GRAVEL AND WATER |
| 119 | 125 | CLAY- GRAVEL- SAND AND WATER |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 4/10/1972

# Well #29 / 76H 40166 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/23/2009 10:04:55 AM)

**Site Name: MOUNTAIN WATER COMPANY - WELL 28**
**GWIC Id: 67046**
**DNRC Water Right: W040166-00**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
4701 ORCHARD AVE
MISSOULA MT N/A [06/20/1973]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 20W | 1 | SE¼ SW¼ SE¼ NE¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8278 | -114.0476 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3076 | | | |

**Addition:** **Block:** **Lot:**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CHURN
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Wednesday, June 20, 1973

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.7 | 136 | 16 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 100 | 125 | 16 | | | 3/8X3 MILLS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 136
Static Water Level: 24
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1000 gpm pump rate with _ feet of drawdown after 4 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 35 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 1 | BLACK DIRT |
| 1 | 5 | SANDY CLAY |
| 5 | 15 | SAND AND GRAVEL |
| 15 | 24 | SAND GRAVEL & SEEPS OF WATER |
| 24 | 33 | CLAY AND GRAVEL |
| 33 | 35 | SAND AND WATER |
| 35 | 49 | SAND GRAVEL AND WATER |
| 49 | 64 | SAND AND CLAY |
| 64 | 68 | SAND SMALL GRAVEL & WATER |
| 68 | 75 | CLAY AND GRAVEL |
| 75 | 78 | SAND WATER |
| 78 | 84 | SAND GRAVEL & WATER |
| 84 | 90 | SAND GRAVEL WATER WITH SEAMS OF CLAY |
| 90 | 125 | SAND GRAVEL & WATER |
| 125 | 136 | GRAY CLAY & GRAVEL |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 6/20/1973

# Well #38 / 76H 107536 00 and 76H 70436 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
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**Site Name: MOUNTAIN WATER COMPANY - WELL 39**
**GWIC Id: 66867**
**DNRC Water Right: P070436-00**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
P.O. BOX 4826
MISSOULA MT 59806 [01/11/1995]
2) CURAN CONSTRUCTION (MAIL)
BOX 1206
MISSOULA MT 59801 [06/16/1971]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 19W | 6 | NE¼ NE¼ SE¼ NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8304 | -114.0348 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3190 | | | |

| Addition | Block | Lot |
|---|---|---|
| HILLVIEW HEIGHTS | 3 | 1 |

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Wednesday, June 16, 1971

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -3 | 90 | 18 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 90 | 125.5 | 18 | | | JOHNSON WIRE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 125.5
Static Water Level: 26
Water Temperature:

**Air Test** *

2000 gpm with drill stem set at _ feet for 40 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 66 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | BROWN TOPSOIL |
| 6 | 11 | COBBLESTONES GRAVEL |
| 11 | 31 | COBBLESTONES GRAVEL & BOULDERS |
| 31 | 53 | SAND & GRAVEL MIXED IN TAN SILTY CLAY |
| 53 | 61 | SAND GRAVEL & COBBLESTONES EMBEDDED IN TAN CLAY |
| 61 | 89 | SAND & GRAVEL |
| 89 | 109 | COARSE SAND & GRAVEL |
| 109 | 119 | SAND GRAVEL & LARGE COBBLESTONES |
| 119 | 125 | SAND & GRAVEL EMBEDDED IN CLAY |
| 125 | 125.5 | CLAY |
| | | |
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### Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** OSBORNE
**License No:** WWC-52
**Date Completed:** 6/16/1971

# Well #39 / 76H 107536 00 and 76H 70436 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
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**Site Name: MOUNTAIN WATER COMPANY**
**GWIC Id: 154873**

## Section 1: Well Owner(s)

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 19W | 6 | SW¼ SW¼ NW¼ NE¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8309 | -114.0394 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3190 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water
PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work
Drilling Method: CABLE AND ROTARY
Status: NEW WELL

## Section 5: Well Completion Date
Date well completed: Wednesday, June 16, 1971

## Section 6: Well Construction Details
There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.3 | 90 | 18 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 90 | 120 | 18 | | | 0.1 JOHNSON WIR |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 125.5
Static Water Level: 25.75
Water Temperature:

**Air Test** *

2000 gpm with drill stem set at _ feet for 40 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 66 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**
112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | BROWN TOPSOIL |
| 6 | 11 | COBBLESTONES AND GRAVEL |
| 11 | 31 | COBBLESTONES GRAVEL AND BOULDERS |
| 31 | 53 | SAND AND GRAVEL MIXED IN TAN SILTY CLAY |
| 53 | 61 | SAND GRAVEL AND COBBLESTONES EMBEDDED IN TAN CLAY |
| 61 | 89 | SAND AND GRAVEL |
| 89 | 109 | COARSE SAND AND GRAVEL |
| 109 | 119 | SAND GRAVEL AND LARGE COBBLESTONES |
| 119 | 125 | SAND AND GRAVEL EMBEDDED IN CLAY |
| 125 | 125.5 | CLAY |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** LIBERTY DRILLING & PUMP CO
**License No:** -0
**Date Completed:** 6/16/1971

# Well #41 / 76M 108816 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


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View field visits for this site
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**Site Name: MISSOULA WATER WORKS - EAST WELL 1**
**GWIC Id: 68413**
**DNRC Water Right: P091259-00**

## Section 1: Well Owner(s)

1) MISSOULA WATER WORKS (MAIL)
3333 E CLARK RD
MISSOULA MT N/A [11/15/2000]
2) AMERICAN CRYSTAL SUGAR CO. (MAIL)
N/A
MISSOULA MT N/A [09/26/1962]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 17 | SE¼ NE¼ SW¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8872 | -114.0347 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3174 | | | 11/15/2000 |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE TOOLS
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, September 26, 1962

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 218 | 16 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 8 | 213 | 16 | | | | 63 LB STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 107 | 115 | 16 | | 3/8X3 | MILLS KNIFE |
| 121 | 147 | 16 | | 3/8X3 | MILLS KNIFE |
| 192 | 208 | 16 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 218
Static Water Level: 29.5
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
4120 gpm pump rate with _ feet of drawdown after 144 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 36 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

WELL CONSTRUCTED IN 8 FT DEEP PIT. CASING STRING STARTS AT 8 FT BELOW LAND SURFACE

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 8 | PIT |
| 8 | 36 | SAND GRAVEL AND COBBLESTONES SOME DIRT MIXED IN |
| 36 | 39 | GRAVEL MIXED IN TAN CLAY |
| 39 | 64 | SAND AND GRAVEL |
| 64 | 76 | FINE TO COARSE SAND FEW SCATTERED GRAVELS IN TAN SILT |
| 76 | 79 | GRAVEL IMBEDDED IN TAN SILT |
| 79 | 83 | COARSE GRAVEL AND COBBLESTONES MIXED IN FINE SAND |
| 83 | 88 | FINE TO COARSE SAND |
| 88 | 107 | SAND AND GRAVEL IMBEDDED IN TAN SILT |
| 107 | 115 | CLEAN COARSE SAND AND GRAVEL |
| 115 | 121 | SAND AND GRAVEL MIXED IN TAN SILT |
| 121 | 147 | CLEAN COARSE SAND AND GRAVEL |
| 147 | 156 | SAND AND GRAVEL IMBEDDED IN TAN SILT |
| 156 | 167 | TAN STICKY CLAY |
| 167 | 191 | GREEN STICKY CLAY FEW STRAY GRAVELS IMBEDDED |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** LIBERTY DRILLING & PUMP CO
**License No:** WWC-52
**Date Completed:** 9/26/1962

**Site Name: MISSOULA WATER WORKS - EAST WELL 1**
**GWIC Id: 68413**
**Additional Lithology Records**

| From | To | Description |
|---|---|---|
| 191 | 208 | CLEAN COARSE SAND AND GRAVEL |
| 208 | 218 | GRAY CLAY |

# Well #42 / 76M 108816 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


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**Site Name: MISSOULA WATER WORKS - WEST WELL 2**
**GWIC Id: 68599**
**DNRC Water Right: P031907-00**

### Section 1: Well Owner(s)

1) MISSOULA WATER WORKS (MAIL)
3333 E CLARK RD
MISSOULA MT N/A [11/15/2000]
2) VALLEY WEST WATER COMPANY (MAIL)
SUITE D - 2806 GARFIELD
MISSOULA MT N/A [06/01/1981]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 17 | SW¼ NE¼ SW¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8872 | -114.0367 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3172 | | | 11/15/2000 |

**Addition:** **Block:** **Lot:**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Monday, June 01, 1981

### Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 171 | 16 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.5 | 170 | 16 | | | | 62.5 LB STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 127 | 147 | 16 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 15 | CEMENT | |

### Section 7: Well Test Data

Total Depth: 171
Static Water Level: 35
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1500 gpm pump rate with _ feet of drawdown after 2 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 37 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

TOTAL OF 240 HOLES IN PERFORATIONS.

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 26 | CLAY GRAVEL AND COBBLESTONES |
| 26 | 44 | SANDY CLAY AND GRAVEL |
| 44 | 70 | SILTY CLAY SAND GRAVEL AND WATER |
| 70 | 87 | TAN CLAY SAND GRAVEL AND WATER |
| 87 | 93 | SAND AND WATER |
| 93 | 159 | SAND GRAVEL AND WATER |
| 159 | 171 | YELLOW CLAY AND GRAVEL |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 6/1/1981

# Well #30 / 76M 706 00 and 76M 53868 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

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**Site Name: MOUNTAIN WATER COMPANY - WELL 29**
**GWIC Id: 132845**
**DNRC Water Right: P000706-00**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
101 BANK ST
MISSOULA MT 59801 [10/22/1999]
2) MONTANA POWER COMPANY (MAIL)
N/A
MISSOULA MT 59803 [01/25/1974]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | NE¼ NW¼ SW¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8661 | -113.9945 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3129.5 | | | |

**Addition:** **Block:** **Lot:**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Friday, January 25, 1974

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 160.5 | 18 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 80 | 96 | 18 | | | 3/8X3 SLOT PERF |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 176
Static Water Level: 31.3
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1200 gpm pump rate with _ feet of drawdown after 4 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 41.5 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | FILL |
| 6 | 16 | ROCK AND GRAVEL |
| 16 | 40 | CLAY AND GRAVEL |
| 40 | 50 | SAND- GRAVEL SOME CLAY W/WATER |
| 50 | 55 | CLAY- GRAVEL |
| 55 | 73 | GRAVEL- SAND & WITH CLAY BALLS WATER |
| 73 | 78 | SAND AND CLAY |
| 78 | 98 | CLAY- GRAVEL- BOULDERS & WATER |
| 98 | 108 | CLAY |
| 108 | 115 | CLAY AND GRAVEL |
| 115 | 150 | TIGHT CLAY- SAND & GRAVEL |
| 150 | 152 | CLAY AND GRAVEL |
| 152 | 158 | GRAY CLAY AND SAND |
| 158 | 176 | CLAY AND SHARP ROCK |
| | | |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 1/25/1974

# Well #31 / 76M 5452 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

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**Site Name: MOUNTAIN WATER COMPANY * WELL #30**
**GWIC Id: 69073**
**DNRC Water Right: P005452-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER SUPPLY (MAIL)
311 KIWANIS ST
MISSOULA MT N/A [10/22/1999]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | NW¼ NE¼ SW¼ SW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8666 | -113.9934 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3122.6 | | | |

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, December 10, 1976

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.5 | 135 | 18 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 101 | 117 | 18 | | | 3/8X3 SLOTS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 135
Static Water Level: 32
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
4100 gpm pump rate with _ feet of drawdown after 2 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 47 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 15 | FILL |
| 15 | 51 | GRAVEL AND CLAY |
| 51 | 80 | GRAVEL SAND AND WATER |
| 80 | 92 | CLAY AND SILT |
| 92 | 118 | GRAVEL AND WATER |
| 118 | 135 | CLAY AND GRAVEL SILT |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-239
**Date Completed:** 12/10/1976

# Well #32 / 76M 5604 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


Return to menu
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**Site Name: MOUNTAIN WATER COMPANY * WELL 32**
**GWIC Id: 69078**
**DNRC Water Right: C005604-00**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER SUPPLY (MAIL)
540 S. 5TH E.
MISSOULA MT N/A [08/17/1976]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | SW¼ NE¼ SE¼ SW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8657 | -113.9892 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3133.7 | | | |

**Addition** **Block** **Lot**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Tuesday, August 17, 1976

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 139.5 | 18 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 100 | 125 | 18 | | | 3/8X3 SLOTS |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 139.5
Static Water Level: 43.8
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1500 gpm pump rate with _ feet of drawdown after 3 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 44.3 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 21 | CLAY GRAVEL BOULDERS AND FILL |
| 21 | 40 | CLAY GRAVEL AND BOULDERS |
| 40 | 129 | GRAVEL BOULDERS AND WATER |
| 129 | 139.5 | CLAY |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-239
**Date Completed:** 8/17/1976

# Well #33 / 76M 6616 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

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**Site Name: MOUNTAIN WATER COMPANY - WELL 32**
**GWIC Id: 69077**
**DNRC Water Right: P010378-00**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
500 GERALD
MISSOULA MT 59801 [08/17/1977]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | NE¼ NW¼ SW¼ SW¼ |

**County**

MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8663 | -113.995 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3127.7 | | | |

**Addition** **Block** **Lot**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Wednesday, August 17, 1977

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -4 | 147 | 18 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 118 | 138 | 18 | | | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 147
Static Water Level: 51.5
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
2000 gpm pump rate with _ feet of drawdown after 1 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 52.4 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | BLACK DIRT AND GRAVEL |
| 6 | 15 | CLAY GRAVEL AND COBBLESTONES |
| 15 | 58 | CLAY AND GRAVEL |
| 58 | 65 | SAND GRAVEL AND WATER |
| 65 | 80 | GRAVEL BOULDERS AND WATER |
| 80 | 88 | SAND SMALL GRAVEL AND WATER |
| 88 | 92 | SAND GRAVEL AND WATER |
| 92 | 96 | SMALL GRAVEL AND WATER |
| 96 | 100 | CLAY AND GRAVEL |
| 100 | 104 | SILTY CLAY |
| 104 | 113 | TIGHT CLAY AND BOULDERS |
| 113 | 116 | SAND GRAVEL AND WATER |
| 116 | 147 | GRAVEL AND WATER |
| | | |
| | | |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-239
**Date Completed:** 8/17/1977

# Well #34 / 76M 10378 00 and 76M 53872 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/26/2009 12:07:16 PM)

**Site Name: MOUNTAIN WATER COMPANY - WELL 33**
**GWIC Id: 69063**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
1903 RUSSELL
MISSOULA MT 59801 [02/10/1978]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 22 | SE¼ NE¼ SE¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8657 | -113.9864 | MAP | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3119.6 | | | |

| Addition | Block | Lot |
|---|---|---|
| MONTANA | 16 | 15 |

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Friday, February 10, 1978

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -3 | 196 | 18 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 80 | 104 | 18 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 196
Static Water Level: 40.8
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1400 gpm pump rate with _ feet of drawdown after 2 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 41.9 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 2 | TOPSOI |
| 2 | 43 | SAND GRAVEL AND CLAY |
| 15 | 186 | SAND GRAVEL AND WATER |
| 43 | 78 | GRAVEL AND WATER |
| 78 | 104 | SAND GRAVEL AND WATER |
| 104 | 110 | FINE BROWN SAND GRAVEL AND WATER |
| 110 | 118 | FINE BROWN SAND AND CLAY |
| 118 | 151 | FINE BROWN SAND CLAY AND GRAVEL |
| 186 | 196 | TAN CLAY |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-239
**Date Completed:** 2/10/1978

# Well #35 / 76H 14489 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/3/2009 11:59:53 AM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 35**
**GWIC Id: 132858**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
2650 KEMP
MISSOULA MT 59803 [10/22/1999]
2) THE MONTANA POWER COMPANY (MAIL)
1903 RUSSELL
MISSOULA MT 59803 [07/18/1978]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 32 | SE¼ NE¼ NW¼ |

**County**
MISSOULA

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.845973 | -114.030967 | TRS-SEC | NAD83 |

**Ground Surface Altitude** **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, July 18, 1978

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -4 | 145 | 18 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 104 | 129 | 18 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 145
Static Water Level: 32.5
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
2000 gpm pump rate with _ feet of drawdown after 1 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 36.5 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 6 | GRAVEL- SAND AND CLAY |
| 6 | 25 | GRAVEL AND BOULDERS |
| 25 | 38 | GRAVEL- BOULDERS & CLAY |
| 38 | 42 | GRAVEL- CLAY SOME WATER |
| 42 | 57 | GRAVEL- SAND & WATER |
| 57 | 70 | GRAVEL- SAND- LOTS OF WATER |
| 70 | 85 | GRAVEL AND WATER |
| 85 | 94 | GRAVEL- SEAMS OF CLAY AND WATER |
| 94 | 99 | CLAY AND GRAVEL |
| 99 | 102 | SAND- SMALL GRAVEL & WATER |
| 102 | 127 | SAND- LARGE GRAVEL & WATER |
| 127 | 134.5 | CLAY- GRAVEL & BOULDERS |
| 134.5 | 145 | GRAVEL- SAND & WATER |
| | | |
| | | |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 7/18/1978

# Well #36 / 76M 23029 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

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Plot this site in Google Maps
View scanned well log (4/6/2009 12:02:37 PM)

**Site Name: MOUNTAIN WATER COMPANY - WELL 35**
**GWIC Id: 68567**
**DNRC Water Right: P023029-00**

### Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
1250 DICKENS
MISSOULA MT N/A [10/22/1999]

### Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 16 | NW¼ SE¼ NE¼ SE¼ |

**County** MISSOULA **Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8818 | -114.0013 | MAP | NAD27 |

**Ground Surface Altitude** 3099 **Ground Surface Method** **Datum** **Date**

**Addition** **Block** **Lot**

### Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

### Section 4: Type of Work

Drilling Method:
Status: NEW WELL

### Section 5: Well Completion Date

Date well completed: Tuesday, January 01, 1980

### Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 0 | 16 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 100 | 120 | 0 | | | |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

### Section 7: Well Test Data

Total Depth: 131
Static Water Level: 51
Water Temperature:

**Unknown Test Method** *

Yield 200 gpm.
Pumping water level 51 feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

### Section 8: Remarks

### Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

Lithology Data

There are no lithologic details assigned to this well.

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:**
**License No:** -0
**Date Completed:** 1/1/1980

# Well #41 / 76M 23029 00 and 76M 91259 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**


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Plot this site in Google Maps
View field visits for this site
View scanned well log (4/6/2009 12:28:27 PM)


**Site Name: MISSOULA WATER WORKS - EAST WELL 1**
**GWIC Id: 68413**
**DNRC Water Right: P091259-00**

## Section 1: Well Owner(s)

1) MISSOULA WATER WORKS (MAIL)
3333 E CLARK RD
MISSOULA MT N/A [11/15/2000]
2) AMERICAN CRYSTAL SUGAR CO. (MAIL)
N/A
MISSOULA MT N/A [09/26/1962]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 17 | SE¼ NE¼ SW¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8872 | -114.0347 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3174 | | | 11/15/2000 |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE TOOLS
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, September 26, 1962

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 218 | 16 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 8 | 213 | 16 | | | | 63 LB STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 107 | 115 | 16 | | 3/8X3 | MILLS KNIFE |
| 121 | 147 | 16 | | 3/8X3 | MILLS KNIFE |
| 192 | 208 | 16 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

There are no annular space records assigned to this well.

## Section 7: Well Test Data

Total Depth: 218
Static Water Level: 29.5
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
4120 gpm pump rate with _ feet of drawdown after 144 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 36 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

WELL CONSTRUCTED IN 8 FT DEEP PIT. CASING STRING STARTS AT 8 FT BELOW LAND SURFACE

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 8 | PIT |
| 8 | 36 | SAND GRAVEL AND COBBLESTONES SOME DIRT MIXED IN |
| 36 | 39 | GRAVEL MIXED IN TAN CLAY |
| 39 | 64 | SAND AND GRAVEL |
| 64 | 76 | FINE TO COARSE SAND FEW SCATTERED GRAVELS IN TAN SILT |
| 76 | 79 | GRAVEL IMBEDDED IN TAN SILT |
| 79 | 83 | COARSE GRAVEL AND COBBLESTONES MIXED IN FINE SAND |
| 83 | 88 | FINE TO COARSE SAND |
| 88 | 107 | SAND AND GRAVEL IMBEDDED IN TAN SILT |
| 107 | 115 | CLEAN COARSE SAND AND GRAVEL |
| 115 | 121 | SAND AND GRAVEL MIXED IN TAN SILT |
| 121 | 147 | CLEAN COARSE SAND AND GRAVEL |
| 147 | 156 | SAND AND GRAVEL IMBEDDED IN TAN SILT |
| 156 | 167 | TAN STICKY CLAY |
| 167 | 191 | GREEN STICKY CLAY FEW STRAY GRAVELS IMBEDDED |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** LIBERTY DRILLING & PUMP CO
**License No:** WWC-52
**Date Completed:** 9/26/1962

**Site Name: MISSOULA WATER WORKS - EAST WELL 1**
**GWIC Id: 68413**
**Additional Lithology Records**

| From | To | Description |
|---|---|---|
| 191 | 208 | CLEAN COARSE SAND AND GRAVEL |
| 208 | 218 | GRAY CLAY |

# Well #42 / 76M 23029 00 and 76M 31907 00 and 76M 91259 00

**MONTANA WELL LOG REPORT**

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**Other Options**


Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View field visits for this site
View scanned well log (4/6/2009 12:24:51 PM)


**Site Name: MISSOULA WATER WORKS - WEST WELL 2**
**GWIC Id: 68599**
**DNRC Water Right: P031907-00**

## Section 1: Well Owner(s)

1) MISSOULA WATER WORKS (MAIL)
3333 E CLARK RD
MISSOULA MT N/A [11/15/2000]
2) VALLEY WEST WATER COMPANY (MAIL)
SUITE D - 2806 GARFIELD
MISSOULA MT N/A [06/01/1981]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 17 | SW¼ NE¼ SW¼ NW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8872 | -114.0367 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3172 | | | 11/15/2000 |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Monday, June 01, 1981

## Section 6: Well Construction Details

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 171 | 16 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -1.5 | 170 | 16 | | | | 62.5 LB STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 127 | 147 | 16 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 15 | CEMENT | |

## Section 7: Well Test Data

Total Depth: 171
Static Water Level: 35
Water Temperature:

**Pump Test** *

Depth pump set for test _ feet.
1500 gpm pump rate with _ feet of drawdown after 2 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 37 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

TOTAL OF 240 HOLES IN PERFORATIONS.

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 26 | CLAY GRAVEL AND COBBLESTONES |
| 26 | 44 | SANDY CLAY AND GRAVEL |
| 44 | 70 | SILTY CLAY SAND GRAVEL AND WATER |
| 70 | 87 | TAN CLAY SAND GRAVEL AND WATER |
| 87 | 93 | SAND AND WATER |
| 93 | 159 | SAND GRAVEL AND WATER |
| 159 | 171 | YELLOW CLAY AND GRAVEL |
| | | |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 6/1/1981

# Well #3B / 76M 53867 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (3/19/2009 12:25:50 PM)

**Site Name: MOUNTAIN WATER COMPANY * WELL 36**
**GWIC Id: 132854**
**DNRC Water Right: P053867-00**

## Section 1: Well Owner(s)

1) MOUNTAIN WATER COMPANY (MAIL)
BOX 4826
MISSOULA MT 59806 [07/03/1984]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 13N | 19W | 28 | SE¼ SE¼ SW¼ SE¼ |

**County**: MISSOULA
**Geocode**:

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8489 | -114.0025 | MAP | NAD27 |

**Ground Surface Altitude**: **Ground Surface Method**: **Datum**: **Date**:

| Addition | Block | Lot |
|---|---|---|
| HOMEVALE ADDITION | 42 | 15 |

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: CABLE
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, July 03, 1984

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 192 | 18 | | | | |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 80 | 104 | 18 | | 3/8X3 | MILLS KNIFE |
| 149 | 152 | 18 | | 3/8X3 | MILLS KNIFE |
| 177 | 180 | 18 | | 3/8X3 | MILLS KNIFE |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | CEMENT | |

## Section 7: Well Test Data

Total Depth: 192
Static Water Level: 51
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
_2400_ gpm pump rate with _ feet of drawdown after _4_ hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _55_ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 2 | TOPSOIL |
| 2 | 25 | GRAVEL |
| 25 | 53 | CLAY- SAND AND GRAVEL |
| 53 | 104 | CLAY- SAND- GRAVEL AND WATER |
| 104 | 130 | CLAY- GRAVEL AND BOULDERS |
| 130 | 133 | CLAY- SAND- GRAVEL AND WATER |
| 133 | 148 | CLAY- GRAVEL AND BOULDERS |
| 148 | 149 | CLAY- GRAVEL- BOULDERS AND WATER |
| 149 | 151 | SAND- GRAVEL- BOULDERS AND WATER |
| 151 | 152 | SAND- GRAVEL- BOULDERS AND WATER |
| 152 | 176 | CLAY- SAND- GRAVEL AND BOULDERS |
| 176 | 179 | SAND- GRAVEL- BOULDERS AND WATER |
| 179 | 192 | CLAY- SAND AND GRAVEL |
| | | |
| | | |

**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** CAMP WELL DRILLING
**License No:** WWC-7
**Date Completed:** 7/3/1984

# Well #40A / 76H 67585 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/25/2009 10:01:58 AM)

**Site Name: LINDA VISTA WATER CO. N. WELL 01**
**GWIC Id: 67309**

## Section 1: Well Owner(s)

1) LINDA VISTA WATER CO (MAIL)
C/O LLOYD TWITE 3000 ELDORA
MISSOULA MT 59803 [03/03/1988]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 20W | 12 | NE¼ SW¼ SE¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8217 | -114.0588 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3040 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Thursday, March 03, 1988

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -5 | 100 | 8 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 85 | 100 | 8 | | | 8 INCH |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 100
Static Water Level: 14
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
370 gpm pump rate with _ feet of drawdown after 6.5 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

JEROMES FILE NO: 1988

## Section 9: Well Log

**Geologic Source**

120SDMS - SEDIMENTS (TERTIARY)

| From | To | Description |
|---|---|---|
| 0 | 2 | SOIL |
| 2 | 12 | SAND GRVEL |
| 12 | 20 | CLAY |
| 20 | 55 | SATURATED SAND |
| 55 | 70 | SAND GRAVEL |
| 70 | 80 | SANDY GRAY CLAY |
| 80 | 100 | GRAVEL WITH WATER |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** JEROMES DRILLING CO
**License No:** WWC-249
**Date Completed:** 3/3/1988

# Well #40B / 76H 67585 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/25/2009 10:02:10 AM)

**Site Name: LINDA VISTA WATER CO. WELL 03**
**GWIC Id: 67310**

## Section 1: Well Owner(s)

1) LINDA VISTA WATER CO (MAIL)
C/O LLOYD TWITE 3000 ELDORA
MISSOULA MT 59803 [03/02/1988]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 20W | 12 | NW¼ SW¼ SE¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8213 | -114.0588 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3040 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Tuesday, March 22, 1988

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -4 | 110 | 8 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 85 | 100 | 8 | | | 8INCH |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 25 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 110
Static Water Level: 14
Water Temperature:

**Pump Test ***

Depth pump set for test _ feet.
370 gpm pump rate with _ feet of drawdown after 6.5 hours of pumping.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

JEROMES FILE NO: 1987

## Section 9: Well Log

**Geologic Source**

120SNGR - SAND AND GRAVEL (TERTIARY)

| From | To | Description |
|---|---|---|
| 0 | 5 | MULTICOLORED GRAVEL AND SOIL |
| 5 | 20 | CLAY AND SAND |
| 20 | 62 | SAND SATURATED |
| 62 | 71 | SAND AND GRAVEL |
| 71 | 82 | GRAY SANDY CLAY |
| 82 | 110 | GRAVEL WITH WATER |
| | | |
| | | |
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**Driller Certification**

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** JEROMES DRILLING CO
**License No:** WWC-249
**Date Completed:** 3/22/1988

# Well #40C / 76H 96947 00

**MONTANA WELL LOG REPORT**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

**Other Options**

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/23/2009 10:20:43 AM)

**Site Name: LINDA VISTA WATER CO. S. WELL 02**
**GWIC Id: 127528**

## Section 1: Well Owner(s)

1) TWITE, LLOYD (MAIL)
3000 ELDORA LN
MISSOULA MT 59803 [03/25/1992]

## Section 2: Location

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 12N | 20W | 1 | NE¼ SW¼ SE¼ SW¼ |

**County:** MISSOULA
**Geocode:**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 46.8212 | -114.0597 | NAV-GPS | NAD27 |

| Ground Surface Altitude | Ground Surface Method | Datum | Date |
|---|---|---|---|
| 3040 | | | |

**Addition:** **Block:** **Lot:**

## Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

## Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

## Section 5: Well Completion Date

Date well completed: Wednesday, March 25, 1992

## Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 113 | 8 | | | | STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 85 | 100 | 8 | | 3/16X1 | HOLTE PERFORATOR SLOTS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 20 | BENTONITE | |

## Section 7: Well Test Data

Total Depth: 113
Static Water Level: 10
Water Temperature:

**Air Test** *

_350_ gpm with drill stem set at _ feet for _2_ hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _14_ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

## Section 8: Remarks

JEROMES FILE NO: 3443

## Section 9: Well Log

**Geologic Source**

112ALVM - ALLUVIUM (PLEISTOCENE)

| From | To | Description |
|---|---|---|
| 0 | 3 | SOIL |
| 3 | 11 | SILTY SAND |
| 11 | 18 | SAND- GRAVEL- SILT |
| 18 | 43 | CLAY- GRAVEL |
| 43 | 62 | GRAVEL- SAND |
| 62 | 70 | CLAY- GRAVEL |
| 70 | 78 | GRAY CLAY |
| 78 | 103 | COARSE GRAVEL |
| 103 | 106 | SAND |
| 106 | 113 | GRAVEL- SAND- SILT |
| | | |
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| | | |

## Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**
**Company:** JEROMES DRILLING CO
**License No:** WWC-249
**Date Completed:** 3/25/1992

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# Chapter 5
# Water Quality and Regulatory Issues

2018 Water System Master Plan

*Missoula, Montana*

## 5.1 Introduction

The City of Missoula's water is supplied through numerous wells drawing water from the Missoula aquifer, which provides plentiful, high quality water. This chapter summarizes the source water characteristics, current U.S. Environmental Protection Agency (USEPA) and Montana Department of Environmental Quality (MDEQ) drinking water regulations and recent water quality sampling, as well as potential future drinking water regulations and the potential impacts to the Missoula water system. The MDEQ Public Water Supply Monitoring Schedule is included as Appendix D.

## 5.2 Aquifer Water Quality

Water from the Missoula aquifer is generally of the calcium bicarbonate type. The mineral content in groundwater increases in the direction of groundwater flow. Mineral concentrations in groundwater fluctuate seasonally close to the Clark Fork River and remain relatively stable throughout the rest of the aquifer[1].

Groundwater from the Missoula aquifer is generally good quality and meets drinking water standards. The quality of the aquifer's water decreases in the downgradient direction from the Hellgate Canyon area east and southwest toward the Bitterroot River as concentrations of calcium, magnesium, bicarbonate, and total dissolved solids increase downgradient from the eastern boundary of the Missoula aquifer, likely due to carbonate minerals dissolving through the aquifer (Woessner 1988[1]).

*The Missoula aquifer is good quality and meets drinking water standards*

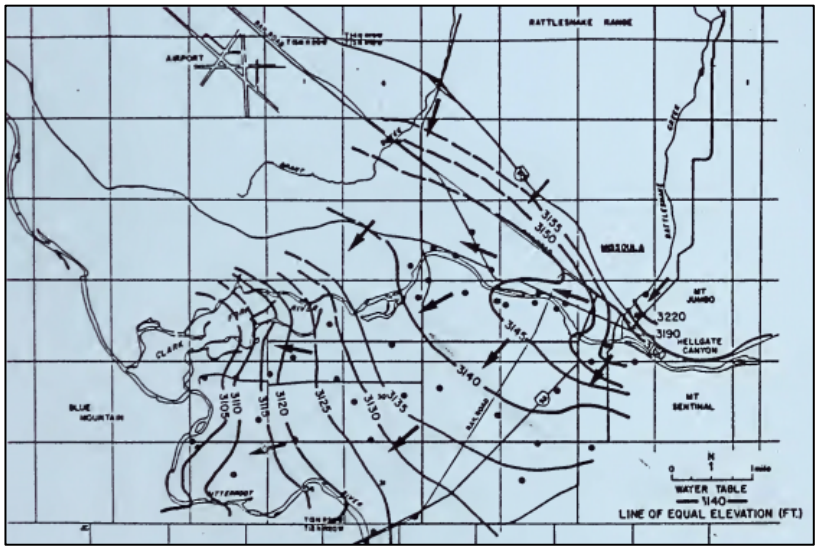


**Figure 5-1. Aquifer Flow Direction[1]**

[1] Woessner, William. 1988. Missoula Valley Aquifer Study: Hydrogeology of the Eastern Portion of the Missoula Aquifer, Missoula County, Montana. Prepared for Water Development Bureau, Montana Department of Natural Resources and Conservation, December 1988.

As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and, in some cases, radioactive material, and can pick up contaminates that are created by animals or human activity.

Contaminants that can be present in source water include:

- Microbial contaminants, such as viruses and bacteria from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.
- Inorganic contaminants, such as salts and metals, that can be naturally occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.
- Pesticides and herbicides, which can come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses.
- Organic chemical contaminants, including synthetic and volatile organic chemicals that are byproducts of industrial processes and petroleum production and can also come from gas stations, urban stormwater runoff, and septic systems.
- Radioactive contaminants, which can be either naturally occurring or the result of oil and gas production and mining activities.

## 5.3 Current Drinking Water Regulations

USEPA and the MDEQ establish regulations that limit the amount of certain contaminants in water provided by public water systems. In general, these regulations focus on providing drinking water that is microbially safe, that contains minimal disinfection by-products, and that does not contain excess levels of metals due to corrosion of piping materials.

The Groundwater Rule[2] applies to all public water systems (PWSs) that use ground water, including consecutive systems, except that it does not apply to PWSs that combine all of their ground water with surface water or with ground water under the direct influence of surface water prior to treatment. The GWR establishes a risk-targeted approach to identify Ground Water Systems (GWSs) susceptible to fecal contamination and requires corrective action to correct significant deficiencies and source water fecal contamination in all public GWSs.

GWSs must take corrective action if a significant deficiency is identified, or if the initial source sample (if required by the state) or one of the five additional ground water source samples tests positive for fecal contamination. The GWS must implement at least one of the following corrective actions:

- Correct all significant deficiencies.
- Provide an alternate source of water.
- Eliminate the source of contamination.
- Provide treatment that reliably achieves at least 4-log treatment of viruses (using inactivation, removal, or a state-approved combination of 4-log virus inactivation and removal) before or at the first customer for the ground water source.

2 GWR 71 FR 65574, November 8, 2006, Vol. 71, No. 216 Correction 71 FR 67427, November 21, 2006, Vol. 71, No. 224.

Because the Groundwater Rule applies to the system itself *and* consecutive systems, the City of Missoula could be required to take corrective action related to one of its own wells or to a consecutive system. If the city were required by the state to take corrective action to achieve 4-log removal, that could include providing adequate contact time at each water source or each well. Because water is sent directly into the distribution system from wells, there is very little contact time. Adding enough pipe to provide adequate contact time to achieve 4-log removal would be extremely costly, and the city should take precautions to avoid that requirement.

In accordance with USEPA requirements, the City of Missoula publishes a Consumer Confidence Report each year that includes fundamental information about drinking water quality. This report is mailed to water service customers and is available on the City's website. The information in this section was taken from the 2017 Consumer Confidence Report and the City's water quality sampling records.

Tables 5-1 through 5-8 present the current water quality standards that pertain to Missoula's drinking water and summarize the results of the City's recent water quality sampling. The tables use the following terms and abbreviations:

**Average for City Wells** = The average is weighted according to the individual contribution in pumping by each well to the total (active wells only).

**Date of Last Measurement** = The State of Montana allows the City to monitor for some contaminants less than once per year because the concentrations of these contaminants in groundwater do not change frequently. Some of the City's data, though representative, are more than 1 year old.

**DSMRT** = Distribution system maximum residence time

**MCL** = Maximum contaminant level, which is the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs (see below) as feasible using the best available treatment technology.

**MCLG** = Maximum contaminant level goal, which is the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

**MRDL** = Maximum residual disinfectant level, which is the level of a disinfectant added for water treatment that may not be exceeded at the consumer's tap.

**MRDLG** = Maximum residual disinfectant level goal, which is the level of a disinfectant added for water treatment below which there is no known or expected risk to health.

**NA** = Not applicable at this time or not required to be analyzed.

**ND** = Not detected.

**NS** = No standard.

**NTU** = Nephelometric turbidity units, which is a measure of the amount of a suspended material in water.

**pCi/L** = PicoCuries per liter.

**ppb** = Parts per billion, or micrograms per liter (µg/L).

**ppm** = Parts per million, or milligrams per liter (mg/L).

## Table 5-1. Primary Standards – Health-Related

| Parameter | Federal MCL | MCLG | Range (Including Highest Value) | Average for City Wells | Date of Last Measure-ment | Potential Sources of Contamination |
|---|---|---|---|---|---|---|
| Arsenic (ppb) | 10 | 0 | ND – 2 | 0.4 | 2017 | Erosion of natural deposits; historical mining and smelting. |
| Barium (ppm) | 2 | 2 | 0.18 – 0.54 | 0.26 | 2017 | Erosion of natural deposits; discharge from metal refineries; discharge from oil drilling wastes. |
| Fluoride (ppm) | 4 | 4 | ND – 0.2 | 0.16 | 2017 | Natural deposit erosion; discharge from fertilizer factories. |
| Nitrite (ppm) | 1 | 1 | ND – 0.01 | ND | 2016 | Erosion of natural deposits; runoff and leaching from fertilizer use; leaching from septic tanks and sewers. |
| Nitrate/Nitrite Total (ppm) | 10 | 10 | 0.38 – 2.96 | 0.83 | 2017 | Erosion of natural deposits; runoff and leaching from fertilizer use; leaching from septic tanks and sewers. |
| Di(2-ethylhexyl) phthalate (DEHP) (ppb) | 6 | 0 | ND – 0.92 | | 2017 | Commonly used as a plasticizer. Not regulated in bottled water. |

ppb = parts per billion; ppm = parts per million; MCL = maximum contaminant level; MCLG = maximum contaminant level goal; ND = not detected

## Table 5-2. Radionuclides

| Parameter | Federal MCL | MCLG | Range (Including Highest Value) | Average for City Wells | Date of Last Measure-ment | Potential Sources of Contamination |
|---|---|---|---|---|---|---|
| Gross alpha (pCi/L) | 15 | 0 | ND – 6.1 | 2.84 | 2017 | Erosion of natural deposits. |
| Radium 226 (pCi/L) | 5 | 0 | ND – 0.4 | 0.18 | 2017 | Erosion of natural deposits. |
| Radium 288 (pCi/L) | 5 | 0 | ND – 2.0 | 0.76 | 2017 | Erosion of natural deposits. |
| Combined Radium | 5 | 0 | 0.4 – 2.2 | 1.025 | 2017 | Erosion of natural deposits. |
| Uranium | 20 | 0 | ND – 0.002 | 0.001 | 2017 | Erosion of natural deposits. |

MCL = maximum contaminant level; MCLG = maximum contaminant level goal; ND = not detected; pCi/L = picoCuries per liter

**Table 5-3. Lead and Copper Rule Monitoring**

| Parameter | Federal Action Level[a] | Number of Samples Taken | Units of Measure | Range (Including Highest Value) | Amount Detected at 90th Percentile[b] | Date of Last Measure-ment | Potential Sources of Contamination |
|---|---|---|---|---|---|---|---|
| Copper | 1.3 | 30 | ppm | ND – 0.31 | 0.248 | 2017 | Internal corrosion of household plumbing system; erosion of natural deposits; leaching from wood preservatives. |
| Lead | 15 | 30 | ppb | ND – 3 | 2 | 2017 | Internal corrosion of household water plumbing system; discharges from industrial manufacturers. |

[a] Action level: the concentration of a contaminant which, if exceeded, triggers treatment or other requirements that a water system must follow. Action levels are measured at the 90th-percentile sample (third-highest reading out of 30 samples for lead and copper).

These data indicate that lead and copper levels present at customer taps are well below the Federal Action Level for drinking water allowed by the lead and copper rule (LCR). However, the City of Missoula Wastewater Treatment Plant was recently assigned a permit limit for copper in the effluent discharge to the Clark Fork River. The permit allows a 30-day average/maximum copper discharge of 11 ug/L (0.011 ppm) and 13.6 ug/L (0.0136 ppm) respectively. Typically, source water copper levels are low, and the primary source of copper in wastewater is due to the corrosion of copper pipes located in residences and public or private buildings (e.g. premise plumbing) supplied from the drinking water distribution system. The extent that copper piping corrodes is a function of many factors. These include the amount of copper piping present, the age of the copper piping, and how long water typically is allowed to stagnant in contact with copper piping. Water quality also plays an important role in copper corrosion. Generally low pH, low alkalinity water accelerates copper corrosion. Excessively high disinfectant (free chlorine) residual highly oxygenated water can also accelerate copper corrosion.

Depending on water quality, several options exist for attempting to reduce the load of copper entering wastewater due to corrosion of premise plumbing. These include:

- Adjustment of treated drinking water pH
- Adjustment of treated drinking water alkalinity
- Tight management of disinfectant residual and/or dissolved oxygen levels
- Addition of corrosion inhibiting chemical, typically orthophosphate

Generally, the use of a corrosion inhibitor is the most effective treatment option. However, an undesirable consequence of the use of a corrosion inhibitor is the additional nutrient load this places on the wastewater plant. The use of a corrosion inhibitor could increase phosphate levels by roughly 1 mg/L as $PO_4$.

Given the nature of copper corrosion, it is possible that corrosion in premise plumbing supplied by relatively small portions of the distribution system could contribute disproportionately high levels of copper to the wastewater. Most likely candidates would be portions of the distribution system drawing from low pH/alkalinity wells and supplying this water to buildings with recently installed copper piping.

At this time, the City plans to keep this issue largely in the wastewater treatment domain, and solve it as part of the wastewater treatment system and permit.

### Table 5-4. Distribution System Primary Standards

| Parameter | Federal MCL | MCLG | Range (Including Highest Value) | Average for City Wells | Date of Last Measure-ment | Potential Sources of Contamination |
|---|---|---|---|---|---|---|
| Chlorine Residual (ppm) | MRDL = 4.0 | MRDLG = 4.0 | 0.20 – 0.91 | 0.43 | 2017 | Added for disinfection purposes. |
| Total Trihalomethanes (TTHMs) (ppb) | 80 | NS | 1.6 – 3.8 | 2.68 | 2017 | Byproduct of drinking water disinfection. |
| Haloacetic Acids (HAA-5) (ppb) | 60 | NS | 0.48 – 0.71 | 0.60 | 2017 | Byproduct of drinking water disinfection. |

ppb = parts per billion; ppm = parts per million; MCL = maximum contaminant level; MCLG = maximum contaminant level goal; MRDL = maximum residual disinfectant level; MRDLG = maximum residual disinfectant level goal; NS = no standard

### Table 5-5. Secondary Standards – Aesthetic, Non-health-related

| Parameter | Federal MCL | MCLG | Range (Including Highest Value) | Average for City Wells | Date of Last Measure-ment | Potential Sources of Contamination |
|---|---|---|---|---|---|---|
| Chloride (ppm) | 250 | NS | 3 – 22 | 12.4 | 2017 | Runoff and leaching from natural deposits. |
| Foaming Agents (MBAS) | 0.5 | NS | ND – 3 | ND | 2016 | Leaching from natural deposits. |
| Iron (ppm) | 0.3 | NS | ND – ND | 0 | 2017 | Leaching from natural deposits. |
| Manganese (ppm) | 0.05 | NS | ND – 0.001 | 0 | 2017 | Leaching from natural deposits. |
| Sulfate (ppm) | 250 | NS | 8 – 22 | 17.3 | 2017 | Runoff and leaching from natural deposits; industrial wastes. |
| Total Dissolved Solids (TDS) (ppm) | 500 | NS | 164 – 259 | 203 | 2017 | Runoff and leaching from natural deposits. |
| Zinc (ppm) | 5 | NS | ND – 0.01 | 0 | 2017 | Runoff and leaching from natural deposits; industrial wastes. |

ppm = parts per million; MBAS = methylene blue active substances; MCL = maximum contaminant level; MCLG = maximum contaminant level goal; ND = not detected; NS = no standard

## Table 5-6. Physical Parameters

| Parameter | Federal MCL | MCLG | Range (Including Highest Value) | Average for City Wells | Date of Last Measure-ment | Potential Sources of Contamination |
|---|---|---|---|---|---|---|
| Odor Threshold (units) | 3 | NS | 0 – 6 | 0.98 | 2016 | Naturally occurring organic materials. |
| pH (units) | 6.5 – 8.5 | NS | 7.3 – 7.9 | 7.8 | 2016 | Hydrogen ion concentra-tion. Value greater than 7 is basic (non-acidic). |
| Turbidity/ clarity (NTU) | 5.0 | NS | ND – 1.0 | 0.19 | 2016 | Soil runoff. |

MCL = maximum contaminant level; MCLG = maximum contaminant level goal; ND = not detected; NS = no standard; NTU = nephelometric turbidity units

## Table 5-7. Additional Parameters

| Parameter | Federal MCL | MCLG | Units of Measure | Range (Including Highest Value) | Average for City Wells | Date of Last Measurement |
|---|---|---|---|---|---|---|
| Aggressiveness Index[a] | NS | NS | units | 11.7 – 12.2 | 12.0 | 2017 |
| Alkalinity | NS | NS | ppm | 130 – 200 | 156.4 | 2017 |
| Calcium | NS | NS | ppm | 30 – 58 | 46 | 2016 |
| Corrosivity[b] | NS | NS | positive/ negative | (–0.1) – (+0.4) | +0.2 | 2017 |
| Hardness ($CaCO_3$) | NS | NS | ppm | 137 – 216 | 170.1 | 2017 |
| | | | grains | 6.3 – 12.8 | 10 | 2016 |
| Magnesium | NS | NS | ppm | 8 – 20 | 13 | 2016 |
| Potassium | NS | NS | ppm | ND – 2 | 1.93 | 2016 |
| Sodium | NS | NS | ppm | 4 – 19 | 7.6 | 2016 |
| Specific Conductance | NS | NS | micromhos/cm | 260 – 467 | 359 | 2016 |
| Total Trihalomethanes (TTHMs) | NS | NS | ppb | ND – 9.7 | 0.63 | 2016 |

ppb = parts per billion; ppm = parts per million; $CaCO_3$ = calcium carbonate; cm = centimeters; MCL = maximum contaminant level; MCLG = maximum contaminant level goal; ND = not detected; NS = no standard

[a] An aggressiveness index of 11 or greater indicates that the water is not aggressive (noncorrosive).

[b] A positive-number Langlier index indicates that the water is noncorrosive. The Langlier index is an approximate indicator of the degree of saturation of calcium carbonate in water.

## Table 5-8. Unregulated Contaminant Monitoring Rule, Third Round (UCMR3)

| Parameter | Federal MCL | MCLG | Range (Including Highest Value) | Average for City Wells | DSMRT Range | DSMRT Average | Date of Last Measure-ment |
|---|---|---|---|---|---|---|---|
| Chlorate (ppb) | NS | NS | 0 – 153 | 22 | 34 – 91 | 53.6 | 2015 |
| Chromium (total) (ppb) | NS | NS | 0 – 0.32 | ND | 0 – 0.32 | ND | 2015 |
| Chromium (hexavalent) (ppb) | NS | NS | 0.066 – 0.29 | 0.153 | 0.104 – 0.35 | 0.19 | 2015 |
| Molybdenum (ppb) | NS | NS | 0 – 2.2 | ND | ND | ND | 2015 |
| Strontium (ppb) | NS | NS | 65 – 300 | 142 | 90 – 205 | 140 | 2015 |
| Vanadium (ppb) | NS | NS | 0 – 0.99 | 0.43 | 0.213 – 1.045 | 0.503 | 2015 |

DSMRT = distribution system maximum residence time; ppb = parts per billion; MCL = maximum contaminant level; MCLG = maximum contaminant level goal; ND = not detected; NS = no standard

## 5.5 Potential Future Drinking Water Regulations

Table 5-9 lists potential drinking water regulations that may apply to Missoula's water system in the future.

**Table 5-9. Potential Future Drinking Water Regulations**

| Contaminant or Rule | Description | Expected Date | Implications |
|---|---|---|---|
| Lead and Copper Rule Revisions | It is expected that proposed Lead and Copper Rule Revisions will be based on recommend-ations from the National Drinking Water Advisory Committee and lessons learned from the water crisis in Flint, Michigan. The following elements may be included in the proposed revisions:<br>• Lead service line replacement<br>• Improved optimal corrosion control treatment requirements<br>• Establishment of a health-based benchmark<br>• Role of point of use filters for controlling tap lead levels<br>• Sampling requirements<br>• Transparency and information sharing<br>• Public education requirements<br>• Potential revised copper requirements<br>• Relationship with broader lead exposure pathways<br>The State of Montana has proposed legislation that will set up a grant program to assist schools and daycares with testing and remediation for lead, but not copper. The state is working with DPHHS on new lead rules that will set the limits for testing and remediation. Those will require testing of all schools and replacement of any fixture with lead levels above 15 micrograms. | Early 2019 | City records do not indicate lead service lines in the system. However, about 40% of the service line material is unknown, and the City has occasionally encountered galvanized service lines with lead goosenecks.<br><br>The City may choose to take some proactive steps including identifying lead service lines (or galvanized service lines with lead goosenecks), conducting public education and outreach, and implementing a program to identify and replace lead service lines. |
| Perchlorate | As a result of a lawsuit, the Natural Resources Defense Council and USEPA reached a negotiated agreement in 2016 that requires USEPA to complete peer review of a biologically based dose-response model for metabolisms of perchlorate by October 18, 2017, and to sign a proposed regulatory standard by October 31, 2018, with a final rule in place by the end of 2019. With an acceptable model, USEPA will determine whether the model is adequate to support a proposed perchlorate MCLG. | October 2019 | All wells active in the system in 2001-2003 were tested for perchlorate in 2001-2003 as part of UCMR and there were no detects.<br><br>The City may choose to continue with voluntary, periodic testing. |
| Chromium-VI (Cr-VI) | In July 2011, the Office of Environmental Health Hazard Assessment of California's Environmental Protection Agency established a public health goal for Cr-VI of 0.02 µg/L. | USEPA hasn't issued an MCL for Cr-VI. | The City should continue to monitor for Cr-VI. |

## Table 5-9. Potential Future Drinking Water Regulations

| Contaminant or Rule | Description | Expected Date | Implications |
|---|---|---|---|
| Fluoride | The U.S. Department of Health and Human Services issued a recommended fluoride concentration of 0.7 mg/L (ppm) to maintain caries prevention benefits and reduce the risk of dental fluorosis. | USEPA hasn't adopted formal guidance. | In the early 2000s, the City formed committees to address oral health concerns and study the role of fluoridation. While there were both proponents and opponents of adding fluoride to the water supply, fluoridation was never implemented. |
| Perflourinated Compounds | The presence of perfluorinated compounds (PFCs) in source waters and drinking water is of growing concern to water professionals. This group of organic compounds, used for industrial and consumer applications such as nonstick coatings and firefighting foams, has potential health implications for humans and wildlife. PFCs are persistent in the environment and highly soluble in water. The U.S. Environmental Protection Agency (EPA) listed the following PFCs as suspected drinking water contaminants with presence in drinking water under the Unregulated Contaminant Monitoring Rule 3 (UCMR 3): perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), perfluorononanoic acid (PFNA), perfluorohexane sulfonic acid (PFHxS), perfluorohexanoic acid (PFHxA), perfluorobutanesulfonic acid (PFBS). | In May of 2016, EPA released Lifetime Health Advisories of 0.070 microgram per liter (µg/L) (70 ng/L) for PFOA and PFOS (individually or combined) for exposure from drinking water. Several states including Illinois, Maine, Michigan, Minnesota, New Jersey, North Carolina, and Vermont have initiated local campaigns to monitor and reduce PFC contaminations. Some states have enacted health advisory levels below the EPA's LHAs. | The City has tested several wells for Perflourinated compounds as required by UCMR3 and none were detected.<br><br>The City may consider continued voluntary, periodic sampling.<br><br>The primary treatment systems used for PFC contamination are granular activated carbon and ion exchange vessels. |

µg/L = micrograms per liter; Cr-VI = chromium-VI; MCL = maximum contaminant level; MCLG = maximum contaminant level goal; mg/L = milligrams per liter; USEPA = U.S. Environmental Protection Agency

## 5.6 Source Water Delineation and Assessment Report Summary

A Source Water Delineation and Assessment Report (SWDAR) was completed for the Mountain Water Company (MWC) in 2003 and updated in 2014 (RESPEC 2014[3]). The report evaluated the vulnerability and susceptibility of MWC's groundwater wells in order to prevent the drinking water sources from being degraded or contaminated. This section includes information from the SWDAR in order to describe both historical water quality concerns and potential future water quality concerns, as summarized below.

### 5.6.1 Historical Water Quality Concerns

#### Perchloroethylene (PCE) in Supply Wells

In the mid-1980s, low levels of tetrachloroethylene (perchloroethylene, or PCE) was discovered in eight of MWC's supply wells, with two exceeding USEPA's MCLs of 5 µg/L PCE. The sources of PCE in the Missoula aquifer are suspected to be the widespread discharge of chlorinated solvents through industrial injection wells and leakage of chlorinated solvents from sewer mains (English 1992[4] and MCCHD 1999[5], as cited in RESPEC 2014). Since 2002 there have been no detectable levels of PCE in MWC's supply wells.

#### Mining Wastes

The Milltown Reservoir Sediments site is an operable unit of the larger Milltown Reservoir/Clark Fork River Superfund site located about 4½ river miles upstream of the Missoula Valley and about 2 miles upgradient from MWC's easternmost groundwater supply wells (East Missoula #1 and Canyon River). The Superfund site had contained over six million cubic yards of metal-laden sediments that originated from the Butte-Anaconda mining/smelting complex and accumulated behind the Milltown Dam. Removal of about 2.2 million cubic yards of the most-contaminated sediments began in 2007 and ended in 2009 and included removing Milltown Dam. Arsenic from the sediments reduced groundwater quality near the reservoir and forced Milltown to find a replacement water supply.

Groundwater monitoring shows an arsenic plume (>10 µg/L arsenic) located about 9,500 feet upgradient of MWC's Canyon River well. Water quality monitoring of the Missoula aquifer found that arsenic didn't exceed 4 µg/L from 1999 to 2012. During this period, the average concentration ranging between 1 and 2 µg/L.

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[3] Source Water Delineation and Assessment Report, 2014 Update, Prepared by RESPEC, September 14, 2014.

[4] English, Alan. 1992. A Demonstration of Local/Federal Implementation of the Shallow Injection Well Program in Missoula, Montana, Inventory, Inspection and Closure of 5x28 Injection Wells in the Greater Missoula Urban Area.

[5] Missoula City-County Health Department, 1988. Sole Source Aquifer Petition for the Missoula Valley Aquifer. Petition submitted to the US Environmental Protection Agency by the Missoula City-County Health Department, Missoula, Montana.

## Bacterial Contamination

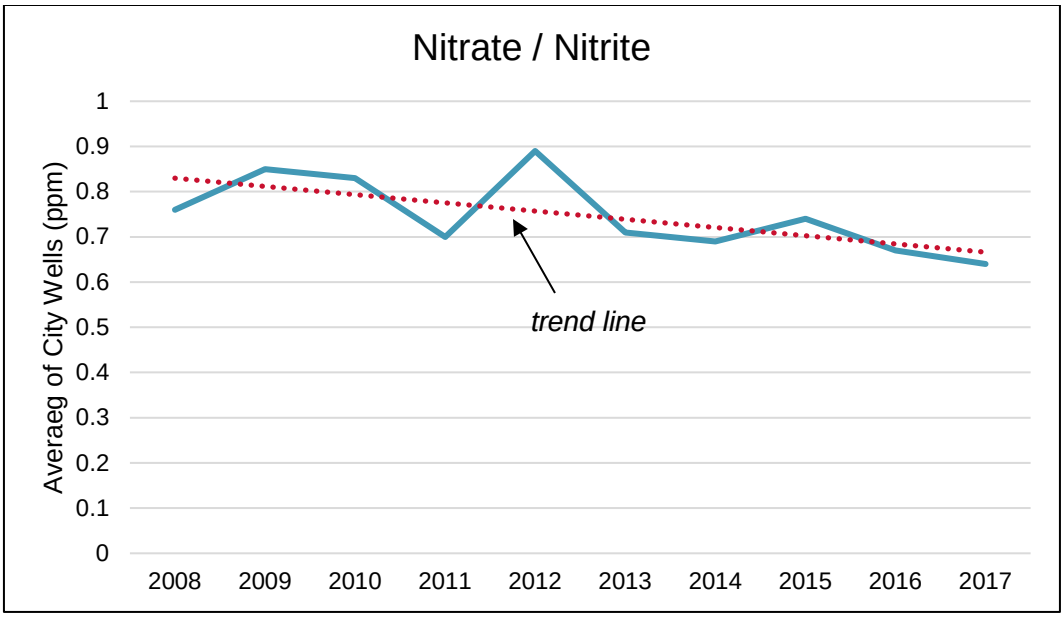
A pump failure in a sewer lift station in the spring of 1990 contaminated the Maurice Street supply well with fecal coliform bacteria. Sewer lift stations at that time had no radio telemetry, and monitoring consisted of weekly manual inspections. Since that time, the City has installed radio telemetry in all lift stations with various degrees of controls depending on the volume of sewage pumped. Contamination of the Maurice Street well was temporary, and the well was brought back online after a few weeks of daily fecal coliform sampling.

That same year, coliform contamination was also detected in the West Rattlesnake/Mountain View well from an unknown source (Hydrometrics 1992[6] , as cited in RESPEC 2014).

Besides coliform bacteria, nitrates are often used as an indicator of groundwater effects from sanitary wastewater. The Linda Vista subdivision in southwest Missoula historically had nitrates exceeding 10 mg/L MCL in individual wells. Homes in the subdivision originally discharged sanitary wastewater into individual on-site septic systems. The City of Missoula extended its wastewater collection system into Linda Vista in 1997, and nitrate levels have steadily decreased in the subdivision since that time. Overall, nitrate/nitrite levels have been declining city-wide. In 2016, total nitrite plus nitrate as nitrogen levels in these wells ranged from non-detect to 2.59 ppm, with an average of 0.64 ppm.

The system has had a small number of total coliform detections, and the city's procedure when this occurs is re-disinfection and re-sampling. For example, in 2018, extremely high water levels due to widespread flooding resulted in 4 wells being taken offline, disinfected, and placed back online after correspondence with and the approval of MDEQ.

[6] Hydrometrics, Inc. (Hydrometrics). 1992. Development of a Wellhead Protection Program for Groundwater Resources in the Missoula Aquifer. Prepared for Mountain Water Company, April 1992.




Source: Data taken from Consumer Confidence Reports, prepared by Mountain Water Company

**Figure 5-2. Nitrate/Nitrite Levels in Missoula Wells (2008–2017)**

### *Giardia iamblia* and Flow Alteration in Rattlesnake Creek

The Rattlesnake Creek surface water supply system formerly operated as the primary source of water for MWC's drinking water system. *Giardia iamblia*, a parasite commonly found in surface water and associated with wildlife excrement, was detected in MWC's water supply in 1983 following an extremely high seasonal runoff. Because of the presence of the parasite, MWC suspended using Rattlesnake Creek as an active part of its drinking water system. *Giardia iamblia* hasn't been detected in the water samples collected at the Rattlesnake Creek intake dam since the 1980s, and the water source is considered good quality.

MWC has maintained the Rattlesnake Creek surface water source as an emergency backup water source.

Rattlesnake Creek is classified as "partially impaired" as a cold-water fishery on MDEQ's 2012 303(d) list, which is a list of Montana's impaired waters. The partial-impairment classification is due to the flow alteration caused by Rattlesnake Dam. Rattlesnake Creek is included in the Middle Clark Fork Total Maximum Daily Load Planning Area.

The City has partnered with Trout Unlimited to remove Rattlesnake Dam and restore this reach of Rattlesnake Creek.

## 5.6.2 Potential Future Water Quality Concerns

Potential future water quality concerns fall into the following categories:

- Hazardous or regulated water sites
- Hazardous or regulated material handling
- Stormwater sources

- Sanitary wastewater sources
- Miscellaneous sources

Relevant water quality concerns are discussed below.

## Missoula White Pine and Sash Site

The Missoula White Pine Sash facility was a precision wood, window, and door-component manufacturing facility that operated from the 1920s through 1996. From the mid-1930s until 1987, milled wood products were dipped into mixtures of pentachlorophenol (PCP) and petroleum products. These substances were released into the environment, contaminating soil and groundwater with PCP, petroleum hydrocarbons, and dioxins and furans.

The primary groundwater contaminants at the site are PCP, diesel fuel fractions, dioxins, and cadmium, but the site also includes additional petroleum constituents, several volatile contaminants, and five metals. Groundwater wells near the site aren't used as drinking water sources, since drinking water is provided by the City. MDEQ has approved a risk assessment and established site-specific cleanup levels that will protect groundwater beneath the site (MDEQ 2013[7], as cited in RESPEC 2014). The Dickins-Defoe well is near the site; it has been taken out of service, the building is being demolished, and its water rights have been transferred to the Palmer and Great Northern wells.

In 2018, the City installed a new water main along Scott Street, this will allow for the eventual abandonment of the water main through the White Pine and Sash site.

## Hazardous or Regulated Material Handling

Hazardous or regulated material handling sites includes facilities that currently handle hazardous or regulated materials. These facilities include underground storage tanks that store petroleum, generators of hazardous wastes, petroleum pipelines, and facilities required to report chemical use and storage under the Environmental Protection and Community Right to Know Act. Also included in this category are railroad routes and highway routes that are used for transporting hazardous and regulated materials.

The potential for these sites to affect City wells is a function of the protective measures (engineered barriers) in place to prevent hazardous or regulated materials from being released into the environment. Protective measures include secondary containment for aboveground storage of tanks and drums, and double-walled tanks and pipelines for underground storage and transmission. Protective measures can also include stormwater collection systems along highway routes used for transporting hazardous materials. Facilities, equipment, and routes that lack protective measures present a high hazard for accidental releases of hazardous materials to enter the environment and potentially affect groundwater flowing to wells.

Fixed facilities that handle, store, or generate hazardous wastes above threshold amounts are required under the City of Missoula's Aquifer Protection Ordinance to maintain a

[7] Montana Department of Environmental Quality, 2013. Missoula White Pine Sash Update. Fact sheet prepared by the Montana Department of Environmental Quality for the clean-up of the site. January, 2013.

pollution prevention permit. The permit requires regulated substances to be stored within secondary containment structures, thus reducing the potential for these substances to be discharged into the environment (Missoula Municipal Code 13.26.010). The threshold amount varies depending on the type of regulated substance. Facilities that have current pollution prevention permits are considered to have protective measures in place to reduce the susceptibility of wells to being affected by regulated substances.

The primary potential contaminant that's stored and handled in Missoula is petroleum, whether it's transported through pipelines or stored in aboveground and belowground storage tanks.

## Stormwater Sources

The coarse nature of the subsurface geologic materials in the Missoula Valley allows stormwater to be discharged into shallow injection wells. Using injection wells for discharging street runoff and runoff from parking lots is the approved practice for handling stormwater in Missoula, and most city street intersections have an injection well at each corner. For private parking lots and parking structures, building codes require a stormwater injection well for every 10,000 square feet of impervious surface (such as parking spaces, sidewalks, and rooftops). These injection wells don't retain the stormwater for very long, so they do little to filter out sediment with a high concentration of metals, remove dissolved or free petroleum hydrocarbons from the water, or remove de-icing chemicals that were applied to the streets.

A few areas in Missoula have stormwater collection systems that don't directly discharge into injection wells but rather pass the stormwater to surface waters.

The City of Missoula has mapped all stormwater injection wells on city streets. Private stormwater injection wells on parking lots were located using the State of Montana's Computer Assisted Mass Appraisal (CAMA) database. The CAMA database was queried for assessed paved areas, and one injection well was assigned to the property for every 10,000 square feet of pavement. Using this assumption, there are approximately 6,000 injection wells throughout Missoula.

The City's stormwater discharges are regulated by a Municipal Separate Storm Sewer System (MS4) permit. As a requirement of the permit, the City has implemented a stormwater program to reduce contaminants in stormwater through education and public involvement, regulation, and stormwater standards for construction sites.

However, even with source control methods to prevent pollutants from being released into the environment, stormwater can generally degrade water quality over time, reduce attenuation in the vadose zone (the layer of unsaturated soil above the groundwater level), and increase levels of metals and major cations and anions. There might also be acute risks from spills and releases into storm drains and injection wells close to drinking water wells.

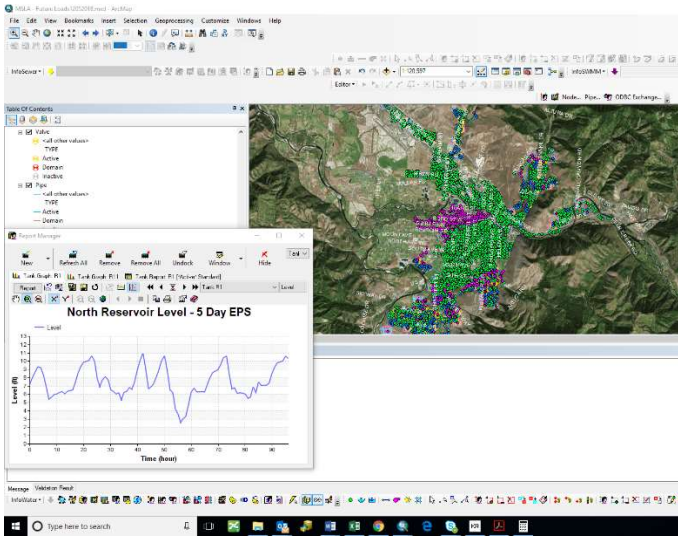
The City may wish to consider identifying the injection wells within 500 feet of drinking water wells and retrofitting these wells with pretreatment measures (such as oil/water separators, settling/swirl chambers or vegetated filter strips) to protect groundwater quality.

## Sanitary Wastewater Sources

Sanitary wastewater sources can include both collection systems and on-site discharge systems. Sanitary wastewater can contain a number of contaminants, but the principal contaminants of concern are bacterial and viral organisms and inorganic compounds such as ammonia and nitrate.

Water-collection systems, such as the City of Missoula's wastewater collection system, are intended to prevent water from discharging directly to the subsurface. However, water quality problems can arise from leaking collection lines and pumping stations, and power or equipment failures can cause inadvertent discharges of untreated wastewater to the subsurface.

The City of Missoula has been inspecting sewer mains to identify major cracks and pipe failures and ensuring that back-up systems are in place at lift stations to prevent accidental releases of wastewater. The City has installed telemetry and backup power systems at all sewer lift stations to ensure that a power failure doesn't cause an inadvertent release of untreated wastewater.




# Chapter 6
# System Analysis

2018 Water System Master Plan

Draft

*Missoula, MT*

# 6.1 System Analysis

## 6.1.1 Introduction

The City has been using a hydraulic model for over a decade to analyze potential new developments and projected growth, to determine system capacity and to identify system deficiencies. For the past several years, the City has been using an *InfoWater* modeling software by Innovyze. The software runs on *ArcGIS* platform by ESRI, which allows integration between the City's GIS data and hydraulic analysis.

The model includes water facilities in the distribution system including water mains, groundwater wells, storage tanks, booster stations, pressure regulating valves, isolation valves, and hydrants. Water pipelines and their associated parameters (e.g. diameter, year of installation, material, lengths, etc.) are imported from the City's GIS into *InfoWater* to form the initial pipe network. Spatial data such as location of valves, hydrants, billing meters, ground elevations (based on LIDAR data) was provided by the City. Water demands and other necessary modeling data such as operating conditions, control sets, system curves, etc. are also incorporated into the model using *ArcMap* and *InfoWater*. *InfoWater* uses the EPANET 2.0 hydraulic engine. The program has a GIS-based model interface and features many useful add-on tools for model development, calibration, and simulation results analysis.

The purpose of this chapter is to describe the existing system model including work completed to calibrate the model, document applicable system evaluation criteria, examine future scenarios, and perform system analysis to identify the water system's ability to perform under various current and future conditions.

# 6.2 Distribution System Assessment Criteria

Distribution system criteria defines the minimum system pressure and pipeline requirements. These criteria are established to ensure that the proposed distribution system will provide adequate, but not excessive, water pressure and the conveyance system can accommodate peak demands without excessive energy usage. It should be noted that the assessment criteria recommended below are planning criteria that are calculated such that they will protect the distribution system under repeated normal operation. These criteria are not recommended to limit, for example, pipeline velocities during intermittent activity such as system flushing programs or emergency events. Similarly, assessment criteria are not intended for the new pipe design.

Water system assessment criteria recommended for this Water System Master Plan are generally taken from the Montana Department of Environmental Quality (DEQ) Standards for Water Works, August 9, 2014 Edition, which are based on the 10 State Standards for Water Works and augmented with our experience on similar water utility system master planning projects.

The water service pressure requirements recommended for this analysis are as follows:

- Maximum allowable pressure: 150 psi
- Minimum allowable pressure at peak flow conditions: 40 psi
- Minimum allowable pressure with maximum day demands plus fire flow: 20 psi

In order to help provide standardization throughout the City, provide adequate fire protection and avoid excessive velocity and head loss within the distribution system, the following pipeline design criteria are also recommended:

- Minimum pipe size for new construction with fire hydrants: 8 inch
- Maximum allowable velocity at peak flow conditions: 7 feet per second
- Maximum allowable velocity at maximum day demands plus fire flow: 15 feet per second
- Maximum allowable head loss at peak flow: 10 feet per 1,000,000 feet
- The City primarily installs ductile iron pipe for new or replacement applications. A roughness coefficient or 'C factor' of 130 for new ductile iron pipe is recommended. HDPE is occasionally used, and a C factor of 150 is recommended.

## 6.3 Pump Station Criteria

Pump stations will be sized to handle maximum day demand flows to meet the required pressure at all demand nodes. Reservoir storage provides for flow differences between maximum day demand and peak hour plus fire flow. Pump stations should be able to meet the required pumping rates, including fire protection, with the largest capacity pump at that facility on standby (inactive). This operating condition is referred to as firm capacity, and will be used as the criteria to evaluate each facility's ability to meet various flow conditions.

## 6.4 Pressure Reducing Station Criteria

Pressure Reducing Stations or Pressure Reducing Valves (PRV), as they are typically referred to, will be sized to meet maximum day demand flows in cases where the downstream pressure zone has a reservoir for flow support during maximum day plus fire flow and peak hour demand conditions. If there are no reservoirs in the downstream pressure zone, the PRV will be sized to provide the peak hour flow and fire flow demand. The PRV design shall include low flow and high flow pressure reducing valves operating in parallel to allow the PRV to operate over a wide range of flows from minimum nighttime demand to the required maximum demand.

## 6.5 Storage Criteria

City potable water reservoirs and tanks should provide storage in order to meet three (3) main objectives:

- Moderate the fluctuations during normal operations between supply and demand in the distribution system (Equalization Storage).
- Provide storage for fire protection in each pressure zone (Fire Flow Storage).
- Provide emergency supply (Emergency Storage)

The following recommendation is from the DEQ Water Works Standards:

- Storage facilities must be sufficient, as determined from engineering studies, to supplement source capacity to satisfy all system demands occurring on the maximum day, plus fire flow demands where fire protection is provided.

It is recommended that the DEQ standard for reservoir sizing be used in this Water System Master Plan. From Section 7.01 of the DEQ standard:

- a. The minimum allowable storage must be equal to the average day demand plus fire flow demand, as defined below, where fire protection is provided.
- Any volume less than that required under a. above must be accompanied by a Storage Sizing Engineering Analysis, as defined in the glossary. Large non-residential demands must be accompanied by an Emergency Storage Sizing Engineering Analysis and may require additional storage to meet system demands.
    - Storage Sizing Engineering Analysis: A detailed engineering study that includes diurnally-peaked water usage demands during the maximum day and subsequent and preceding days, operational storage volume requirements, reserve standby storage requirements, dead storage volume, and extended time reservoir mass flow analysis for the maximum day demand with the required fire flow, when fire protection is provided, occurring during the hours of peak demand. The required design storage volume must be determined with the largest well, largest treatment train, or the largest booster pump out of service and must include provisions for auxiliary power.
- Where fire protection is provided, fire flow demand must satisfy the governing fire protection agency recommendation, or without such a recommendation, the fire code adopted by the State of Montana.
- Each pressure zone of systems with multiple pressure zones must be analyzed separately and provided with sufficient storage to satisfy the above requirements.
- Excessive storage capacity should be avoided to prevent water quality deterioration and potential freezing problems.

The InfoWater hydraulic model was used for the Storage Sizing Engineering Analysis and assumed a five (5) day extended period simulation (EPS) with two (2) maximum days, followed by one (1) maximum day with the required fire flow rate and duration, followed by two (2) maximum days. It should be noted that a peak hour occurs once each maximum day.

A graphical representation of water storage use and operational use and purpose is shown in Figure 6-1.

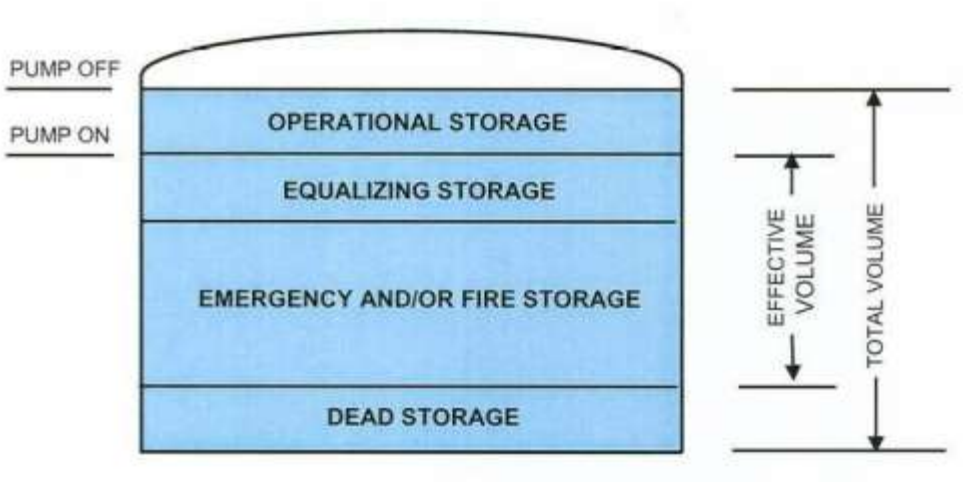



**Figure 6-1. Water Storage Graphic**

### 6.5.1 Fire Flow Criteria

The fire flows required for a specific development, building, or land use are guided by the International Fire Code and set by the local fire marshal. These criteria are shown on Figure 6-2 and in Table 6-1. Project specific fire flow requirements are provided in Appendix E. Where fire flows have not been specifically set or required by the fire marshal, the City's goal is to provide a minimum of 1,000 gpm fire flow for two (2) hours with a minimum system pressure of 20 psi. The highest required fire flow in the system is in the North Pressure zone, 3,500 gpm for three (3) hours. It should be noted that it is generally not possible for a single hydrant to supply 3,500 gpm, even if the distribution system can supply that rate of flow to the hydrant. In this case, multiple nearby hydrants could assist in meeting the fire flow requirement and developments should be designed accordingly. Fire flow requirements associated with past development projects are provided in Appendix E (Table E-1). These requirements are based on project specific conditions and the location within the water system, the fire flow requirements by pressure zone are provided in Table 6-1.

**Table 6-1. Fire Flow Requirements by Pressure Zone**

| Pressure Zone | Required Fire Flow (gpm) | Duration (hours) |
|---|---|---|
| East Missoula | 1,500 | 2 |
| Hillview | 1,000 | 2 |
| Lower Elk Ridge | 1,000 | 2 |
| Lower Farviews | 1,000 | 2 |
| Lower Lincoln Hills | 1,000 | 2 |
| North | 3,500 | 3 |

| Pressure Zone | Required Fire Flow (gpm) | Duration (hours) |
|---|---|---|
| PRV Fox Farm/Timberlane | 1,000 | 2 |
| PRV Ft Missoula | 1,000 | 2 |
| PRV Miller Creek at Jeff Road | 1,500 | 2 |
| PRV Mountainview | 1,000 | 2 |
| PRV Old Quarry | 1,500 | 2 |
| PRV Paul Lane/Jack Drive | 1,500 | 2 |
| PRV St Thomas/St Francis | 1,000 | 2 |
| Rattlesnake | 1,500 | 2 |
| South | 2,250 | 2 |
| Upper Linda Vista | 1,500 | 2 |

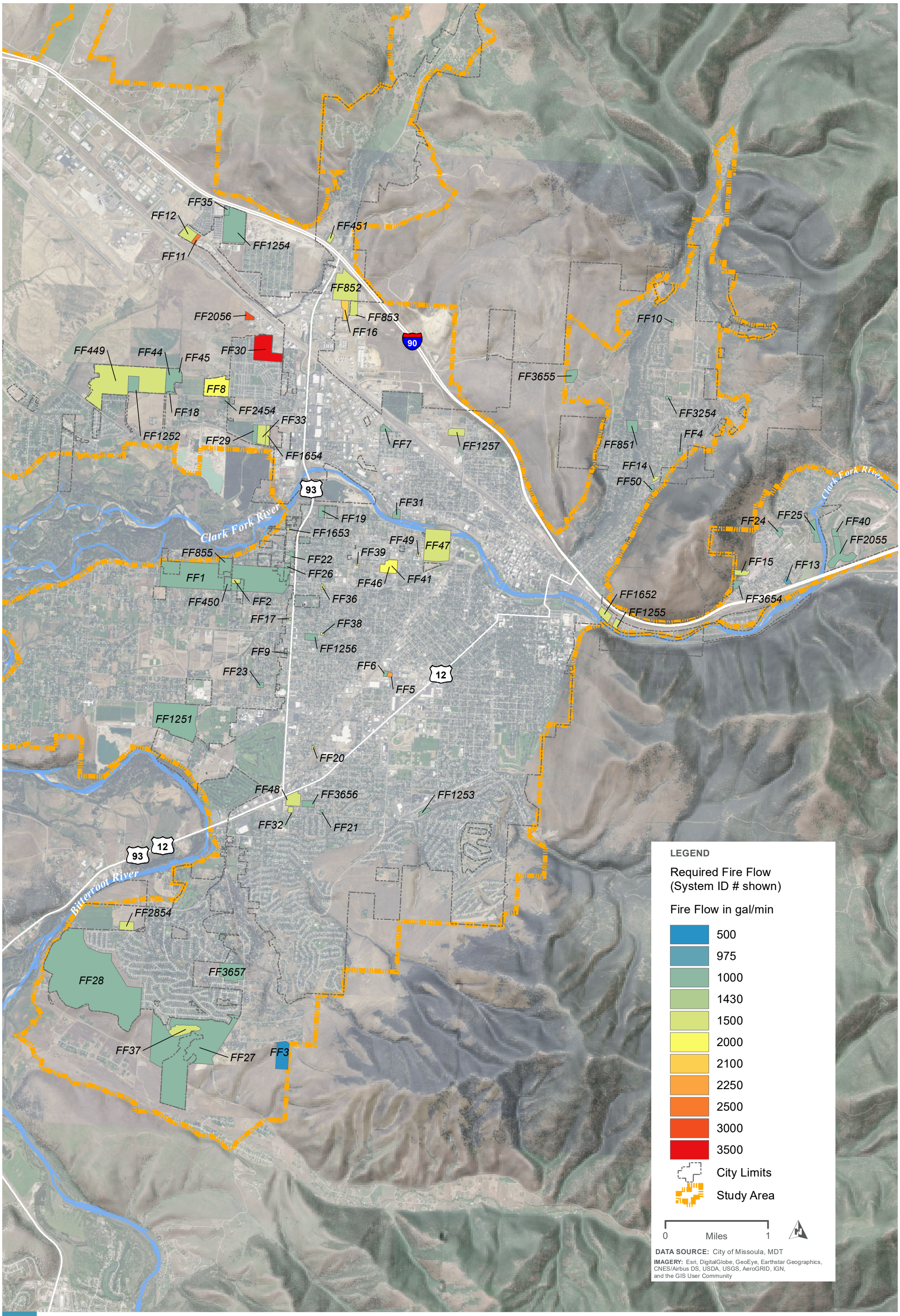



FIGURE 6-2 REQUIRED FIRE FLOW

## 6.6 Existing System Model

### 6.6.1 Existing Model Quality Control / Quality Assurance

The hydraulic model is the primary analytical tool used to determine facility sizing, capacity need and fire flow requirements.

HDR received an existing InfoWater ® hydraulic model from the City to use as the basis for water system analysis. HDR performed a quality control/quality assurance (QA/QC) check on the existing model to detect inaccuracies and errors. HDR's QA/QC protocol is used to further define boundary conditions (i.e. tank levels, pump station discharge pressures, PRV settings), determine network connectivity issues, and ensure proper pressure zone isolation. The QA/QC process uncovered errors that were resolved prior to proceeding with model calibration. A detailed list of errors identified during QA/QC process is provided in Appendix E.

### 6.6.2 Model Calibration

A comprehensive model calibration process is integral to increasing the model's ability to represent accurately actual field conditions. The calibration process of water distribution system models should lead to accurate and reliable hydraulic analysis results and thus, is of utmost importance. Calibration of the City's model was completed in two steps, as described below.

**Step 1 - Boundary Level Calibration.** The City has fire hydrant testing information for all fire hydrants in the system (about 1,440). This information includes static hydrant pressure. These static pressures were compared to the pressures associated with corresponding junctions in the hydraulic model. A 96-hour Extended Period Simulation (EPS) simulation was conducted, and all pressure ranges from the model were compared with hydrant flow test static pressures. The results of this calibration process determined that 98.1% of the model fell within +/- 10 psi, and 77.1% was within +/-5 psi.

**Step 2 – C Factor Calibration**. Five locations in the larger pressure zones were selected to develop C factors by material and then those factors were applied to pipes in the other pressure zones. Then three tests per smaller pressure zone were run to verify the C factors were within established tolerances. Therefore, C factors are based upon location and material and adjusted to fit the available field data. Global C factors were not used. A table of the C factors used in the model is provided in Appendix E (Table E-2).

It should be noted that the only pressure zone that could not be fully calibrated is the Fort Missoula zone. The test results indicated extremely high pressure drops that the model is not predicting without very low C factors (outside of normal ranges). This could indicate a partially closed valve or some type of obstruction, and the City may want to do further evaluations in this area to increase model accuracy. Table 6-2 shows the hydrant flow tests in the Fort Missoula zone. Pressure drops ranged from 10 to 40 psi, with higher pressure drops in the outlying areas of the zone. This data was also provided to the City in GIS Shape file format.

Table 6-1. Hydrant Flow Tests in Fort Missoula Zone

| System ID | Flow (gpm) | Static (psi) | Residual (psi) | Pressure Drop (psi) |
|---|---|---|---|---|
| H868 | 531 | 56 | 16 | 40 |
| H880 | 503 | 52 | 13 | 39 |
| H873 | 605 | 52 | 20 | 32 |
| H869 | 605 | 56 | 28 | 28 |
| H872 | 650 | 52 | 26 | 26 |
| H879 | 671 | 50 | 29 | 21 |
| H877 | 605 | 52 | 32 | 20 |
| H874 | 750 | 52 | 32 | 20 |
| H876 | 692 | 52 | 32 | 20 |
| H871 | 692 | 52 | 36 | 16 |
| H875 | 769 | 52 | 38 | 14 |
| H878 | 1,138 | 95 | 85 | 10 |
| H870 | 1,150 | 96 | 86 | 10 |

### 6.6.3 Diurnal Patterns and Peaking Factors

A diurnal curve is a pattern that represents water demand variations over a 24-hour period. The hydraulic model uses the diurnal curve for an Extended Period Simulation, typically for a 24-hour time period with one-hour time steps. At each time step, average demands are multiplied by the appropriate peaking factor throughout the day based on the diurnal curve and the time step being calculated.

The City provided a general maximum day hourly demand multipliers and a peaking factors for each of the 21 storage zones. The diurnal pattern was adjusted to remove non-revenue water, which resulted in a PHD/MDD factor of 1.55. The general diurnal pattern was adjusted to match the Peak Hour Day (PHD) divided by the Maximum Daily Demand (MDD) peak factor and a specific diurnal pattern for each of the 21 storage zones was developed. Each pressure zone was assigned the corresponding diurnal pattern. The City has a global MDD peaking factor of 2.03 and a global PHD peaking factor of 3.15 (i.e. 2.03 * 1.55), so during a maximum day EPS, each pressure zone will hit its individual peak hour demand. The diurnal curve and system wide demand is shown in the Figure 6-3.

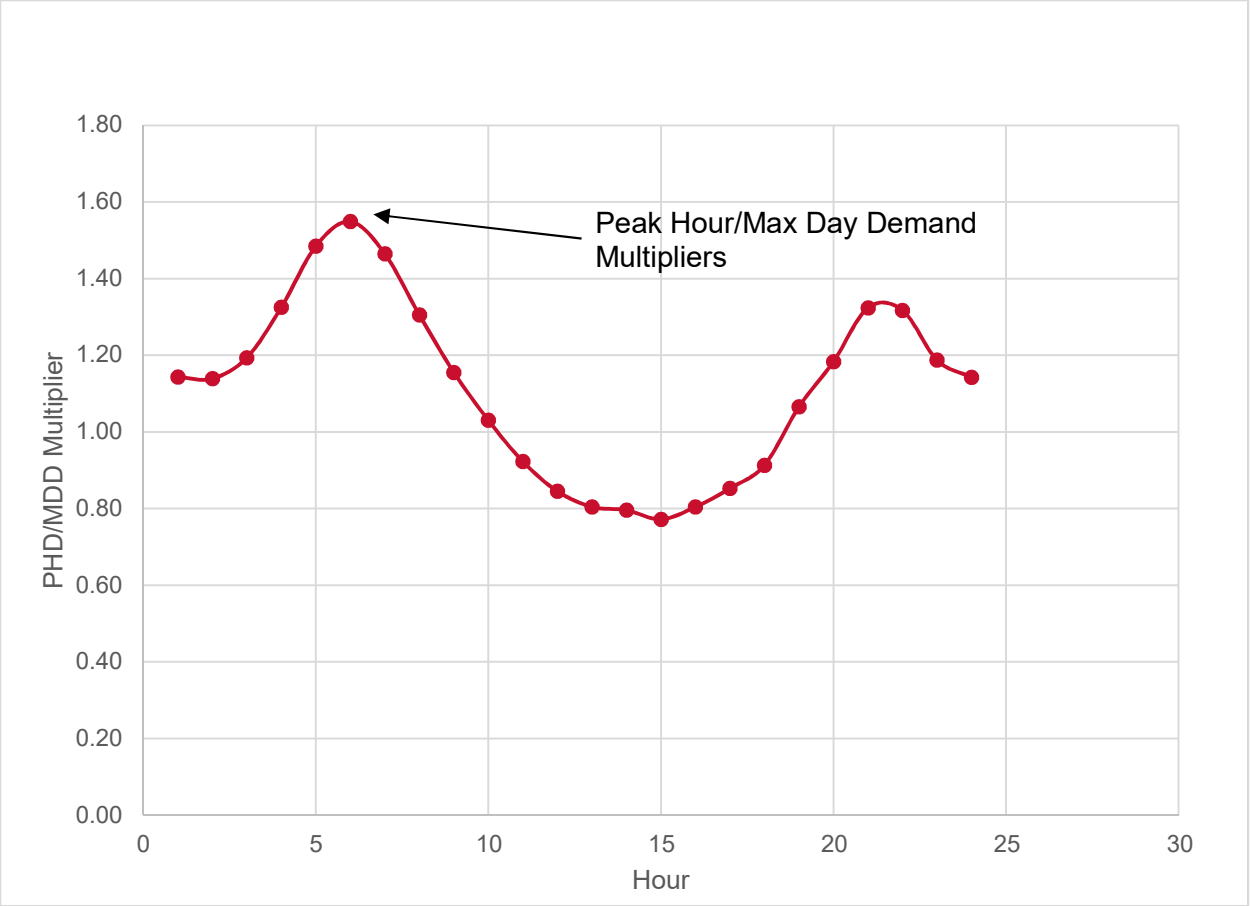



**Figure 6-3. Missoula Hourly Max Day Demand Pattern (7/25/17)**

### 6.6.4 Demand Allocation

The existing water demands in the hydraulic model are allocated using actual water usage information obtained from the City's customer billing records for 2017. Water loss was included as a separate demand.

The future water demands are predicted and allocated using the demand projections calculated based upon traffic analysis zone (TAZ) data, which includes population growth as residential and non-residential.

The large demand customers were individually checked to verify that these large demands are assigned to the correct location. This procedure is used to verify the spatial accuracy of the demand allocation, since customers sometimes have different billing addresses than their physical locations (i.e., corporate offices different from physical operations).

Flat rate customers are assumed to convert to metered customers at a rate of approximately 5% per year. Flat rate demand was assumed to be 1.7 times greater than metered demand as described in Chapter 3.

Irrigation demand was assumed to occur over a six-month annual period (between May and October) and over a 12 hour per day period (between (6pm and 6am) which would lead to the actual demand that is four (4) times as large as the annual average demand.

Water loss may decrease as the City implements a robust water main rehabilitation and replacement project. However, water main and service lines continue to age. Therefore, for modeling purposes water loss was assumed to remain at 2017 rates.

### 6.6.5 Existing System Findings

The system analysis predicts that the existing water system is able to meet most of the necessary performance criteria, as only two water mains were identified that did not meet the velocity criteria. However, water storage for three (3) areas did not meet the storage criteria: the Upper Lincoln Hills, Lower Lincoln Hills and the Upper Elk Ridge. The model predicts that the existing water demands can be provided with a combination of supply and storage during all maximum day demand conditions.

## 6.7 Near-Term Future Growth Analysis (2022)

The near-term future growth scenario includes projected demands for the next five years, along with new developments and water system facilities. It should be noted that the existing conditions are based upon demand data for 2017, and the near term future growth scenarios includes 2018 – 2022. To implement this scenario, year one of the Capital Improvement Plan (CIP) is scheduled for FY20, which starts in July 2019. Table 6-3 shows the list of Near Term Future pipeline improvements. All of these proposed improvements are in the Upper Elk Ridge pressure zone, which was not originally designed to provide fire flow protection. However, there is a 400,000-gallon Lower Elk Ridge tank that the fire department can pump out of in an emergency situation.

**Table 6-2. Near Term Pipe Upgrades**

| ID | Year Installed | Pressure Zone | Pipe Material | CIP Year Recommended | Project Trigger | Length | Existing Diameter | Proposed Diameter | FROM | TO |
|---|---|---|---|---|---|---|---|---|---|---|
| M1288 | 1968 | PZ-18 | STC | 2021 | FIRE FLOW | 1404 | 4 | 8 | J26648 | J26650 |
| M5068 | 1968 | PZ-18 | STC | 2021 | FIRE FLOW | 856 | 4 | 8 | J26848 | J26648 |
| M5236 | 1989 | PZ-18 | DI | 2021 | FIRE FLOW | 112 | 6 | 8 | J20618 | J26650 |

**Low Pressure Areas (<40 psi):** There are a number of areas that have been predicted by the model to have pressures below 40 psi during average day, max day, and peak hour demand conditions for both the existing time step and the 2022 time step. After removing areas around tanks, pump stations, and PRVs, the remaining areas were predicted to have pressures in range from 11 psi to 38 psi. These areas are shown in Figure 6-4.

**High Velocity Areas:** Two pipelines have been predicted for upsizing using 2022 Peak Hour Demands, in order to meet the peak velocity criteria of 7 ft/s. These are shown on Figure 6-4.

**Fire Flow Results:** The model was used to run fire flow analysis for max day demand scenario. A fire flow analysis was run at each hydrant within the hydraulic model. Table 6-4 shows a summary of the available flow at the fire hydrants based on the results of the analysis. Figure 6-5 shows the fire flow results that are less than 1,000 gpm.

**Table 6-4. Fire flow results summary**

| Available Fire Flow (GPM) | Count |
|---|---|
| <500 | 12 |
| 500-1,000 | 42 |
| 1,000-1,500 | 120 |
| >1,500 | 1294 |
| Total | 1468 |

Pipe requiring upsizing

Pipe requiring upsizing

93

## LEGEND

Pipes Requiring Upsizing

**2022 Avg. Daily Demands**

**Pressure (PSI)**

- 20 or Less
- 20 - 30
- 30 - 40

Diameter

- 3/8"
- 3/4"
- 1/2"
- 5/8"
- 1"
- 1 1/4"
- 1 1/2"
- 2"
- 2 1/2"
- 3"
- 4"
- 5"
- 6"
- 8"
- 10"
- 12"
- 14"
- 16"
- 18"
- 20"
- 22"
- 24"
- 30"

Booster Pump

Well

Water Storage Facility

Study Area Boundary

0 Miles 1

**DATA SOURCE:** City of Missoula; MDT; USGS NHD; MT State Library

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

# FIGURE 6-4 PRESSURE AND VELOCITY DEFICIENCIES FOR 2022 (FOR PLANNING PURPOSES ONLY)

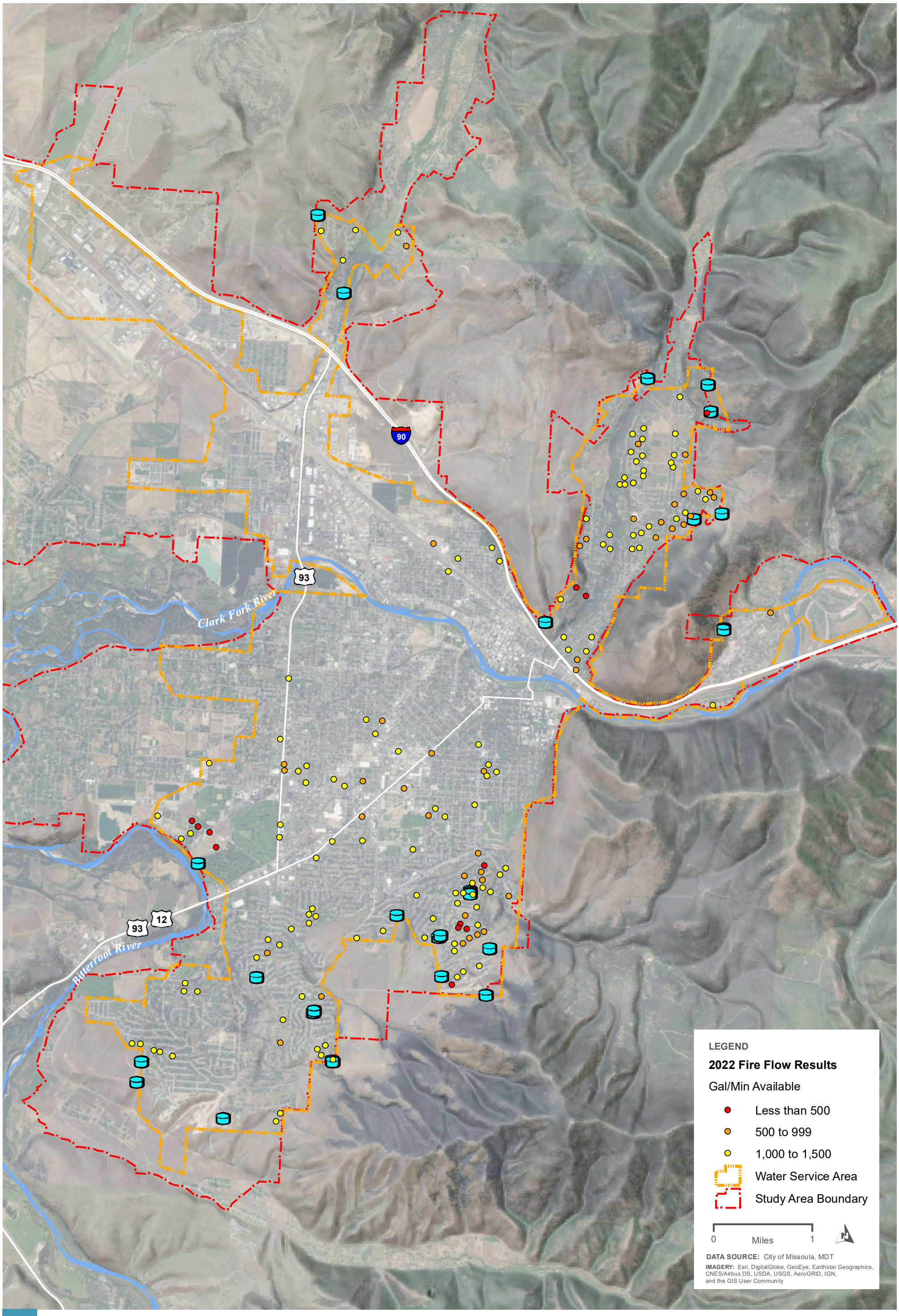



Figure 6-5 2022 FIRE FLOW RESULTS - HYDRANTS

### 6.7.1 Near Term Future Growth Storage

Water storage sufficiency was determined first by evaluating whether or not the storage facility could accommodate average day demand plus fire flow demand. Under existing conditions, two (2) tanks meet the DEQ storage requirement, the Rattlesnake tank, and the High Park tank/High Park reservoir. For the remaining water storage tanks, a Storage Sizing Engineering Analysis (SSEA), as described in Section 6.5, must be performed to account for system pumping capabilities and tank storage requirements over a 5 day period. All tanks meet the SSEA except for the following;

- Upper and Lower Lincoln Hills tanks, which will be replaced in the next one to two years. While the City is already planning 170,000 gallon for Lower Lincoln Hills, it is recommended that this tank be upsized to 180,000 gallons. The Upper Lincoln Hills tank is planned for 220,000 gallons and this meets the SSEA requirements for a 5 day EPS.
- Mansion Heights tank can provide 1,000 gpm for 2 hours (120,000 gallons) fire flow, but cannot provide the 1,500 gpm for 2 hours (180,000 gallons) fire flow desired by the City. No improvement is suggested for this tank as this fire flow rate appears adequate for this pressure zone because it is entirely residential.
- Upper Prospect tank can provide 800 gpm fire flow, but not 1,500 gpm fire flow. It should be noted that the Prospect system was originally approved by DEQ to provide 500 gpm fire flow. There are potential developments in the North Reserve and Lower Grant Creek areas that may drive the need for additional storage in this area. Developers should be required to add storage to the Lower Grant Creek Area before additional development is allowed to occur.
- Upper Elk Ridge tank cannot provide 1,000 gpm for 2 hours (120,000 gallons) fire flow. This area was designed with a 22,000 gallon tank, 4” water mains, and no fire hydrants. Although this is a small pressure zone with approximately 27 services, it is recommended that the City explore options for increasing fire protection in this zone. This report recommends a fire pump, the upsizing of a water main from 4” to 8” and the addition of fire hydrants be considered for future improvements.

According to the results of the SSEA, no additional storage is required in the North Zone. However, the City may desire additional redundancy of storage in the North Zone. The Waterworks Hill tank currently provided water as far west as the Missoula airport, and with the increased development in lower Grant Creek, North Reserve, and west toward the airport it would be advantageous to have another storage facility in that area. Table 6-4 presents the results of the storage analysis for the Near Term. The DEQ Storage Requirement is based upon Section 7.01 of the DEQ standard presented in Section 6.5. The 5 Day SSEA is based upon the DEQ’s alternative method for storage sizing using a 5 Day Storage Sizing Engineering Analysis.

**Table 6-3. 2022 Water Storage Analysis**

| Storage Zone | Pressure Zones Names | Pressure Zone numbers | Storage Tanks | Volume (MG) | 2022ADD (GPM) | 2022ADD (MG) | Fire Flow (GPM) | Fire protection Volume Requirement (MG) | DEQ Storage Requirement (MG) | 5 Day SSEA | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 MILLION RES | south, PRV Fort Missoula, | PZ3, PZ47, | South | 3.000 | 7,938 | 11.431 | 2,250 | 0.3 | 11.7 | Pass | |
| # 2 RES | rattlesnake, PRV richard st | PZ2, PZ31 | Rattlesnake | 1.000 | 597 | 0.860 | 1,500 | 0.2 | 1.0 | Pass | |
| # 1 RES (north reservoir) | North | PZ1 | North | 1.000 | 4,649 | 6.694 | 3,500 | 0.6 | 7.3 | Pass | |
| WHITAKER 400K TANK (Upper Farviews Tank) | upper farviews, PRV whitaker @ parkview, PRV Highland park / crestline, PRV Westview | PZ13, PZ28, PZ48, PZ29 | Upper Fairviews Tank | 0.400 | 281 | 0.405 | 1,500 | 0.2 | 0.6 | Pass | |
| HIGHPARK RES | high park | PZ10 | High Park Tank/High Park Reservoir | 0.685 | 220 | 0.317 | 1,500 | 0.2 | 0.5 | Pass | |
| EAST MSLA TANK | east missoula | PZ9 | East Missoula Tank/East Missoula Reservoir | 0.300 | 489 | 0.704 | 1,500 | 0.2 | 0.9 | Pass | |
| MANSION HEIGHTS TANK | mansion heights, PRV whitaker @ mansion heights, PRV Whitaker @ Pintlar Mtn | PZ15, PZ46, PZ45 | Mansion Heights Tank | 0.210 | 100 | 0.144 | 1,000 | 0.1 | 0.3 | Pass | |
| TWITE 85K RES (Lower Linda Vista) | lower linda vista, PRV helena dr., | PZ6, PZ36, | Lower Linda Vista Reservoir | 0.085 | 154 | 0.222 | 1,500 | 0.2 | 0.4 | Pass | |
| TWITE 500K RES (Upper Linda Vista) | upper linda vista, PRV mark court | PZ7, PZ43, | Upper Linda Vista Reservoir | 0.500 | 363 | 0.522 | 1,500 | 0.2 | 0.7 | Pass | |
| Upper Elk Ridge | upper elk ridge | PZ18 | Upper Elk Ridge Tank | 0.022 | 18 | 0.026 | 1,500 | 0.2 | 0.2 | Fail | Solution is for a fire pump and upsizing mains to 8" (currently they are 4") |
| ELK RIDGE TANK (Lower Elk Ridge) | lower elk ridge, PRV fox farm rd/timberline | PZ14, PZ33 | Lower Elk Ridge | 0.404 | 242 | 0.348 | 1,500 | 0.2 | 0.5 | Pass | |
| LINCOLN 6 TANK (Lower Lincoln Hills) | PRV mountainview, lower lincoln hills dr | PZ32, PZ17 | Lower Lincoln Hills | 0.035 | 241 | 0.348 | 1,500 | 0.2 | 0.5 | Fail | Passes with new 170,000 gallon Lower Lincoln Hills Reservoir |
| LINCOLN HILLS TANK (Upper Lincoln Hills) | Upper Lincoln Hills, PRV lincoln hills dr | PZ11, PZ35 | Upper Lincoln Hills | 0.041 | 89 | 0.129 | 1,500 | 0.2 | 0.3 | Fail | Passes with new 220,000 gallon Upper Lincoln Hills Reservoir |

| Storage Zone | Pressure Zones Names | Pressure Zone numbers | Storage Tanks | Volume (MG) | 2022ADD (GPM) | 2022ADD (MG) | Fire Flow (GPM) | Fire protection Volume Requirement (MG) | DEQ Storage Requirement (MG) | 5 Day SSEA | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CRESTLINE TANKS (Lower Farviews Tanks) | PRV Stephens, Lower Farviews | PZ30, PZ19 | Lower Fairviews Tanks North/Middle/South | .120 | 271 | 0.390 | 1,500 | 0.2 | 0.6 | Pass | Crestline Tanks abandoned, now served via 39th PRVs (one at Crestline and one at Whitaker) |
| HILLVIEW TANK | hillview, PRV Gharrett, upper hillview, PRV longview/grandview, PRV 57th, PRV Miller Crk @ Jeff Drive | PZ12, PZ26, PZ20, PZ24, PZ23, PZ44, | Hillview Tank/Hillview Reservoir | 0.500 | 473 | 0.682 | 1,500 | 0.2 | 0.9 | Pass | |
| SKYVIEW RES excluding Paul Ln | PRV Pinewood, PRV foothills/23rd, PRV st. thomas, st. francis | PZ4, PZ27, PZ22, PZ25, | Skyview Reservoir | 1.000 | 669 | 0.964 | 1,500 | 0.2 | 1.1 | Pass | |
| GHARRETT TANK | gharrett | PZ16 | Gharrett Tank | 0.152 | 102 | 0.147 | 1,500 | 0.2 | 0.3 | Pass | |
| UPPER PROSPECT | upper prospect, PRV klondike@prospect, PRV Argenta@prospect | PZ8, PZ39, PZ38 | Upper Prospect Reservoir | 0.150 | 170 | 0.244 | 1,000 | 0.1 | 0.4 | Fail | The tank can provide 800 gpm for two hours; therefore, a new storage tank has been recommended. |
| SOPHIE | Sophie | New PZ | Sophie Reservoir | .300 | 80 | 0.115 | 1,500 | .2 | .3 | Pass | Meets DEQ Requirement |

## 6.8 20-year Future Growth Model (2037)

### 6.8.1 20-Year Future Growth Distribution System

The 2037 hydraulic model predicts a number of existing water mains that may require upsizing to meet the velocity, fire flow, water storage or supply criteria. These are shown in Table 6-5 below and Figure 6-6.

**Table 6-4. 20-Year Water Main Upgrades**

| ID | Year Installed | Pressure Zone | Pipe Material | CIP Year Recommended | Project Trigger | Length (ft) | Existing Diameter (in) | Proposed Diameter (in) | FROM | TO |
|---|---|---|---|---|---|---|---|---|---|---|
| M1061 | 2005 | PZ-4 | DI | 2022 | VELOCITY | 30 | 6 | 12 | J24476 | J24254 |
| M4182 | 1968 | PZ-2 | STC | 2022 | VELOCITY | 63 | 6 | 12 | J19616 | J19142 |
| M784 | 1978 | PZ-3 | STL | 2027 | VELOCITY | 473 | 16 | 21 | J15992 | J15994 |
| M9957 | 2013 | PZ-9 | DI | 2027 | VELOCITY | 13 | 6 | 8 | J24170 | J24172 |
| M1766 | 1957 | PZ-3 | ST | 2027 | VELOCITY | 91 | 8 | 12 | P-W10 | J24214 |
| M1193 | 2011 | PZ-3 | DI | 2027 | VELOCITY | 6 | 16 | 21 | J25172 | J25174 |
| M1194 | 2011 | PZ-3 | DI | 2027 | VELOCITY | 25 | 16 | 21 | J15994 | J25174 |
| M7182 | 1914 | PZ-1 | K | 2027 | VELOCITY | 69 | 6 | 12 | J24392 | J18880 |
| M7949 | 2013 | PZ-9 | DI | 2027 | VELOCITY | 42 | 6 | 8 | P-W43 | J24172 |
| P481 | New Pipe | New Pipe | New Pipe | 2027 | VELOCITY | 478 | New Pipe | 21 | P-W34 | J15992 |
| P707 | New Pipe | New Pipe | New Pipe | 2027 | VELOCITY | 10 | New Pipe | 21 | W34 | P-W34 |
| P727 | New Pipe | New Pipe | New Pipe | 2027 | VELOCITY | 10 | New Pipe | 8 | W43 | P-W43 |
| P1813 | New Pipe | New Pipe | New Pipe | 2027 | VELOCITY | 10 | New Pipe | 12 | W10 | P-W10 |
| M525 | 1972 | PZ-1 | STC | 2032 | VELOCITY | 199 | 6 | 12 | J15740 | J15742 |
| M598 | 1973 | PZ-1 | STC | 2032 | VELOCITY | 43 | 6 | 12 | J15806 | J15808 |
| M614 | 1924 | PZ-1 | K | 2032 | VELOCITY | 194 | 6 | 12 | J15818 | J15820 |
| M615 | 1924 | PZ-1 | K | 2032 | VELOCITY | 193 | 6 | 12 | J15822 | J15824 |
| M693 | 1914 | PZ-1 | K | 2032 | VELOCITY | 304 | 6 | 12 | J15908 | J15910 |
| M2692 | 1966 | PZ-1 | STC | 2032 | VELOCITY | 38 | 6 | 12 | J17988 | J17990 |
| M3624 | 1971 | PZ-1 | STC | 2032 | VELOCITY | 318 | 6 | 12 | J19000 | J19002 |
| M5085 | 1991 | PZ-12 | AC | 2032 | VELOCITY | 97 | 10 | 12 | J15444 | J16612 |
| M5764 | 1976 | PZ-1 | STC | 2032 | VELOCITY | 20 | 6 | 12 | J21152 | J21154 |
| M6418 | 1914 | PZ-1 | K | 2032 | VELOCITY | 443 | 6 | 12 | J23010 | J23012 |
| M574 | 1914 | PZ-1 | K | 2032 | VELOCITY | 5 | 6 | 12 | J17990 | J23286 |
| M1343 | 1991 | PZ-12 | AC | 2032 | VELOCITY | 550 | 10 | 12 | J16612 | J24168 |
| M2603 | 1914 | PZ-1 | K | 2032 | VELOCITY | 490 | 10 | 12 | J17924 | J16732 |
| M2606 | 1914 | PZ-1 | K | 2032 | VELOCITY | 380 | 10 | 12 | J24388 | J24390 |
| M573 | 1914 | PZ-1 | K | 2032 | VELOCITY | 296 | 6 | 12 | J15778 | J24392 |
| M6408 | 1914 | PZ-1 | K | 2032 | VELOCITY | 20 | 6 | 12 | J21734 | J16772 |
| M150 | 1966 | PZ-1 | STC | 2032 | VELOCITY | 117 | 6 | 12 | J25806 | J16784 |
| M572 | 1914 | PZ-1 | K | 2032 | VELOCITY | 302 | 6 | 12 | J15786 | J17988 |
| M597 | 1995 | PZ-1 | DI | 2032 | VELOCITY | 121 | 6 | 12 | J24366 | J24368 |
| M3625 | 1914 | PZ-1 | K | 2032 | VELOCITY | 365 | 6 | 12 | J22282 | J23010 |
| M1231 | 1997 | PZ-1 | PVC | 2032 | VELOCITY | 343 | 8 | 12 | J26636 | J15740 |
| M2607 | 1914 | PZ-1 | K | 2032 | VELOCITY | 355 | 10 | 12 | J23306 | J24388 |
| M3623 | 2010 | PZ-1 | DI | 2032 | VELOCITY | 20 | 6 | 12 | J19002 | J22284 |
| M7051 | 1966 | PZ-1 | STC | 2032 | VELOCITY | 14 | 6 | 12 | J19006 | J25806 |
| M7071 | 1997 | PZ-1 | PVC | 2032 | VELOCITY | 91 | 8 | 12 | J25746 | J26636 |
| P1073 | New Pipe | New Pipe | New Pipe | 2032 | VELOCITY | 10 | New Pipe | 12 | J22704 | J15806 |
| TOTAL | | | | | | 7,618 | | | | |

### 6.8.2 Proposed Facilities

In addition to existing facilities that require upsizing to accommodate growth, there are also a number of facilities that will be required to accommodate future expansion of the water distribution system. These include pipelines, pump stations, and reservoirs to serve currently undeveloped areas and/or satellite water systems. Proposed water system facilities are shown in Figure 6-7.

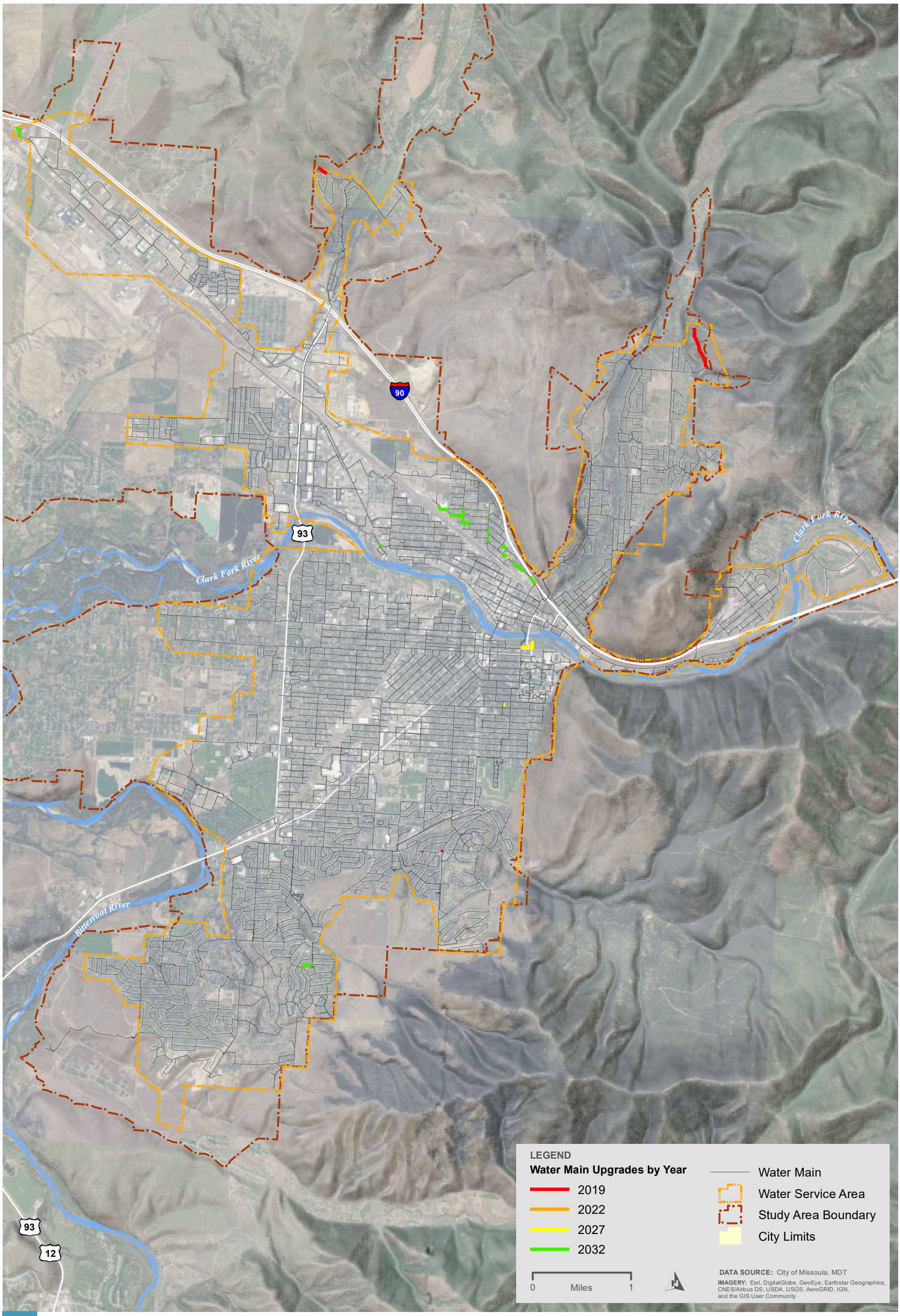
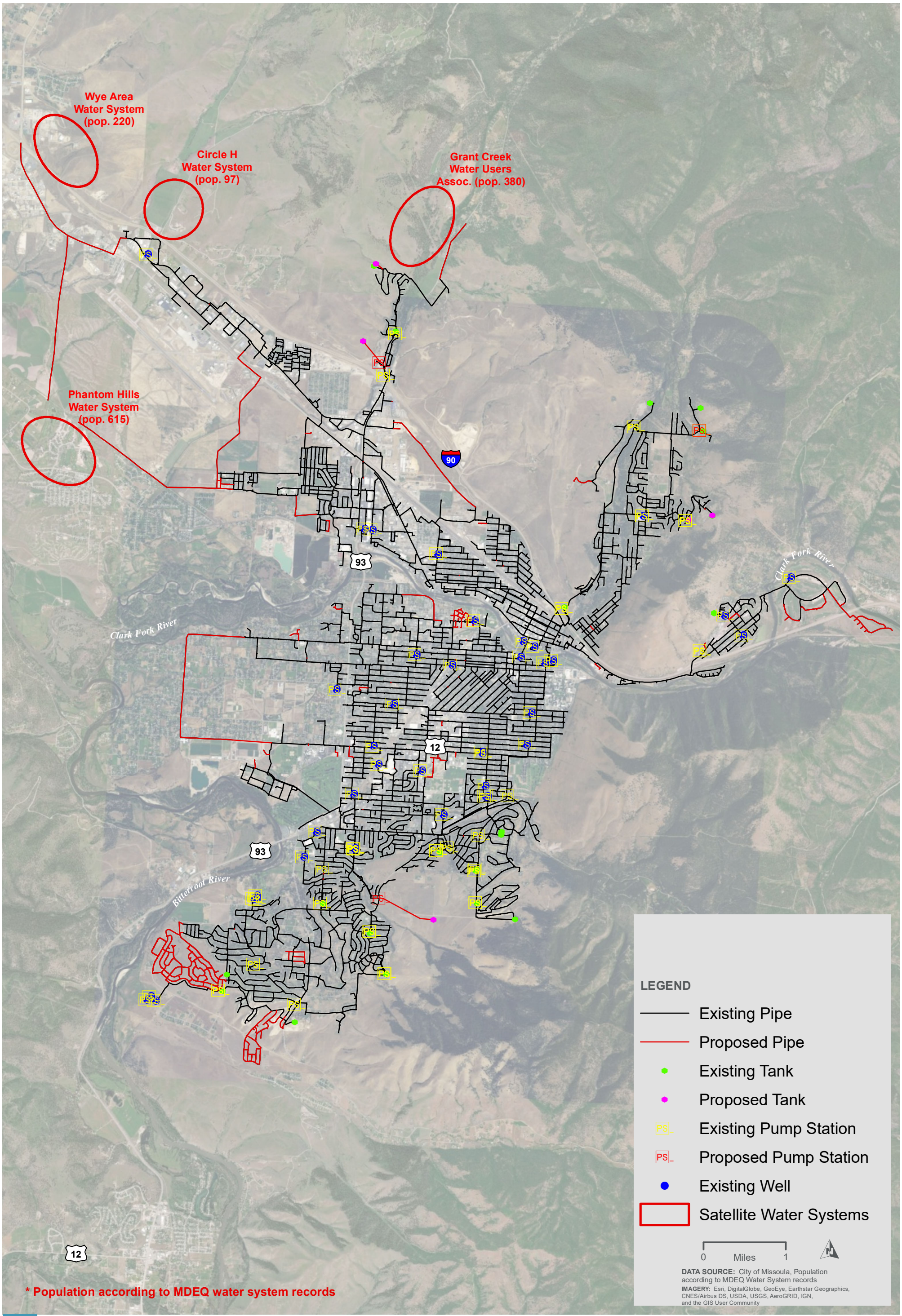



**FIGURE 6-6 FUTURE WATER MAIN UPGRADES**




* Population according to MDEQ water system records

**FIGURE 6-7 PROPOSED FACILITIES**

### 6.8.3 20-Year Future Growth Storage

By 2037, there are six (6) water storage facilities that may not be able to meet the water storage criteria. These are shown in Table 6-6.

**Table 6-5. 20-Year Water Storage Analysis**

| Storage Zone | Pressure zones names | Pressure Zone numbers | Storage Tanks | Volume | 2037ADD (GPM) | 2037ADD (MG) | Fire Flow (GPM) | Fire Flow Requirement (MG) | DEQ Storage Requirement (MG) | 5 Day SSEA | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 MILLION RES | south, PRV Fort Missoula, | PZ3, PZ47, | South | 3.000 | 8,757 | 12.611 | 2,250 | 0.3 | 12.9 | Pass | |
| # 2 RES | rattlesnake, PRV richard st | PZ2, PZ31 | Rattlesnake | 1.000 | 596 | 0.858 | 1,500 | 0.2 | 1.0 | Pass | Level gets down to 1.4 feet |
| # 1 RES (north reservoir) | north | PZ1 | North | 1.000 | 6,688 | 9.630 | 3,500 | 0.6 | 10.3 | Pass | 3,500 for 3 hours can be met through 2037 |
| WHITAKER 400K TANK (Upper Farviews Tank) | upper farviews, PRV whitaker @ parkview, PRV Highland park / crestline, PRV Westview | PZ13, PZ28, PZ48, PZ29 | Upper Fairviews Tank | 0.400 | 286 | 0.411 | 1,500 | 0.2 | 0.6 | Pass | |
| HIGHPARK RES | high park | PZ10 | High Park Tank/High Park Reservoir | 0.685 | 270 | 0.389 | 1,500 | 0.2 | 0.6 | Pass | Meets DEQ Storage Requirement |
| EAST MSLA TANK | east missoula | PZ9 | East Missoula Tank/East Missoula Reservoir | 0.300 | 556 | 0.801 | 1,500 | 0.2 | 1.0 | Pass | |
| MANSION HEIGHTS TANK | mansion heights, PRV whitaker @ mansion heights, PRV Whitaker @ Pintlar Mtn | PZ15, PZ46, PZ45 | Mansion Heights Tank | 0.210 | 104 | 0.150 | 1,000 | 0.2 | 0.3 | Pass | Mansion Heights can provide 1,000 gpm, but the tank is very close to emptying (less than 1 foot). |
| TWITE 85K RES (Lower Linda Vista) | lower linda vista, PRV helena dr., | PZ6, PZ36, | Lower Linda Vista Reservoir | 0.085 | 157 | 0.226 | 1,500 | 0.2 | 0.4 | Pass | |
| TWITE 500K RES (Upper Linda Vista) | upper linda vista, PRV mark court | PZ7, PZ43, | Upper Linda Vista Reservoir | 0.500 | 429 | 0.617 | 1,500 | 0.2 | 0.8 | Pass | |
| UPPER ELK RIDGE TANK | upper elk ridge | PZ18 | Upper Elk Ridge Tank | 0.022 | 18 | 0.026 | 1,500 | 0.2 | 0.2 | Fail | Solution is for a fire pump and upsizing mains to 8" (currently they are 4"). |
| ELK RIDGE TANK (Lower Elk Ridge) | lower elk ridge, PRV fox farm rd/timberline | PZ14, PZ33 | Lower Elk Ridge | 0.404 | 246 | 0.354 | 1,500 | 0.2 | 0.5 | Fail | 1,000 gpm for 2 hours can be delivered with existing system. An additional 100,000 storage tank will be required to meet 1,500 gpm for 2 hours. |

| Storage Zone | Pressure zones names | Pressure Zone numbers | Storage Tanks | Volume | 2037ADD (GPM) | 2037ADD (MG) | Fire Flow (GPM) | Fire Flow Requirement (MG) | DEQ Storage Requirement (MG) | 5 Day SSEA | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LINCOLN 6 TANK (Lower Lincoln Hills) | PRV mountainview, lower lincoln hills dr | PZ32, PZ17 | Lower Lincoln Hills | 0.035 | 246 | 0.354 | 1,500 | 0.2 | 0.5 | Fail | Passes with new 170,000 gallon Lower Lincoln Hills Reservoir. Tank levels get below 1 foot. 180,000 gallon tank is recommended. |
| LINCOLN HILLS TANK (Upper Lincoln Hills) | Upper Lincoln Hills, PRV lincoln hills dr | PZ11, PZ35 | Upper Lincoln Hills | 0.041 | 92 | 0.132 | 1,500 | 0.2 | 0.3 | Fail | Passes with new 220,000 gallon Upper Lincoln Hills Reservoir |
| CRESTLINE TANKS (Lower Farviews Tanks) | PRV Stephens, Lower Farviews | PZ30, PZ19 | Lower Fairviews Tanks North/Middle/South | .120 | 291 | 0.420 | 1,500 | 0.2 | 0.6 | Pass | Crestline Tanks abandoned, now served via 39th PRVs (one at Crestline and one at Whitaker) |
| HILLVIEW TANK | hillview, PRV Gharrett, upper hillview, PRV longview/grandview, PRV 57th, PRV Miller Crk @ Jeff Drive | PZ12, PZ26, PZ20, PZ24, PZ23, PZ44, | Hillview Tank/Hillview Reservoir | 0.500 | 486 | 0.700 | 1,500 | 0.2 | 0.9 | Pass | |
| SKYVIEW RES excluding Paul Ln | PRV Pinewood, PRV foothills/23rd, PRV st. thomas, st. francis | PZ4, PZ27, PZ22, PZ25, | Skyview Reservoir | 1.000 | 702 | 1.011 | 1,500 | 0.2 | 1.2 | Pass | |
| GHARRETT TANK | gharrett | PZ16 | Gharrett Tank | 0.152 | 111 | 0.160 | 1,500 | 0.2 | 0.3 | Pass | |
| UPPER PROSPECT | upper prospect, PRV klondike@prospect, PRV Argenta@prospect | PZ8, PZ39, PZ38 | Upper Prospect Reservoir | 0.150 | 170 | 0.245 | 1,500 | 0.2 | 0.4 | Fail | Need additional storage, an additional tank was recommended. 800 gpm can be provided with no improvements |
| PRV Paul Lane/Jack DR | PRV Paul Lane / Jack Dr | PZ42 | Lower Linda Vista Reservoir | 0.085 | 170 | 0.244 | 1,500 | 0.2 | 0.4 | Pass | |
| PRV Old Quarry/Grant Cr booster | PRV Old Quarry | PZ21 | Upper Prospect Reservoir | 0.15 | 73.006 | 0 | 1500.000 | 0 | 0.3 | Fail | Need additional storage, an additional tank was recommended (See Upper Prospect). |
| Sophie | Sophie | New PZ | Sophie Reservoir | 0.300 | 80 | 0.115 | 1,500 | 0.2 | 0.3 | Pass | Meets DEQ Storage Requirement |

### 6.8.4 Water Production Capacity

The City's existing groundwater supply is adequate overall to supply water demands for the foreseeable future. However, the location of water supply and the ability to move water around the system and between pressure zones is critical. Water demand and supply by pressure zone is shown in Appendix F.

**Table 6-6. Water Demand Projections**

| Demand Estimate with Flat Rate Reduction Estimate | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Res and Non-Res Avg. Demand (MGD) | Res and Non-Res Max Demand (MGD) | Flat Rate Demand Estimate (MGD) | Flat Rate Reduction (MGD) | Converted Flat Rate Demand (MGD) | Estimate of Average Non-Revenue Water (MGD) | Average Day Customer Demand (MGD) | Average Day Customer Demand w/ NRW (MGD) | Max Day Total Demand (MGD) | Max Day Total Demand w/ NRW (MGD) | Peak Hour (MGD) | Peak Hour w/ NRW (MGD) |
| 2011 | 7.0 | 14.2 | 1.79 | | | | 8.8 | | 17.8 | | 27.6 | |
| 2012 | 9.6 | 19.5 | 2.46 | | | | 12.1 | | 24.5 | | 38.0 | |
| 2013 | 9.6 | 19.5 | 2.46 | | | | 12.1 | | 24.5 | | 38.0 | |
| 2014 | 9.6 | 19.5 | 2.44 | | | | 12.0 | | 24.4 | | 37.9 | |
| 2015 | 10.3 | 20.9 | 2.63 | | | 11.2 | 12.9 | 24.1 | 26.2 | 39.1 | 40.7 | 51.9 |
| 2016 | 9.7 | 19.7 | 2.46 | | | 11.7 | 12.2 | 23.9 | 24.7 | 36.9 | 38.3 | 50.0 |
| 2017 | 10.7 | 21.7 | 2.61 | | | 12.6 | 13.3 | 25.9 | 27.0 | 39.6 | 41.9 | 54.5 |
| 2022 | 11.3 | 22.9 | 1.96 | 0.65 | 0.33 | 12.6 | 13.6 | 26.2 | 27.6 | 40.2 | 42.8 | 55.4 |
| 2027 | 12.2 | 24.8 | 1.31 | 0.65 | 0.65 | 12.6 | 14.2 | 26.8 | 28.7 | 41.3 | 44.6 | 57.2 |
| 2032 | 13.6 | 27.6 | 0.65 | 0.65 | 0.98 | 12.6 | 15.2 | 27.8 | 30.9 | 43.5 | 48.0 | 60.6 |
| 2037 | 15.7 | 31.9 | 0 | 0.65 | 1.31 | 12.6 | 17.0 | 29.6 | 34.5 | 47.1 | 53.6 | 66.2 |
| 2042 | 20.1 | 40.8 | 0 | 0 | 1.31 | 12.6 | 21.4 | 34.0 | 43.5 | 56.1 | 67.4 | 80.0 |

### 6.8.5 System Surge

Surge, also known as water hammer or hydraulic transient, is caused by a rapid change in flow velocity. Events that can cause surge pressures include, but not limited to, the following conditions in the distribution system:

- Rapid opening or closing of pump station or distribution valves
- Pump start-up or shutdown
- Opening or closing multiple hydrants causing rapid changes in demands
- Main break
- Pipe filling

The distribution system operations listed above, except main break, can be controlled to minimize surge pressures. The distribution system operation which generally causes relatively high magnitude of surge pressures (positive or negative) is pump shutdown during power failure when all of the operating pumps shut off suddenly. Even if backup power generation available, it might take at least a minute or so to switch to backup power and restart the pumps, and that amount of time is too long to prevent surge events during power failure events.

The highest surge pressures (positive or negative) often occur when the maximum number of pumps in operation at a pumping station stop as a result of a power failure. The change in pressure and velocity can cause a hydraulic transient or wave, which is not limited to the point of disturbance, it continues upstream and downstream at pressure wave propagation velocity. However, pump stations are typically designed with some type of surge protection (surge anticipator valves, etc.) which should limit the ability of a transient to leave the building. The boundary conditions determine the degree to which waves are reflected at locations of non-steady flow (e. g. pipe branches, valves, changes in cross-sections, tanks) resulting in a phase or amplitude reversal. Following their change in velocity direction, the liquid columns will reverse and often collide with high velocity differentials, causing a new pressure surge. This pressure surge is often significantly greater than the original surge.

MDEQ, Circular 1 states that raw water pumping wells and discharge piping and appurtenances must have provisions for withstanding surges or water hammer where necessary. MDEQ states that surge relief valves, slow acting check valves, or other means to minimize hydraulic transients must be incorporated in the system design.

#### Previous Surge Analysis

The City of Missoula (or previous owners) conducted a surge analysis during the design of new water supply wells over the past few years including the Canyon River and Haugan wells. Surge analysis conducted for the Canyon River well was very conservative:

- The scenario analyzed assumed a system wide power outage with all wells and booster stations running. The wide spread power outage assumed is highly unlikely based on an analysis of the power grid in Missoula (see Chapter 8).

- The surge model did not include existing storage tanks, surge anticipator or surge relief valves, or air relief valves that could help to mitigate surge pressures.
- The pipe paths selected in the surge model were analyzed without all their existing connections to other pipes that could also help to mitigate surge pressures.

The most conservative boundary conditions (for example, peak future demands, all well pumps running, power outage at all locations in the City) are generally used by design engineers to protect the system under worst case scenario, and result in the highest cost for surge protection. However, operators who are interested in protecting the system during daily operation may not experience the most conservative conditions because the likelihood of these conditions may be small. A risk analysis can be conducted to determine likelihood of the most conservative boundary condition actually happening and various levels of risk acceptable to Missoula for various levels of less stringent conditions. The less stringent conditions would generally result in less costly solutions for surge protection. The conditions to be used for surge analysis need to be based on water system operations data such as:

- Number of well pumps operating and their locations during peak demands over the past 5 years
- Number and locations of well pumps that shut down due to power failure over the past 10 years
- Changes in electrical supply grid that power the well pumps
- Likelihood of power failure at all well pump locations verses power failure at selective well pumps
- Confidence levels in the future peak hour demands

In addition to determining appropriate assumptions and boundary conditions for distribution system operational conditions and risk factors associated with each assumption, all existing surge protection devices that are in working condition need to be considered in a surge model.

*Surge analysis should be conducted for new facilities using reasonable assumptions. Retrofitting existing facilities would be extremely costly, and the city has experienced few, if any, surge events that caused damage.*

## Existing System Surge Analysis:

Information gathered and evaluated to determine appropriate boundary conditions and assumptions for conducting surge analysis of existing system include:

- Information gathered from staff interviews and SCADA data:
  - Types of power outages seen over the past 10 years within the system
  - Changes to the electrical supply grid implemented by Missoula that changes the number of wells pumps that could experience power outage need to be considered
  - Appropriate peak demands and their locations
  - How the system is operated during peak hour demands

- Historical demand trends and future land use development to determine appropriate future peak demands.

- Information gathered from record drawings and GIS:
  - Well pump stations and associated valves
  - Existing water system infrastructure such as storage tanks, air valves, and any other surge control devices
  - Delivery points and connections to distribution system piping network
  - Ground surface elevations
  - Pipeline profiles and laying drawings for major transmission mains
- Information gathered from manufacturers' catalogs and shop drawings:
  - Pump curves and motor data
  - Control valves, check valves, air valves (manufacturer, model, size)
- Information gathered from field visits:
  - Pump stations
  - Air valves and appurtenances
  - Verification or clarification of distribution system infrastructure data obtained from drawings

## Surge Recommendations

Surge pressures due to power failure at pumps stations can be reduced if the rate of change of flow is reduced at the pump station. The reduction in the rate of change of flow can be achieved by various methods as listed below.

- Increasing moment of inertia of pump – Higher the moment of inertia of the pump causes the pump to slow down more slowly during power failure. The pump inertia can be increased by attaching a flywheel (which is a large diameter steel plate) to the pump motor. Flywheels are generally large, and if a pump is housed inside a building, sufficient space is needed for the flywheel.
- Pump bypass line – A pump bypass line allows water to flow from high pressure location upstream of the pump to low pressure area downstream of the pump during power failure, thus reducing down-surge pressures. A check valve normally prevents the water from going backwards from discharge side to suction side. The suitability of a pump bypass line depends on the pressures downstream of the pump compared to upstream of the pump.
- Standpipe – A standpipe can be used to reduce high pressures during pump start-up by accepting water or reduce down-surge during pump shutdown by providing water to low-pressure areas. The height of standpipe required depends on the static pressure head.
- Hydropneumatic tank – These are also called surge tanks partially filled with air. They can function in a similar manner as a standpipe to provide water at low pressure locations downstream of the pump. The hydropneumatic tanks respond

faster than standpipes and allow wider range of pressure fluctuations. The effectiveness of a hydropneumatic tank depends on location, size, initial gas volume and pressure, and resistance of the tank inlet pipe.

Sometimes surge control devices at pump station may not mitigate surge pressures in the entire pipeline. In such situations, surge control devices at localized areas may be needed. Common surge control devices used at localized areas include:

- Combination air release and vacuum breaker valve – These types of valves allow air into the pipes when the pressure drops below atmospheric pressure thus preventing cavitation. These valves can also expel trapped air from the pipes during high pressures conditions. The valves are typically installed at high points within a pipe.
- Pressure relief valve – This type of valve expels water if the pressures downstream of the pump exceeds the desired value, this reducing the high surge pressures. The pressure setting at which the valve opens needs to be carefully established. If the pressure reducing valve is inside a pump station, provisions may need to be made to dispose the water expelled.
- Surge anticipator valve – This type of valve provides relief from high pressure by opening during down-surge condition, which is known to cause subsequent high pressures. This type of valve may be installed if water column separation does not occur.

All types of valves installed for surge control need to be maintained per manufacturers' recommendations so that they remain in workable condition. The maintenance normally involves testing the valves under specified conditions. If corrosion of valves is detected, the corrosion issue needs to be addressed or new valve needs to replace the corroded valve.

In summary, the City of Missoula personnel (and previous owners) have a long history of water system operational knowledge and data, and are aware of few, if any, surge events that have caused damage. Given the small footprints available at existing facilities, we recommend that surge analysis be conducted as part of the design of new facilities where adequate room can be available for installation of surge protection devices.

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# Chapter 7
# Condition Assessment

2018 Water Facilities Master Plan

*Missoula, MT*

# 7.1 Condition Assessment

## 7.1.1 Introduction

The objective of this chapter is to provide a summary of the condition of the City's primary above ground water system components including booster pump stations, reservoirs, tanks and wells. While water mains were not inspected for this Water System Master Plan, a great deal of information is known about the size, type, age, and condition of water mains and they are also discussed in this chapter.

The purpose of this condition assessment is to establish the current condition of assets as a means of prioritizing and forecasting maintenance and rehabilitation efforts. In addition, condition assessments can assist water providers in better understanding existing conditions and estimate remaining life, assist with targeting future expenditures and capital planning, help identify means to extend asset life, help develop a strategy for replacement or rehabilitation and support future asset management activities.

## 7.1.2 Condition Assessment Protocol

HDR conducted condition assessments for a majority of the facilities from September 29, 2014 – October 3, 2014. Three additional facilities were inspected on October 24, 2018.

For the system inspections, HDR provided a team of four technical specialists with experience in water utility operations, maintenance, facility design, construction and water asset condition assessment. As a result, assessment of lateral and buried assets such as distribution piping, valves, services, meters, and other appurtenances was not performed as part of this water facilities master plan.

The scope of the field inspections was to assess the condition of each of the facilities, identify deficiencies and equipment that had reached or exceeded its useful life and to provide an opinion of the range in costs to address deficiencies.

The condition assessment scope was limited to 30 minute to 45 minute observations at each site of the physical condition of each of the various pieces of equipment, structure, site, and instrumentation controls at each site or facility.

## 7.1.3 Condition Assessment Documentation

Individual condition assessment reports and improvement cost opinions for each facility were developed using the observations made during the field inspections. These are included in Appendix G and Appendix H respectively. To facilitate the ratings, HDR established a list of asset classes that encompassed all the different types of vertical facilities that were observed at each facility. A rating of 1 to 5 was assigned based on a condition rating system. Asset classes were evaluated and assigned a Condition Rating (CR) value for each facility as applicable. Table 7-1 below identifies the asset classes evaluated for each facility.

**Table 7-1. Asset Classes**

| Asset Type |
|---|
| Site |
| Buildings and Structures |
| Security |
| Power Distribution |
| Electrical |
| Instrumentation / Analyzers |
| Pump |
| Motor |
| Piping |
| Valves |
| HVAC |
| Chemical Equipment |
| Overall Facility Rating |

Table 7-2 below describes numerical CR ratings. A numerical rating was given for each asset class inspected and an overall facility condition assessment rating was calculated based on an average value of the asset classes.

**Table 7-2. Condition Assessment Rating**

| Rating | Description |
|---|---|
| 1 | Unserviceable – Failure is imminent |
| 2 | Poor – Shows severe signs of deterioration |
| 3 | Fair – Shows moderate signs of deterioration |
| 4 | Good – shows age, but no apparent signs of deterioration |
| 5 | Excellent – like new condition |

The asset class condition assessment ratings were initially based on the age of the asset as compared to the original asset useful life. This rating was then adjusted up or down based on field observations, review of any available maintenance records, engineering judgment, risk assessment, and input from HDR technical staff and City staff for specific issues encountered. Specific observations and deficiencies were identified in the comments by asset class. An AACE International Class 5 cost opinion range was then developed for facility improvements by asset class that would resolve the deficiencies and bring the facility in line with guidance from American Waterworks Association (AWWA), American Society of Civil Engineers (ASCE), Environmental Protection Agency (EPA) and other guidelines and state and industry requirements. The facility inspection/improvement reports served as the basis for the overall cost opinion range.

## Wells

There are 43 total and 40 active wells in the system that range in age from 13 to 80 years old and range in capacity from 185 gpm to nearly 5,700 gpm. The wells are relatively shallow ranging in depth from about 90 feet to 360 feet.There are 10 wells in the North Service Area, 2 in East Missoula, and 28 in the South Service Area. More detailed well information (including active and inactive wells) is listed in Table 7-3, including location, installation date, flow rate, horsepower, and whether or not there is emergency backup power at the well.

## Tanks and Reservoirs

Missoula's water system includes 25 tanks and reservoirs in the Missoula water system with an estimated total storage capacity of 10.2 million gallons. This is a relatively small quantity of storage for a system of this size and average day demand. This puts more reliance on the wells to provide operational (peak hour) storage and fire flow reserve.

The majority of the storage reservoirs are buried. As a result HDR could not provide a physical inspection of most of these facilities. However, HDR did review data from 13 tank diving inspections performed by other contractors from 2015-2018. Tank and reservoir storage facility information is listed in Table 7-4.

## Booster Stations

Booster stations are used in the Missoula water system to lift water from the two main pressure zones – the north zone and the south zone – into the tank and reservoirs in the smaller, higher elevation pressure zones in each of the service areas. There are a total of 22 booster stations in the City ranging in capacity from about 100 gpm to about 4,000 gpm, with pumps ranging from 15 HP to 150 HP. Booster station information is listed in Table 7-5.

## Table 7-3. Missoula Water System Water Supply Wells

| System ID | Pump Name | Pressure Zone | Year Installed* | Horsepower | Rated Flow (gpm) | Overall Condition Rating |
|---|---|---|---|---|---|---|
| W1 | 6th Street Well | South | 1935 | 100 | 1,125 | 2.8 |
| W2 | 14th Street Well | South | 1935 | 100 | 1,000 | 3.0 |
| W3A | South Avenue Wells | South | 1935 | 100 | 1,250 | 3.2 |
| W3B | South Avenue Wells | South | 1984 | 200 | 2,450 | 3.2 |
| W4 | Sommers Street Well | East Missoula | 1937 | 50 | 500 | 3.6 |
| W8 | Schilling Street Well | South | 1955 | 100 | 1,000 | 4.3 |
| W9 | Dixon Well | South | 1955 | 100 | 1,000 | 2.6 |
| W10 | Hilda Well | South | 1957 | 100 | 950 | 2.5 |
| W11 | Agnes Well | South | 1957 | 100 | 1,350 | 2.8 |
| W12 | Judi Drive Well | East Missoula | 1964 | 50 | 525 | 2.9 |
| W13 | Mountainview Well | Rattlesnake | 1964 | 60 | 900 | 2.9 |
| W17 | Momont Well | North | 2014 | 100 | 1,000 | 3.6 |
| W18 | Willowwood Well | South | 1968 | 100 | 850 | 2.8 |
| W19 | North Russell Well | North | 1969 | 100 | 1,100 | 2.7 |
| W20 | Catlin Well | South | 1969 | 100 | 1,100 | 2.9 |
| W21 | East Central Well | South | 1969 | 100 | 1,250 | 3.0 |
| W22 | Intermountain Well | South | 1970 | 100 | 1,075 | 3.0 |
| W23 | Pattee Creek (25-hp) Well | Lower Farviews | 1973 | 25 | 185 | 3.3 |
| W24 | Pattee Creek (50-hp) Well | Lower Farviews | 1973 | 50 | 320 | 3.1 |
| W25 | Stephens Well | South | 1973 | 100 | 825 | 3.1 |
| W26 | Benton Well | South | 1972 | 100 | 950 | 2.9 |
| W27 | 26th Avenue Well | South | 1972 | 50 | 525 | 2.9 |
| W29 | Orchard Well | Gharrett | 1973 | 100 | 950 | 3.0 |
| W30 | Bank Street Well | North | 2014 | 300 | 3,600 | 2.7 |
| W31 | Kiwanis Well | North | 1976 | 300 | 3,400 | 2.7 |
| W32 | Arthur Well | North | 1976 | 300 | 3,800 | 3.0 |
| W33 | Gerald Well | South | 1977 | 300 | 3,800 | 3.3 |
| W34 | Maurice Well | South | 1978 | 500 | 5,700 | 3.1 |
| W35 | Southgate Well | South | 1978 | 300 | 2,425 | 2.8 |
| W38 | 23rd Street Well East | Skyview | 1971 | 300 | 1,775 | 3.3 |
| W39 | 23rd Street Well West | Skyview | 1971 | 300 | 1,750 | 3.3 |

## Table 7-3. Missoula Water System Water Supply Wells

| System ID | Pump Name | Pressure Zone | Year Installed* | Horsepower | Rated Flow (gpm) | Overall Condition Rating |
|---|---|---|---|---|---|---|
| W40A | Linda Vista Well 1(East) | Lower Linda Vista | 1990 | 30 | 220 | 3.2 |
| W40B | Linda Vista Well 2 (North) | Lower Linda Vista | 1990 | 40 | 220 | 3.2 |
| W40C | Linda Vista Well 3 (West) | Lower Linda Vista | 1990 | 40 | 250 | 3.2 |
| W41 | Great Northern Well | North | 2001 | 100 | 1,200 | 3.8 |
| W42 | Palmer Street Well | North | 2001 | 100 | 1,140 | 3.7 |
| W43 | Canyon River Well | — | 2013 | 60 | 555 | 5.0 |
| W45A | Haugan Drive Well (North) | — | 2015 | 100 | — | 5.0 |
| W45B | Haugan Drive Well (South) | — | 2015 | 125 | — | 5.0 |
| W45C | Haugan Drive Well (West) | — | 2015 | 150 | — | 5.0 |

hp = horsepower

*Year installed indicated when the well was drilled. In many cases the well pumps and motors have been replaced or rebuilt since they were installed.

## Table 7-4. Missoula Water System Tanks and Reservoirs

| System ID | Facility Name | Pressure Zones Served | Year Installed | CapaCity (gallons) | Overall Condition Rating |
|---|---|---|---|---|---|
| R1 | North Reservoir | North | 1902 | 1,000,000 | 4.0 |
| R2 | Rattlesnake Reservoir | Rattlesnake, PRV Richard St | 1978 | 1,000,000 | 4.0 |
| R3 | South Reservoir | South, PRV Fort Missoula | 1979 | 3,000,000 | 4.1 |
| R4 | Lower Linda Vista Reservoir | Lower Linda ,Vista, PRV Helena Dr., PRV Paul Lake / Jack Dr[a] | 1998 | 85,000 | 4.0 |
| R5 | Upper Linda Vista Reservoir | Upper Linda Vista, PRV Mark Court | 1998 | 500,000 | 3.9 |
| R6 | Lower Prospect Reservoir | North | 2001 | 550,000 | - |
| R10 | Skyview Reservoir | Skyview, PRV Pinewood, PRV Foothills / 23rd, PRV St. Thomas / St. Francis | 2000 | 1,000,000 | 4.0 |
| R11 | Upper Prospect Reservoir | Upper Prospect, PRV Klondike@ Prospect, PRV Argenta@Prospect, PRV Old Quarry | 2001 | 150,000 | 3.8 |
| R12 | East Missoula Reservoir | East Missoula | 2004 | 250,000 | 4.2 |
| R13 | High Park Reservoir | High Park | 2007 | 600,000 | 3.9 |
| R14 | Hillview Reservoir | Hillview, PRV Gharrett, Upper Hillview, PRV Longview / Grandview, PRV 57th, PRV Miller Creek @ Jeff Dr. | 2013 | 300,000 | 3.9 |
| R15 | Sophie Reservoir | — | 2015 | 300,000 | - |
| T1 | East Missoula Tank | East Missoula | 1964 | 50,000 | 3.7 |
| T2 | Lower Elk Ridge Tank | Lower Elk Ridge | 1988 | 404,000 | 3.9 |
| T4 | Gharrett Tank | Gharrett | 2007 | 152,350 | 3.7 |
| T6 | Lower Lincoln Hills Tank | Lower Lincoln Hills Dr., PRV Mountainvew | 1967 | 35,000 | 3.7 |
| T8 | Upper Elk Ridge Tank | Upper Elk Ridge | 1989 | 22,000 | - |
| T9 | Lower Farviews Tank (north) | Lower Farviews, PRV Stephens | 1973 | 50,000 | 3.6 |
| T10 | Upper Farviews Tank (inactive) | Upper Farviews, PRV Whitaker@ Parkview, PRV Highland Park / Crestline, PRV Westview | 1973 | 120,000 | - |
| T13 | Lower Farviews Tank (middle) | Lower Farviews | 1977 | 35,000 | 3.6 |
| T14 | Lower Farviews Tank (south) | Lower Farviews | 1977 | 35,000 | 3.6 |

## Table 7-4. Missoula Water System Tanks and Reservoirs

| System ID | Facility Name | Pressure Zones Served | Year Installed | CapaCity (gallons) | Overall Condition Rating |
|---|---|---|---|---|---|
| T15 | High Park Tank | High Park | 1979 | 85,000 | 3.7 |
| T16 | Upper Lincoln Hills Tank | Upper Lincoln Hills | 1977 | 41,000 | 3.4 |
| T17 | Skyview Tank (inactive, Emergency Ops) | Hillview | 1991 | — | - |
| T18 | Hillview Tank | Hillview | 1985 | 200,000 | 3.7 |
| T19 | Upper Farviews Tank | Upper Farviews | 1993 | 400,000 | 3.6 |
| T20 | Mansion Heights Tank | Mansion Heights, PRV Whitaker@ Mansion Heights, PRV Whitaker @ Pintlar Mtn | 1998 | 210,000 | 3.6 |

a. PRV Paul Lane / Jack Dr. can be fed from Skyview Rservoir or from the Lower Linda Vista Reservoir

## Table 7-5. Missoula Water System Booster Stations

| System ID | Booster Name | Pressure Zone | Year Installed | Overall Condition Rating |
|---|---|---|---|---|
| B1 | Gharrett | Gharrett | 1965 | 3.7 |
| B2 | Lower Elk Ridge | Lower Elk Ridge | 1975 | 3.5 |
| B4 | High Park | High Park | 1991 | 2.6 |
| B5 | High Park Tank | Upper Farviews | 1991 | 3.7 |
| B6 | Upper Elk Ridge | Upper Elk Ridge | 1975 | 3.9 |
| B7 | Upper Lincoln Hills | Upper Lincoln Hills | 1975 | 3.2 |
| B8 | Whitaker | Upper Farviews | 1978 | 2.9 |
| B9 | Gharrett Tank | Skyview | 1978 | 3.0 |
| B13 | North Res | Rattlesnake | 2006 | 2.6 |
| B14 | Mountain View | Lower Lincoln Hills | 2011 | 3.2 |
| B15 | South Reservoir | High Park | 2008 | 4.1 |
| B16 | Lower Farviews | Lower Farviews | 2008 | 2.8 |
| B17 | Skyview Tank | Hillview | 1979 | 3.7 |
| B18 | Hillview Tank | Upper Hillview | 2011 | 3.1 |
| B20 | East Missoula | East Missoula | 1992 | 3.8 |
| B21 | Mark Court | Upper Linda Vista | 1999 | 3.0 |
| B23 | Upper Prospect | Upper Prospect | 2011 | 3.3 |
| B24 | Grant Creek | PRV Old Qua | 2002 | 3.8 |

| System ID | Booster Name | Pressure Zone | Year Installed | Overall Condition Rating |
|---|---|---|---|---|
| B25 | Miller Creek | Hillvieew | 2002 | 3.6 |
| B26 | Mansion Heights | Mansion Heights | 2002 | 3.1 |
| B27 | 23rd Street | Skyview | 2006 | - |
| B28 | Sophie Drive | Upper Linda Vista | 2015 | 5.0 |

PRV = pressure-reducing valve

### 7.1.4 Condition Assessment Summary

#### Wells

The overall condition assessment rating of the well facilities is 3.2. A rating of 3.0 is considered fair and that facilities show moderate signs of deterioration. Observations that led to the assessment included facilities that are old and nearing the end of their useful lives, pump/motors that are rated generally poor to fair, HVAC and piping in poor to unserviceable condition, and well structures that are in fair condition. The wells are older facilities and in need of mechanical and structural remediation. It is apparent that improvements to the SCADA system, electrical panels, security, and painting have been performed but the core mechanical equipment is antiquated. The age of the wells range from 13 to 80 years old, with the majority of the wells older than 45 years. The typical life expectancy of a groundwater well is 50 years without performing any maintenance or redevelopment of the well.

Overall the chemical feed systems and storage buildings are in poor condition and in need of improvement/replacement. It was apparent from inspection that the sodium hypochlorite feed systems and buildings were added after the wells and buildings were constructed. These chemical feed structures are in fair to poor condition and some lack adequate spill containment. There was no spill containment at the feed application point at the diffuser mounted on the well discharge piping at all well sites, and there was evidence of chemical spills in the past at several well facilities. In addition, there is no chemical spill containment for the filling operation of the chemical day tanks and there is a risk that a chemical spill would occur outside of the building spill containment basin. Additionally several of the chemical spill containment basins had floor drains or open sumps that would allow spilled chemicals to be dumped on to the ground and there is risk of liability associated with that exposure. Many of the wells did not have chlorine residual analyzers which are used to monitor the amount of sodium hypochlorite being fed at the well facilities. This could lead to over or under feeding chemical disinfectant needed for bacteria protection in the distribution system. Additionally, since wells are often taken off line or only used periodically and because the HVAC systems in the chemical buildings appeared to be generally non operable there is a concern that the sodium hypochlorite could age or be subjected to warmer temperatures in the summer and could convert to chlorate which would no longer disinfect the well water. Without a residual analyzer this issue could go undetected.

The opinion of probable costs to improve the well facilities to meet industry standards is approximately $3.7 million to $6.9 million.

### Table 7-6. Well Ratings

| System Component - Wells | Average Rating (1-5) |
|---|---|
| Building and Structures | 3.1 |
| Chemical Equipment | 2.6 |
| Electrical | 4.0 |
| HVAC | 2.2 |
| Instrumentation | 3.4 |
| Pump and Motor | 2.9 |
| Piping | 2.2 |
| Power Distribution | 3.3 |
| Security | 3.9 |
| Site | 3.5 |
| Valves | 3.1 |
| Wells – Overall Rating | 3.2 |

## Tanks and Reservoirs

The tanks and reservoirs that were observed were in fair to good condition overall, and need only minor improvements. Overall condition assessment ratings for tanks is a 3.7 and for reservoirs is a 3.9. A rating of 4.0 is considered "Good – Shows age, but no apparent signs of deterioration."

It was noted that several of the above ground tanks will require painting within the next 5 to 10 years.

The opinion of probable costs to improve the existing tanks and reservoirs that were observed to meet industry standards is approximately $188,000 to $356,000.

### Table 7-7. Tank Ratings

| System Component – Tanks | Average Rating (1-5) |
|---|---|
| Building and Structures | 3.1 |
| Electrical | 4.0 |
| Instrumentation | 4.0 |
| Piping | 2.9 |
| Power Distribution | 4.0 |
| Security | 4.0 |
| Site | 3.7 |
| Valves | * |
| Tanks – Overall Rating | 3.7 |

* Unknown – All tank valves are buried

**Table 7-8. Reservoir Ratings**

| System Component - Reservoirs | Average Rating (1-5) |
|---|---|
| Building and Structures | 3.4 |
| Electrical | 4.0 |
| Instrumentation | 4.0 |
| Piping | 3.8* |
| Power Distribution | 4.0 |
| Security | 4.4 |
| Site | 4.0 |
| Valves | ** |
| Reservoirs – Overall Rating | 3.9 |

* Only above grade piping was inspected (overflow pipes)

** Unknown – All tank valves are buried

It should also be noted that interiors and below grade surfaces of the tanks and reservoirs were not inspected. However, specialty contractors are hired to conduct diving inspections of the tanks and reservoirs on a 5-year inspection cycle. The past three years of storage facility inspections have been summarized below, and the inspection reports are included as Appendix I.

## Tank/Reservoir Inspection Summary

**Tank/Reservoir:** Lower Prospect

**Inspection Date:** 8/12/2015

The Lower Prospect Tank was deemed to be in good overall condition during its inspection. However, there were several deficiencies noted. A 1/8" deposit of iron sediment was present throughout the tank. Bug holes were also present on the floor, walls, and roof of the tank. Spalling was observed along the floor to wall and roof to wall seam. Despite these deficiencies, the tank was still rated to be in good condition overall. The tank support columns were holding up well top to bottom, the interior ladder was in great condition, as was the telemetry spike behind the ladder. The common inlet/outlet was structurally sound and in good overall condition, although did show signs of concentration cell formations. The entry hatch was deemed to be in great shape. A cleaning and inspection of the tank every three years was ultimately recommended.

**Tank/Reservoir:** Upper Linda Vista

**Inspection Date:** 8/12/2015

The Upper Linda Vista Tank was deemed to be in good overall condition during its inspection. However, there were several deficiencies noted. A 1/8" deposit of iron sediment was present throughout the tank. Bug holes were also present on the floor, walls, and roof of the tank. Spalling was observed along the floor to wall and roof to wall seam. Despite these deficiencies, the tank was still rated to be in good condition overall. The tank center support column was holding up well top to bottom. The interior ladder was in great condition, as was the telemetry spike behind the ladder. The common inlet/outlet was

structurally sound and in good overall condition, although did show signs of concentration cell formations. The entry hatch was deemed to be in great shape. A cleaning and inspection of the tank every three years was ultimately recommended.

**Tank/Reservoir:** Upper Prospect

**Inspection Date:** 8/12/2015

The Upper Prospect Tank was deemed to be in good overall condition during its inspection. However, there were several deficiencies noted. A 1/8” deposit of iron sediment was present throughout the tank. Bug holes were also present on the floor, walls, and roof of the tank. Spalling was observed along the floor to wall and roof to wall seam. Despite these deficiencies, the tank was still rated to be in good condition overall. The tank center support column was holding up well top to bottom. The interior ladder was in great condition, as was the telemetry spike behind the ladder. The common inlet/outlet was structurally sound and in good overall condition, although did show signs of concentration cell formations. The entry hatch was deemed to be in great shape. A cleaning and inspection of the tank every three years was ultimately recommended.

**Tank/Reservoir:** Gharret

**Inspection Date:** 10/18/2017

Most aspects of the Gharret 152KG Tank were rated to be in good overall condition. The floor was found to be in good overall condition, although some staining around and underneath bolt caps indicated possible corrosion. It appeared that a short row of bolts had no caps. The walls were found to be in good condition, but light chalking/delamination of the caulking material was present. The roof had light scratches in coating in places that showed surface corrosion, and possible corrosion along the panel edges was present. The plumbing was found to be in good overall condition with the exception of some light corrosion on the bolts. The vent was in good condition. Overall, it was recommended that the tank be cleaned and inspected every 3-5 years.

**Tank/Reservoir:** Lower Prospect

**Inspection Date:** 10/17/2017

The Lower Prospect Tank had several deficiencies. Approximately 1/8” silt sediment was present on the reservoir floor, however portions of the floor was visible and appeared to be in excellent condition. Light staining was present on the walls, as was some bugholing. No cracking was present on the walls though. The roof appeared to be in great condition overall, but there was a heavy amount of condensation present on the roof that made it difficult to clearly evaluate possible deficiencies. Two small settling cracks were present that appeared to be shallow and non-threatening. Small bugholes were present on the column and the column base. The inlet/outlet plumbing had concentration cell corrosion built up on the exterior surface, although the interior plumbing was free of obstructions and had little corrosion. Overall, it was recommended that the tank be cleaned and assessed every three years.

**Tank/Reservoir:** Skyview

**Inspection Date:** 10/17/2017

The Skyview 1MG Tank had several deficiencies. The concrete floor was free of cracks, although a small amount of sediment was present. The upper walls had a settling crack that ran through all four quadrants of the wall. There was a small area of settling cracks with efflorescence present on the roof. Each column had small bugholes, and small concentration cells on small nails left behind from construction were present. Overall, it was recommended that the tank be cleaned and assessed every three years.

**Tank/Reservoir:** South Reservoir

**Inspection Date:** 10/17/2017

Overall the South Reservoir 3MG was found to be in good condition. The roof was in excellent shape; no air gaps were noted on the roof and all of the seams appeared excellent. Minor hairline cracks were noted throughout each quadrant. The walls were in good shape overall. Some isolated points of surface corrosion were forming from exposed reinforcement though, and some areas of patchwork were present on the walls. Some hairline cracks were also present on the walls, but they were not leaking and were likely the result of settling or stress points of the reservoir. The columns were in good condition overall, and the column bases appeared to be in excellent condition. Some hairline cracks were present but they did not appear to be posing any problems. The floor was in excellent condition, but several hairline cracks were present. The cracks were not leaking. Extensive rust and surface corrosion was present on all of the internal plumbing, as well as the outlet, but everything appeared to be holding strong. The sump was in excellent condition. It was recommended that the reservoir be cleaned and inspected every 3-5 years.

**Tank/Reservoir:** Upper Prospect

**Inspection Date:** 10/18/2017

The Upper Prospect Tank was found to have several deficiencies. The roof was in good condition, with no settling cracks present. A small spall was present in the first quadrant. The walls had minor settling cracks with visible efflorescence. ¼” of iron sediment was present on the floor. The plumbing inlet/outlet had a medium amount of concentration cell corrosion along the flange and pipe clamps. Minor metal loss was present on the very edge of the common inlet/outlet. The overflow had one missing nut and minor concentration cell corrosion. The inspectors were unable to get accurate measurements of the vent but no corrosion was visible. As the tank was below ground the inspectors were unable to observe the roof, walls or footing. It was recommended that the tank be cleaned and assessed every three years.

**Tank/Reservoir:** Lower Elk Ridge

**Inspection Date:** 10/21/2018

The Lower Elk Ridge Reservoir was inspected by a diver as it was filled with water at the time of inspection. The entry hatch and upper portion of the ladder were in good condition with light surface corrosion. However, the ladder had heavy concentration cell corrosion from the floor to about six feet off of the ground. A small amount of lime and iron sediment were present throughout the reservoir. The common inlet/outlet was in good condition with some concentration cell corrosion. Light staining was found on the walls throughout the reservoir, as well as on a supporting column in the center of the reservoir. The roof and roof supports were in good condition with a small amount of corrosion and staining present. The overflow was in good condition with light staining present. Overall the

reservoir was in good condition, and it was recommended that the reservoir be cleaned and inspected every three years.

**Tank/Reservoir:** Lower Lincoln Hill

**Inspection Date:** 10/21/2018

The Lower Lincoln Hill Reservoir was inspected by a diver as it was filled with water at the time of inspection. A small amount of sand sediment was present in the tank. A light amount of staining was present on the upper, mid and lower level walls. A small amount of concentration cell corrosion was present in the first quadrant but not in the other quadrants. The inlet and outlet were in good condition with a small amount of staining present. Overall, the reservoir is in good condition and should be cleaned and inspected every three years.

**Tank/Reservoir:** Linda Vista

**Inspection Date:** 10/20/2018

The Linda Vista reservoir was inspected by a diver. The ladder was in good condition with some light staining and cell corrosion present. Protective casing for the water level indicators was present. The casing was heavily corroded but the indicators were in good condition. The floors and walls were in good condition, but light staining and concentration cell corrosion was present throughout. The common inlet/outlet appeared to be in good condition other than a medium to heavy concentration cell corrosion. The roof supports were in excellent shape but had light staining and some pop-outs. Heavy spalling was observed in the third quadrant but no leakage was present. The overflow was in excellent shape with light surface corrosion. Overall, the reservoir was in good condition and it was recommended that the reservoir be cleaned and inspected every three to five years.

**Tank/Reservoir:** South Reservoir

**Inspection Date:** 10/20/2018

The South Reservoir was inspected by a diver. A small amount of iron sediment was present throughout the reservoir. The internal ladder has heavy galvanic corrosion. The inlet had mild to heavy concentration cell corrosion. The outlet was in better shape with some mild concentration cell corrosion. The floor and walls were in good condition but had light staining, concentration cell corrosion and bug holes. The columns in the reservoir had light staining and some concentration cell corrosion but were otherwise in good shape. The roof was in good condition with no discrepancies. Overall the reservoir was in good condition and it was recommended that it be cleaned and inspected every three to five years.

**Tank/Reservoir:** Upper Farviews

**Inspection Date:** 10/20/2018

The Upper Farviews Reservoir was inspected by a diver. The roof and roof supports were in good condition with some minor surface corrosion present. The center column was also in good condition. The ladder was in good condition with some light corrosion present. A small amount of iron sediment was present in all four quadrants of the reservoir. The floor beneath the sediment was in good condition with a light stain. The common inlet/outlet was in good condition but had some light concentration cell corrosion. The walls had no major

discrepancies other than some light staining. The overflow structure was in good condition but had some light staining and surface corrosion. Overall the reservoir was in good condition and it was recommended that the reservoir be cleaned and inspected every three years.

**Tank/Reservoir:** North Reservoir

**Inspection Date:** 10/21/2018

The reservoir was inspected by a diver. The floor panels and floor joints were in good condition with light staining. All three hatches were in good condition with no staining. The roof had light surface corrosion in both the first and fourth quadrants but was in good condition overall. The vent was also in good condition despite some light surface corrosion. The upper, mid, and lower walls all appeared to be in good condition except for one small settling crack traveling from the second to the fourth quadrant. The inlet and outlet were in good condition other than some mild concentration cell corrosion. Overall the reservoir was in excellent condition and it was recommended that the reservoir be cleaned and inspected every three to five years.

## Booster Pump Stations

There are 21 booster stations in the City of Missoula's water distribution system ranging in capacity from about 100 gpm to about 4,000 gpm, with pumps ranging from 15 HP to 150 HP. These facilities were overall in good condition needing only minor maintenance and improvements. A few booster stations were overall in fair condition and in need of some improvements.

Overall the cost opinion for booster station improvements is relatively minor with exception of just a few of the older booster pump stations, and range from approximately $930,000 to $1.8 million.

### Table 7-9. Booster Pump Station Ratings

| System Component - Reservoirs | Average Rating (1-5) |
|---|---|
| Building and Structures | 3.4 |
| Electrical | 3.5 |
| HVAC | 3.0 |
| Instrumentation | 3.9 |
| Pump and Motor | 2.8 |
| Piping | 2.8 |
| Power Distribution | 3.4 |
| Security | 3.9 |
| Site | 3.5 |
| Valves | 3.2 |

### 7.1.5 Pressure Reducing Valve Stations

The water distribution system has a number of Pressure Reducing Valve (PRV) stations that regulate the water pressure delivered from higher to lower pressure zones and that help control the pressure delivered to service connections within the system. A PRV station essentially consists of a below grade valve vault which houses a section of the water main, two isolation valves and the PRV. Most stations have pressure reading instrumentation equipment that is connected to the SCADA system and is monitored at the Operations Center.

These facilities were not inspected, however, the City of Missoula is conducting system wide inspections of all PRVs and performing necessary repairs, rehabilitation and valve rebuilding for PRVs with less than 6-inch valves. PRVs larger than 6-inches are being repaired by contract with a local contractor. This program of rebuilding all the pump control valves is estimated to be completed by 2020.

### 7.1.6 Water Mains

The City of Missoula water system includes about 337 miles of water mains, ranging in size from 2-inch to 30-inch. Approximately 70 percent of the water mains are ductile iron, PVC, or steel, the remaining 30 percent includes asbestos concrete, cast iron, cured in place pipe liner, HDPE, steel invasion and kalamein.

Steel invasion pipe refers to light weight, thin walled steel pipe originally manufactured during World War II for the purpose of carrying gas over the ground. Surplus pipe was available after WWII and almost 10 miles of 6-inch steel invasion pipe was installed between 1946 and 1950. This pipe has had a tendency to develop small pin hole sized leaks and has been targeted for replacement. Approximately 4.9 miles still remain in the system.

Kalamein pipe refers to standard steel pipe that was immersed in a molten alloy made primarily of zinc, but also tin and nickel. It was installed in the system in the early 1900's until about 1924. While the kalamein pipe itself has held up relatively well, the joints have a tendency to lose their lead filler and leak. Of the 12 miles originally installed, 11.7 remain in service today.

Figure 7-1 shows the water mains targeted for replacement including the steel invasion, kalamein, and pipes greater than 75 years old.

#### Water Main Replacement Rates

The City has identified steel invasion and kalamein pipe as high priority pipe for rehabilitation or replacement. In addition, the City has conducted several analyzes to determine which pipes should be replaced when to maximize the useful life of the asset. One analysis used the KANEW software, which was originally developed in 1998 through an AWWA Research Foundation project, and has since been upgraded and expanded. KANEW evaluates water main rehabilitation and replacement cycles based upon user entered data such as pipe type, age, length, and upper and lower bounds on useful life expectancies. Life expectancies were determine based upon a combination of literature review and system specific knowledge. Results are shown in Figure 7-2 below.

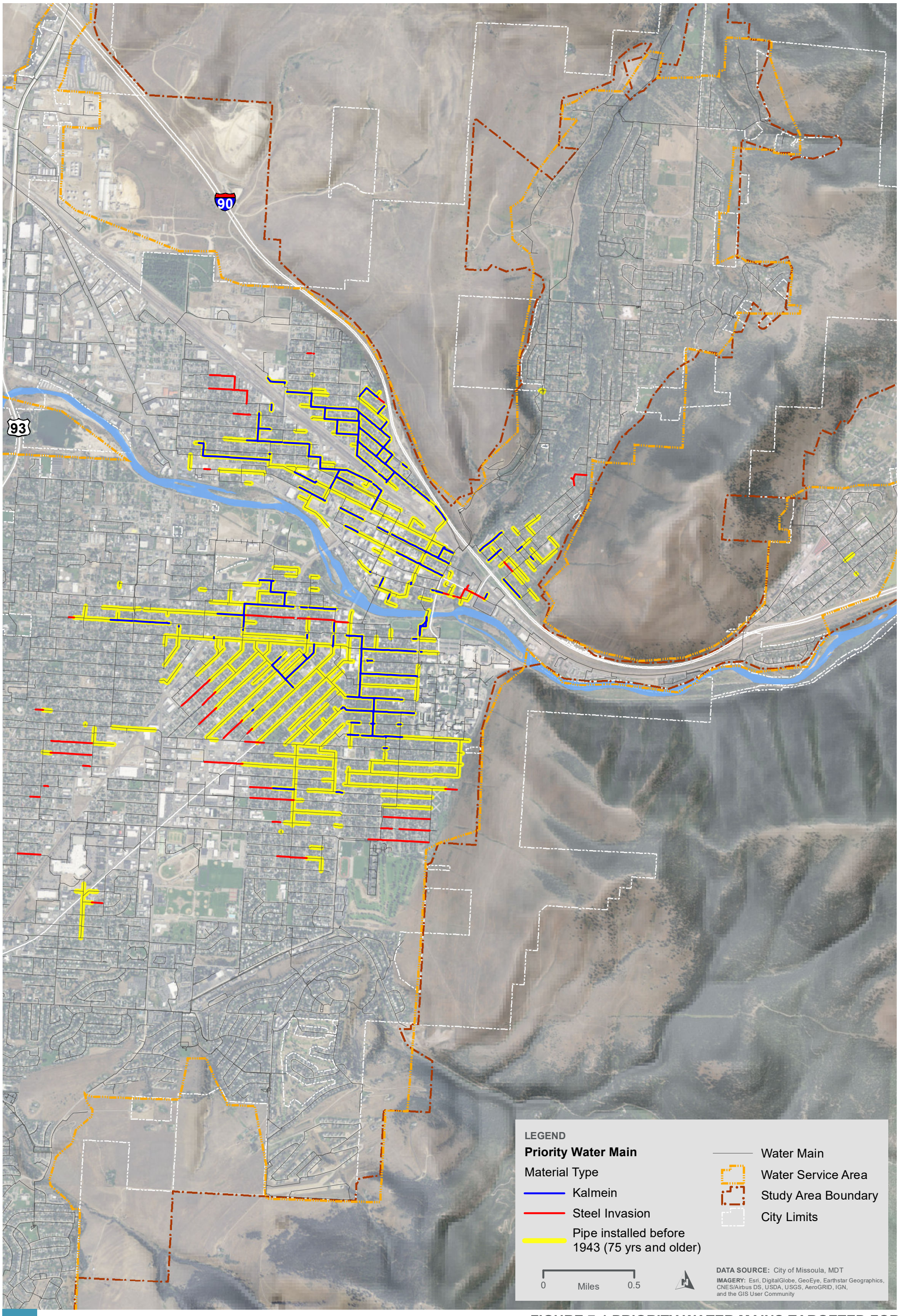



**FIGURE 7-1 PRIORITY WATER MAINS TARGETED FOR REHABILITATION OR REPLACEMENT**

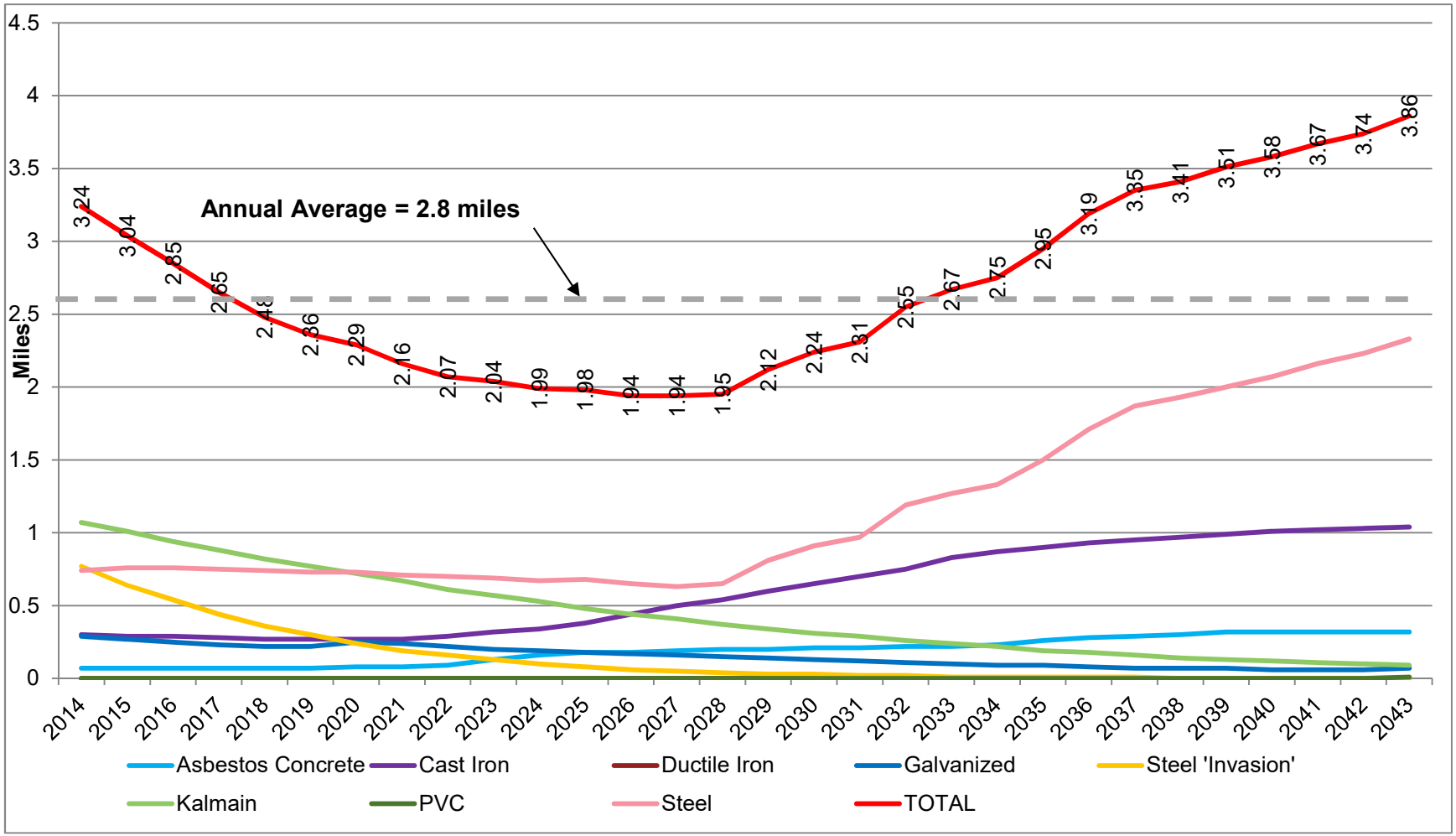



**Figure 7-2. KANEW Pipe Replacement Cycle Recommendations**

As shown in Figure 7-2, the KANEW analysis recommends somewhere between 2.5 and 3.5 miles of water main be replaced annually, which would equate to about a 0.7% to 1.0% replacement rate or between 96 and 135 year replacement cycle. Total project costs in 2018 ranged between $1.5 million and $1.8 million per mile depending upon pipe size, roadway considerations (traffic control costs vary greatly depending upon the road type), and appurtenances including service lines, hydrants, etc. This means a 0.7% to 1.0% water main replacement rate would cost between $3.7 million and $6.3 million in 2018 dollars. In 2018, the City spent $3.1 million on water main replacement projects.

## Water Main Prioritization

The City has developed a prioritization matrix to facilitate the ranking and scheduling of water main replacements. The prioritization matrix includes elements of likelihood of failure and consequence of failure including information such as pipe age, pipe type, number of leaks, road classification, and soil conditions. These parameters are weighted and applied to all pipe segments to come up with a pipe ranking. These pipe rankings can then be grouped in order to minimize impacts to a particular area or neighborhood or combined with other projects such as roads, sewer, or storm in order to gain construction efficiencies and minimize disruptions. The prioritization matrix is shown in Table 7-10 below.

**Table 7-10. Water Main Prioritization Matrix**

| Criteria | Criteria 1 (likelihood of failure) | Criteria 2 (consequence of failure) | Maximum Score |
|---|---|---|---|
| System deficiency? (inadequate fire flow, standard or regulation not being met) | | Yes = 6 points<br>No = 0 points | 6 |
| Number and Cost of Leak Repairs | Number of Leaks:<br>>5 leaks / 1,000 ft = 3 points<br>>1 leak / 1,000ft = 2 points<br><1 leak/1,000 ft = 1 point<br>0 leaks = 0 points | Location of Leaks:<br>Arterial / Hillside = 3 points<br>Collector Street = 2 points<br>Local Street = 1 point | 9 |
| Pipe type, age, and soil conditions | Invasion steel / Kalamein = 6 points<br>Pipe > 75 years old = 4 points<br>Corrosive soils = 2 points | | 6 |
| Pipe Size | | Transmission (>10”) = 6 points<br>Distribution (<10”) = 0 points | 6 |
| Community Impacts | | Critical customer = 3 points<br>Commercial = 2 points | 3 |

As part of this Water System Master Plan, a GIS tool is being built that allows the City to update this matrix and re-rank water mains based on new information.

## Soil and Water Main Testing

Water mains were not inspected for this Water System Master Plan; however, some water main inspection and testing work was completed in 2014. Twelve pipe samples were taken and the results are summarized in the table below. All water mains samples were found in very good or excellent condition, except for the steel invasion pipe which was in poor condition. Data from this analysis is available in Appendix J. In addition, soil testing was completed in 2014 as various locations throughout the system. Testing results are available in Appendix K, the AWWA soil test evaluation did not find any soils that would be classified as corrosive.

### Table 7-11. Pipe Evaluation Summary

| Pipe Size & Type | Location | Wall Thickness | Condition Notes |
|---|---|---|---|
| 6” Steel Invasion | 4th St. at Ash | 0.138”l | Poor condition, when tapped with hammer pipe began to spray water |
| 8” Ductile Iron | 10th Street | 0.433” | Excellent Condition |
| 6” Cast Iron | Bellecrest Dr. / 34th St | 0.454” | Excellent Condition |
| 10” PVC | Brandon Way | 0.798” | Excellent Condition |
| 6” Cast Iron | Burlington Ave., W of Schilling | 0.380” | Excellent Condition |
| 6” Cast Iron | 1805-1816 Ernest Ave | 0.442” | Pipe in very good condition, mechanical joint, dry, excellent condition |
| 6” Ductile Iron | Joseph Crt., & Easy Street | 0.335” | Pipe in excellent condition, bell and spigot joint, very good condition |
| 6” Standard Steel | Palmer St., West of Dickens | 0.479” | Very good condition |
| 6” Steel Coated | St. Anne Street | 0.329” | Excellent Condition |
| 6” Cast Iron | Strand Ave at Schilling | 0.395” | Pipe in excellent condition, mechanical joint, dry, very good condition |
| 6” Steel | Vista Rd. West of 23rd | 0.345” | Very good condition |
| 6” Asbestos Cement | Highland Park at Ben Hogan | 0.69” | Pipe in good condition, coupling – tight, dry, appears in good condition |

Table Source: Replacement Cost New Less Depreciation Valuation, Black and Veach, Appendix G: Inspection of Watermains, 2014.

### 7.1.7 Future Well and Water Storage Facility Inspection, Testing and Maintenance Recommendations

#### Well Rehabilitation

Water wells require regular maintenance and periodic rehabilitation to ensure adequate water flow and optimum water quality. As any water well ages, well yield tends to decrease. A well maintenance and rehabilitation program can assist in prolonging the life of the well and quality of production water.

Well rehabilitation of a low yielding well can assist in prolonging the production and life of a well. The results of any rehabilitation effort is dependent upon the cause of failure or reduced performance and how far these problems have progressed.

A deviation from a normal or historical performance is generally an indication that the well is under performing and should be evaluated more carefully. Regular logging of well performance is a key factor in being able to determine when well yield decreased. As a general rule, a decrease of 25% of more in yield is an indicator that well rehabilitation is in order. Typical characteristics to monitor include; decreased pumping rate, decreased water levels, decreased specific capacity, increased cloudiness, sand or sediment at the tap and decreased total well depth. If any of these conditions persist then well rehabilitation should be considered.

There are two standard methods for rehabilitating a well: physically cleaning of the well or chemical treatment of the well to dissolve encrusted materials or remove biological elements that may be clogging the well screen. A professional well contractor should be consulted to assist with the appropriate method for rehabilitating a well.

#### Well Maintenance

A well maintenance program will enhance well performance, extend asset life, reduce operational costs and enable proactive well management. Wells should be inspected annually for obvious signs of damage to the well head or discharge piping and a visual inspection of the area around the well should be observed for any signs of contamination, mechanical problems, cleanliness, and the presence of certain contaminants, such as coliform bacteria, nitrates/nitrites, and any other contaminants of local concern, (for example, arsenic and radon). All data should be noted and documented in a well maintenance log.

Every ten years wells should be professionally inspected by a licensed water well contractor. This inspection should include a comprehensive condition assessment of all well assets including well hole, casings and screens, evaluation of the pump and motor condition, electrical service and SCADA controls, standby emergency service, site and structure conditions.

In addition, the temperature of the running pump motor should be logged as a part of routine inspections completed during rounds, as increases in running temperatures can signify the need to maintenance.

### 7.1.8 Water Storage Facility Inspection Program

The condition assessment inspection of the tanks and reservoirs was limited to the exterior conditions of the structures. There are six reservoirs that are entirely buried, so the tank itself wasn't inspection, but the site was including SCADA and security features. . Therefore HDR recommends that a tank inspection program be implemented over the 5-year capital plan to allow the de-watering of tanks/reservoirs a few at time each year for cleaning and inspection.

Like water quality monitoring, tank inspections provide information used to identify and evaluate current and potential water quality problems. Both interior and exterior inspections are employed to assure the tank's physical integrity, security, and high water quality. Inspection type and frequency are driven by many factors specific to each storage facility including its type, vandalism potential, age, condition, cleaning program or maintenance history, water quality history, funding, staffing, and other utility criteria. AWWA Manual M42, Steel Water Storage Tanks (1998) provides information regarding periodic operator inspection of existing steel tanks. Specific AWWA guidance does not exist for concrete tanks, however, the former AWWA Standard D101-53 document may be used as a guide to inspect all appurtenances on concrete tanks.

Ideally a tank inspection program will include three types of inspection; routine, periodic and comprehensive.

A robust and thorough tank and reservoir inspection program will assist with the following:

- Compliance with regulatory requirements
- Minimize environmental risk
- Safety/insurance obligations
- Preventative maintenance issues
- Extend the life of assets
- Minimize down-time

#### Routine Inspections

Routine inspections are typically done daily or weekly by operations staff to monitor the exterior of the storage facility and grounds for evidence of intrusion, vandalism, coating failures, security, and obvious signs of leaking and operational readiness. Where SCADA systems include electronic surveillance systems, alarm conditions may substitute for physical inspection.

Routine inspections should include monitoring and reporting of the following;

- Conditions of the exterior and interior coatings
- Compliance with all safety and sanitary regulations
- Verification of the tank's structural integrity
- Functionality of all security measures to protect the tank
- Needed repairs and touchups

## Periodic Inspections

Periodic inspections are designed to review areas of the storage facility not normally accessible from the ground and hence not evaluated by the routine inspections. These inspections usually require climbing the tank. Periodic inspections, like routine inspections, are principally a visual inspection of tank integrity and operational readiness. Periodic are generally conducted quarterly and include a closer look at the exterior of the tank, drains, vents, overflow discharges and appurtenances on the tank site.

Periodic inspections can be broken into four categories;

1. Coatings Conditions
   - Generic type and general condition
   - Approximate percentage and type of coatings system failure
   - Adhesion
   - Coating System Thickness
   - Extent of Pitting Damage
   - Heavy Metal Presence
2. Sanitary Conditions
   - Roof Openings
   - Access Hatches
   - Low Spots on Roofs
   - Vents
   - Overflows
3. Security Conditions:
   - Fences/Locks
   - Barricades
   - Lighting
   - Ladder Guards
   - Vents
   - Alarm Systems
   - Water Monitors
   - Control Systems
4. Safety Conditions
   - Regulations
   - Appurtenances
   - Ladders
   - Fall Prevention
   - Handrails
   - Access
   - Confined Space
   - Radiation

## Comprehensive Inspections

Comprehensive inspections are performed to evaluate the current condition of storage facility components. These inspections often require the facility to be removed from

service and drained unless robotic devices or divers are used. AWWA Manual M42 (revised 2013) recommends that tanks be drained and inspected at least once every 3 years. Comprehensive inspections include evaluation of the structural condition of the tank or reservoir, both interior and exterior.

Typical components of a structural inspection include;

- Anchor bolts
- Foundations
- Wind rods
- Riser/Shell steel
- Spider Rods
- Roof Trusses
- Weld Seams
- Concrete spalling
- Foundation issues

Coatings should also be evaluated during a comprehensive inspection by a qualified coatings specialist. Typical coating conditions to be inspected include;

- Generic type and general condition
- Approximate percentage and type of coatings system failure
- Adhesion
- Coating System Thickness
- Extent of Pitting Damage
- Heavy Metal Presence

Water storage tanks and reservoirs are valuable assets that needs to be inspected regularly for structural and sanitary integrity to help ensure the quality of the water in the community and the life of the tank. The quality of water lies, in part, with the ability to manage the storage conditions. A thorough inspection process not only ensures safety of personnel and the public but assists extending the asset life of infrastructure.

### 7.1.9 Planning Level Cost Estimates

A summary of the specific condition assessment rating by asset class, facility deficiencies, recommended improvements, and associated cost opinion for each of the facility classes inspected is included in Appendix H.

### 7.1.10 Aesthetics

In addition to purely functional considerations, City staff has expressed an interest in upgrading the aesthetics at some water facilities. This could include painting, drywall, pressure washing, siding, corrosion removal and repainting, or landscaping

**Figure 7-3. W41, Great Northern - Example of Aesthetic Improvements Recommended (Remove Pipe Corrosion, Re-Coat Piping)**

**Figure 7-4. W3, South Ave - Example of Aesthetic Improvements Recommended (Rust Removal, Painting)**

### 7.1.11 Energy Efficiency

In 2013 the City conducted an energy efficiency study of all wells and booster pumps and motors in the system. The study evaluated the pump efficiency, energy costs, and potential energy rebates. Water system staff used this information in conjunction with run times and replacement costs to determine if there were any pump and motor replacements that had a 5 year or less payback. Staff identified a number of projects that were completed. It is recommended that the City conduct another energy efficiency study to determine additional improvements that can be made.

# Chapter 8
# Risk and Reliability

2018 Water System Master Plan

*Missoula, MT*

# 8.1 Risk and Reliability Assessment

## 8.1.1 Introduction

The objective of this chapter is to perform a qualitative review of the reliability of the water system, including the identification of risk. For the purposes of this chapter, the assessment will be limited to the electric system and provision of water services during times when electricity from the power grid is not available.

## 8.1.2 Power Grid

In order to understand the risk of power failure to the Missoula water system, an analysis of the power supply was conducted.

The Missoula area is fed from a major transmission substation located northwest of Missoula and owned by NorthWestern Energy. This major transmission substation has ties to multiple generation sources with multiple high voltage transmission lines that bring power into the Missoula area. If one of the major transmission lines is down during an emergency, these other transmission lines provide adequate redundancy to supply power to the Missoula area. Additionally, there are other transmission substations in the area that help support the system and provide reliability to the transmission network. Within the City of Missoula, NorthWestern Energy operates two separate transmission networks that serve multiple distribution substations. There is a 161 kV transmission system loop, as well as a 100 kV loop. All of the distribution substations are loop fed from one or more of these transmission networks. Therefore, even with the loss of a single transmission element, power continues to flow on the transmission system.

Regarding the electrical distribution system, NorthWestern Energy has several distribution substations situated throughout the city and typically NorthWestern Energy maintains several feeders out of each substation that have normally open switches between adjacent feeders. These feeders also often tie to adjacent substations. Typically, the loss of a single distribution element on NorthWestern Energy's primary distribution system will result in a short term loss of power over a several block region (possibly a bit more) until NorthWestern Energy can close a tie breaker or switch. Most of NorthWestern Energy's distribution substations contain multiple transformers. For those stations with only a single transformer, the loss of the transformer may take some time to get the mobile substation in place or a spare transformer. Typically, loads can be picked up on adjacent feeders.

The City of Missoula's water facilities are served by NorthWestern Energy's electrical system. From the City's standpoint, the most critical electrical system elements for reliability are those at the various water facilities where the services are connected to NorthWestern via a radial tap or served by distribution substations with a single transformer. In the case of the radial distribution taps to the service transformers for the City loads, outages for this type of equipment are relatively short, given NorthWestern's personnel and warehouse in Missoula. The exception to this is if the City's facility is served by a non-standard transformer. In that case, the City could improve reliability by working with NorthWestern to insure that a spare transformer is available on site. As for the second case with the single NorthWestern distribution substation transformer, a review of the emergency transfer capabilities could be requested. If the adjacent feeders could not

provide enough power to sustain normal loads, the review could determine if the City's emergency loads could be served until a spare transformer or mobile transformer can be placed into service. As for all critical emergency loads that require true redundancy and cannot handle any sustained outages, the City could investigate backup feeds with NorthWestern Energy, in addition to City's normal backup generators to alleviate concerns.

### 8.1.3 Water Sources During Power Supply Interruptions

Missoula's water system includes a variety of components including wells, booster stations, storage tanks, and pressure reducing stations necessary to supply water to the individual pressure zones. In addition, many of the pressure zones can be supplied by opening valves, either manually or remotely, to allow water to flow from adjacent pressure zones.

Controls for the water facilities are protected from power outages by stationary generators and battery backup to allow for continued operation and monitoring of critical system components.

Water storage facilities do not need power to operate satisfactorily during a power outage. These facilities are reliable sources of water during relatively brief power outages. Having storage allows for generators to be moved between wells and booster stations to alternately fill the storage facilities.

Pressure reducing valves do not require a power source. Pressure zones supplied by PRV stations will function normally during a power outage as long as the zone supplying the water continues to be pressurized.

Wells, booster stations and support facilities need generators to provide water to customers at times when power from the utility is not available. Table 8-1 lists the generators available and the facilities that can operate with generators are listed in Table 8-2.

Most of the City's pressure zones either operate normally during a power outage (PRV zones) or are supplied by multiple sources, at least one of which does not need electricity to supply water (a well and a reservoir, for example). The single exception is the Upper Hillview pressure zone, which has the Hillview Tank Booster Station as its sole source of water. When utility power is not available, this pressure zone relies on the generator to maintain the water supply to the zone.

### 8.1.4 Emergency Power

The City of Missoula maintains emergency power capability at many, but not all, of its facilities. Portable and stationary generators are located to provide basic functionality to the water utility during times of extended power outages. The City owns 20 portable and three stationary generators. Table 8-1 lists the City-owned generators.

### Table 8-1. City Owned Generators

| Generator Number | Status | Capacity | Location |
|---|---|---|---|
| 101 | Portable | 60 kw, 240V, 1 phase | Hillview Tank |
| 203 | Portable | 150 kw, 480V, 3 phase | Office |
| 225 | Stationary | 150 kw, 240V, 1 phase | Office (stationary) |
| 236 | Portable | 250 kw, 480V, 3 phase | Momont Well |
| 237 | Portable | 250 kw, 480V, 3 phase | Office |
| 238 | Portable | 250 kw, 480V, 3 phase | Pattee Creek Well |
| 239 | Portable | 250 kw, 480V, 3 phase | Skyview Reservoir |
| 240 | Portable | 250 kw, 480V, 3 phase | Highway Reservoir |
| 241 | Portable | 250 kw, 480V, 3 phase | Stephens |
| 242 | Portable | 250 kw, 480V, 3 phase | North Reservoir |
| 415 | Portable | 500 kw, 480V, 3 phase | 23rd Wells / Boosters |
| 416 | Portable | 500 kw, 480V, 3 phase | Bank Street Well |
| 417 | Portable | 500 kw, 480V, 3 phase | Arthur Well |
| 601 | Portable | 600 kw, 480V, 3 phase | Maurice Well |
| 602 | Portable | 125 kw, 480V, 3 phase | Office |
| 603 | Portable | 125 kw, 480V, 3 phase | Lower Lincoln Hills Tank |
| 604 | Portable | 350 kw, 480V, 3 phase | South Reservoir |
| 605 | Portable | 125 kw, 480V, 3 phase | Judy Drive Well |
| 606 | Portable | 300 kw, 480V, 3 phase | Lower Elk Ridge Boosters |
| 607 | Portable | 125 kw, 480V, 3 phase | Upper Farviews Tank |
| 608 | Stationary | 100 kw, 480V, 3 phase | Canyon River Well |
| 609 | Portable | 250 kw, 480V, 3 phase | Schilling Well |

The majority of the portable generators are stationed at pumping facilities, have auto-starting capabilities and will begin powering the associated facilities without intervention from City staff. Three of the generators, #203, #237 and #602 are not stationed at pumping facilities and are maintained to replace other portable generators if they are removed for maintenance and to power facilities that do not have generators at them. To support the generators, the City maintains a 60,000 gallon reserve of diesel fuel at a central location. The fuel is conditioned to maintain quality and is delivered to the generator sites as needed using City-owned vehicles. The City is considering contracting with an outside firm for fuel delivery services to provide 24 hour per day availability.

## Facilities Capable of Generator Operation

Table 8-2 lists Missoula's facilities that are equipped to operate with a generator. The table lists the locations where the City's generators are stationed and sites with connections for generators. The sites that have connections, but where there is no generator on site, are listed as Generator Capable. Except as noted, the generator size listed is considered the smallest generator needed to operate the facility at design capacity. In some cases, a smaller generator can be used to operate a facility at partial capacity.

**Table 8-2. Facilities with Generator Capability**

| Facility | Generator Size (kw) | Generator Status | Zone Served |
|---|---|---|---|
| W2 – 14th Street Well | 250 | Generator Capable | South |
| W3A&B – South Avenue Wells | 500 | Generator Capable | South |
| W4 – Sommers Street Well | 125 | Generator Capable | East Missoula |
| W8 – Schilling Street Well | 250 | Generator #609 stationed at site | South |
| W12 – Judi Drive Well | 125 | Generator #605 stationed at site | East Missoula |
| W13 – Mountainview Well | 250 | Generator Capable | Rattlesnake |
| W17 – Momont Well | 250 | Generator #236 stationed at site | North |
| W18 – Willowwood Well | 125 | Generator Capable | South |
| W19 – North Russell Well | 250 | Generator Capable | North |
| W23 & 24 – Pattee Creek Wells | 250 | Generator #238 stationed on site | Lower Farviews |
| W25 – Stephens Well | 250 | Generator #241 stationed on site | Lower Farviews |
| W29 – Orchard Well | 250 | Generator Capable | Gharrett |
| W30 – Bank Street Well | 500 | Generator #416 stationed on site | North |
| W31 – Kiwanis Well | 500 | Generator Capable | North |
| W32 – Arthur Well | 500 | Generator #417 stationed on site | North |
| W34 – Maurice Well | 600 | Generator #601 stationed on site | South |
| W35 – Southgate Well | 250 | Generator Capable | South |
| W38, 39 and Booster Station 27 – 23rd Street Facilities | 500 | Generator #415 stationed on site. Will operate only one well and one booster pump. | Skyview |
| W40A, B, C – Linda Vista Wells | 125 | Generator Capable | Lower Linda Vista |
| W43 – Canyon River Well | 100 | Generator #608 stationed on site | East Missoula |
| B1 – Gharrett Booster | 125 | Generator Capable | Gharrett |
| B2 – Lower Elk Ridge | 125 | Generator #606 stationed on site | Lower Elk Ridge |
| B4 – High Park | 125 | Generator Capable | High Park |
| B5 – High Park Tank | 250 | Generator #240 stationed on site | Upper Farviews |
| B6 – Upper Elk Ridge | 60 | Generator Capable | Upper Elk Ridge |
| B7 – Upper Lincoln Hills | 125 | Generator #603 stationed on site | Upper Lincoln Hills |

**Table 8-2. Facilities with Generator Capability**

| Facility | Generator Size (kw) | Generator Status | Zone Served |
|---|---|---|---|
| B8 – Whittaker | 250 | Generator Capable | Upper Farviews |
| B9 – Gharrett Tank Booster | 250 | Generator Capable | Skyview |
| B13 – North Reservoir Booster | 250 | Generator #242 Stationed on site | Rattlesnake |
| B14 – Mountain View | 250 | Generator Capable | Lower Lincoln Hills |
| B15 – South Reservoir Booster | 350 | Generator #604 stationed on site | High Park |
| B17 – Skyview Tank Booster | 250 | Generator #239 stationed on site | Hillview |
| B18 – Hillview Tank Booster | 60 | Generator #101 stationed on site | Upper Hillview |
| B20 – East Missoula | 125 | Generator Capable | East Missoula |
| B23 – Upper Prospect | 250 | Generator Capable | Upper Prospect |
| B24 – Grant Creek | 60 | Generator Capable | PRV Old Quarry |
| B25 – Miller Creek | 125 | Generator Capable | Hillview |
| B26 – Mansion Heights | 125 | Generator Capable | Mansion Heights |
| B28 – Sophie Drive | 250 | Generator Capable | Upper Linda Vista |

## System Capacity During Power Supply Interruptions

The total production capacity of wells that have generators stationed on site is approximately 27 million gallons per day and is expected to be adequate to provide for the needs of the city during power outages. While it is less than Maximum Day requirements, it is expected water consumption will naturally decrease during a power outage. The City can also impose water restrictions if required. DEQ-1 states that standby power is required so that water may be treated and pumped to the distribution system during power outages to meet the average day demand. While DEQ-1 does require consideration of the largest pump out of service during normal operations, it does not require consideration of the largest pump out of service during a power supply interruption.

Table 9-3 presents water supply and demand in each of 19 Storage Zones. A Storage Zone is a pressure zone or group of pressure zones that depend on a common water storage reservoir. The Storage Zone areas and the demand projections were taken from the basis of planning data presented in Chapter 3 of this Water System Master Plan. The ability to supply water to the zone during a power outage is compared to Average day demands and Average Day demands with Fire Flow. Three water supply values are listed:

- The total amount of supply available from facilities with generation capacity,
- The amount of water supply available from facilities with generators routinely stationed on site, and,
- The firm capacity of the facilities with generators stationed on site (the firm capacity is the capacity with the largest pump supplying the Storage Zone out of service).

At times when demand is at or below Average Day values, it appears that each Storage Zone has adequate water supply capacity to provide average day demands using generators where they are normally stationed, or relying on solenoid operated valves (SOVs) to provide water from a higher elevation reservoir. Therefore the system complies with the DEQ's minimum requirement previously stated. There are five Storage Zones that would rely on Solenoid Operated Valves (SOVs) to supply water to the zone. These SOVs operate automatically with battery backup based on the storage levels in the zone. The South/PRV Fort Missoula Storage Zone shows that there is slightly less water available than required, but this difference is small enough to be inconsequential. In order for the South/PRV Fort Missoula Storage Zone to meet the required capacity for standby power, one of the portable generators located at the main office would need to be placed at a well in the south zone. The Upper Prospect/PRV Argenta/PRV Klondike Zone will need to rely on storage during a power outage but has enough storage to provide average day demands for up to 14 hours and the booster station serving the zone is generator capable.

The firm capacity of the facilities also appears to be adequate to serve each pressure zone except the South/PRV Fort Missoula Storage Zone. Failure of the Maurice Well (5,700 gpm rated flow) would create a significant deficiency in the South zone. To replace the lost capacity, all four of the other generator-capable wells serving the Storage Zone would need to have generators moved to them. An area-wide power outage would require moving generators from other wells or booster stations. Rather than move four generators, the City would likely choose to open one or more normally-closed valves connecting the South Zone to the North Zone, which has excess capacity with its generator powered wells. The excess capacity of the North Zone is somewhat less than the deficit that would be caused by loss of the Maurice Well but use of this connection would substantially ease the requirement to shuffle portable generators between sites. There is also substantial storage available to these two zones and they would operate for many hours before storage would be depleted.

Along with the ability to meet normal water demands, a system needs to be able to provide enough water to meet fire fighting requirements. Fire Flows considered for this analysis are:

- North Pressure Zone: 3,500 gpm for 2 hours for a total volume of 420,000 gallons
- South Pressure Zone: 2,250 gpm for 2 hours for a total volume of 270,000 gallons
- All other Pressure Zones: 1,500 gpm for 2 hours for a total volume of 180,000 gallons per Storage Zone[1]

When performing this analysis, the storage reservoirs were considered to be two-thirds full at the beginning of the fire flow event.

When Fire Flows are added to the Average Day demands, only five of the 19 Storage Zones have the pumping capacity to provide for demands with the generators in their routine locations without relying on storage. Only one Storage Zone, the High Park System, has the capacity to provide water in this scenario with its largest pumping unit out of service.

[1] It should be noted that single family residential areas only require 1,000 gpm for 2 hours (120,000 gallons); 1,500 gpm was chosen as a conservative value.

Most of the Storage Zones have storage available or can receive water from an adjacent zone through a SOV or PRV, neither of which require a generator to function. The Upper Lincoln Hills/PRV Lincoln Hills Dr. System and the Upper Prospect/PRV Argenta/PRV Klondike Systems are the exceptions:

1. The Upper Lincoln Hills Zone has a relatively small storage volume and does not have an SOV or PRV connection to provide additional water. The generator sited at the Upper Lincoln Hills Booster station is only large enough to operate one of the three pumps. If the generator were large enough to operate all three pumps, there would be no deficit as long as all three pumps were operable. Even with the larger generator, the failure of any pump would still result in the inability to meet average day plus fire flow requirements.
2. The Upper Prospect Zone does not have a generator located at its booster station and has to rely on storage to provide water. The storage is not adequate to provide for the fire flow requirements alone, let alone providing for average day demands. Siting a generator at the booster station large enough to operate all three pumps would provide the needed capacity during generator operation and would be very close to providing the capacity with the largest pump out of service.

The analysis does not consider the interaction between zones where some or all of the water being provided to a zone comes from adjacent zones and where increased fire flows may create supply deficits in other Storage Zones. The analysis also assumes that SOV and PRV capacity is sufficient to provide the necessary flows. The City may choose to perform hydraulic modelling to further examine this interaction between the zones.

The analysis also does not consider what is occurring within the Storage Zone. For example, the Upper Hillview pressure zone is one of six pressure zones within its Storage Zone. The Upper Hillview pressure zone is isolated from the rest of the Storage Zone and has a booster station as its sole source of water. The booster station does not have the capacity to meet the goal of 1,500 gpm fire flow[2] even when utility power is available. This is not reflected in the analysis which shows the Storage Zone meeting all requirements.

It is difficult to analyze the ability of the system to provide adequate sources of water during a wide spread extended power outage using shared generators that must be removed from service and moved between sites and a hydraulic model cannot make decisions about which generators can be moved and which sites to move them to.

To analyze the adequacy of the current facilities, the City could perform a table top exercise to examine the performance of the system during the power outage, the decisions that will be necessary to respond to the outage and the manpower required to move generators between facilities. The scenario should include higher than average water demands and failure of a critical component. The exercise will provide insight to weaknesses in the City's ability to provide water to all its customers during extended power outages.

[2] The fire flow requirement for this pressure zone is 1,000 gpm, 1,500 gpm was used as a conservative fire flow goal.

## Table 8-3. Storage Zone Demand and Supply

| Storage Zone | Ave. Day Demand (gpm) | Ave. Day + Fire Flow (gpm) | Rated Flow of Facilities with Generator Capability (gpm) | Rated Flow of Facilities with Auto Start Total/Firm (gpm) | Storage in Zone (Gallons) | Additional Sources of Water* |
|---|---|---|---|---|---|---|
| North (PZ01) | 4,470 | 7970 | 12,900 | 8,400/4,600 | 1,550,000 | NC Valves (3) |
| East Missoula (PZ09) | 480 | 1,980 | 3,630 | 1,080/525 | 300,000 | None |
| Rattlesnake/PRV Richard St. (PZ02, PZ31) | 598 | 2,098 | 4,500 | 3,600/1,800 | 1,000,000 | NC Valves (2) |
| PRV Old Quarry (PZ21) | 72 | 1,572 | 1,300 | 1,300/780 | 0 | PRV |
| Lower Lincoln Hills/PRV Mountainview (PZ32, PZ17) | 241 | 1,741 | 1,850 | 0/0 | 35,000 | NC Valve<br>SOV |
| Lower Elk Ridge/PRV Fox Farm/Timberlane (PZ14, PZ33) | 242 | 1,742 | 1,400 | 1,400/800 | 120,000 | NC Valve<br>PRV |
| Upper Lincoln Hills/PRV Lincoln Hills Dr System (PZ11, PZ35) | 89 | 1,589 | 550 | 550/550 | 41,000 | None |
| Upper Elk Ridge (PZ18) | 18 | 1,518 | 200 | 0/0 | 22,000 | SOV |
| Upper Prospect/PRV Argenta/PRV Klondkie (PZ08, PZ39, PZ38) | 170 | 1,670 | 640 | 0/0 | 150,000 | None |
| South/PRV FT Missoula (PZ03, PZ47) | 7,866 | 10,116 | 14,675 | 7,700/2,000 | 3,000,000 | NC Valves (3) |
| Lower Farviews/PRV Stephens (PZ19, PZ30) | 274 | 1,774 | 1,330 | 1,330/505 | 120,000 | NC Valves (2)<br>SOV<br>PRV |
| High Park System (PZ10) | 212 | 1,712 | 4,740 | 4,100/2,300 | 685,000 | NC Valve |
| Upper Farview/PRV High Park Tank/PRV Highland Park/Crestline System/PRV Westview (PZ13, PZ28, PZ29, PZ48) | 254 | 1,754 | 3,450 | 2,750/1,550 | 120,000 | NC Valves (3)<br>PRV |
| Mansion Heights/PRV Mansion Heights/PRV Pintlar Mountain (PZ15, PZ45, PZ46) | 99 | 1,599 | 620 | 620/340 | 210,000 | None |

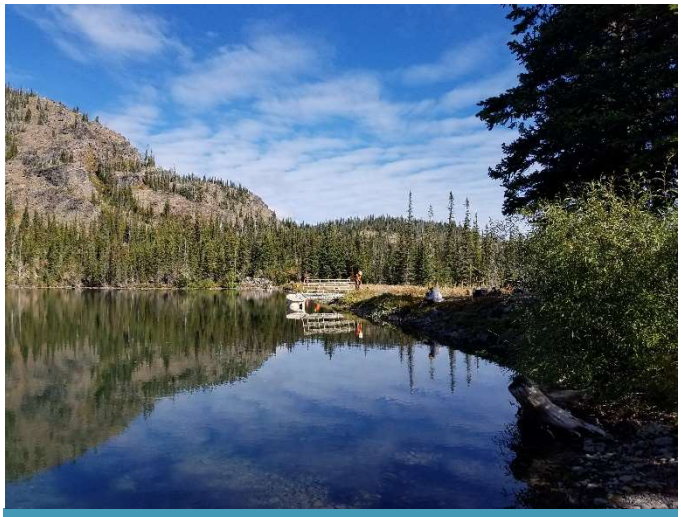
## Table 8-3. Storage Zone Demand and Supply

| Storage Zone | Ave. Day Demand (gpm) | Ave. Day + Fire Flow (gpm) | Rated Flow of Facilities with Generator Capability (gpm) | Rated Flow of Facilities with Auto Start Total/Firm (gpm) | Storage in Zone (Gallons) | Additional Sources of Water* |
|---|---|---|---|---|---|---|
| Gharrett (PZ16) | 102 | 1,602 | 1,450 | 0/0 | 152,350 | NC Valve<br>SOV |
| Skyview/PRV Foothills/23rd System/PRV Pinewood/PRV St Thomas/St Francis System/PRV Paul Lane/Jack Dr System (PZ04, PZ27, PZ22, PZ25, PZ42) | 821 | 2,321 | 2,768 | 1,775/1,750 | 1,000,000 | NC Valves (2) |
| Upper Hillview/Hillview/PRV Miller Creek/PRV Longview/Grandview/PRV 57th/PRV Gharrett (PZ12, PZ26, PZ20, PZ24, PZ23, PZ44) | 472 | 1,972 | 3,250 | 2,150/1,400 | 500,000 | NC Valves (3)<br>PRV (3) |
| Lower Linda Vista/PRV Helena Dr (PZ06, PZ36) | 153 | 1,653 | 690 | 0/0 | 85,000 | SOV |
| Upper Linda Vista/PRV Mark Court/Shaver (PZ7, PZ43,) | 350 | 1,850 | 1,866 | 0/0 | 0 | SOV (2) |

* NC Valve = Normally Closed Valve. A valve that would need to be operated manually to provide flow from an adjacent pressure zone.
SOV = Solenoid Operated Valve. A valve that can be opened remotely to provide flow from an adjacent pressure zone.
PRV = Pressure Reducing Valve. These valves supply water continuously from an adjacent pressure zone.
(#) = A number in parentheses indicated the number of devices available to the zone.

### 8.1.5 Summary and Recommendations

- The electric supply to the City's facilities is generally reliable.
- The large number of wells distributed throughout the system mitigate the effects of isolated power outages that affect a portion of the service area.
- With one exception, the pressure zones either don't require power to provide water during extended power outages or have multiple ways of providing water during power outages. This allows the City flexibility to respond during wide spread power outages and helps ensure adequate water to all its customers. The City should examine improvements necessary to provide the Upper Hillview Pressure Zone with an additional water source.
- The City should determine if any facility is served by a non-standard transformer. If so, the City should work with NorthWestern Energy to acquire a spare transformer or replace the transformer with a standard model.
- The City should determine if any facility is served by a distribution substation with a single transformer. If so, the City should request a review from NorthWestern Energy of emergency transfer capabilities to determine if the facility can be served adequately until a spare or mobile transformer can be placed into service.
- If the City determines that any facility cannot tolerate a sustained outage, the City should investigate installation of a backup feed with NorthWestern Energy for that facility.
- The City should provide replacement capacity to the South Pressure zone should the Maurice well fail during a power outage.
- It is recommended that the City consider providing the Upper Lincoln Hills Booster Station with a generator large enough to operate the entire facility or upsize the Upper Lincoln Hills reservoir to accommodate average day demands plus fire flow
- It is recommended that the City consider stationing a generator at the Upper Prospect Booster Station.
- It is recommended that the City consider performing hydraulic modelling of system performance and the interaction of demands between storage zones while under generator operation and during fire flow demands.
- It is recommended that the City perform a tabletop exercise mimicking a general power outage during elevated water consumption to evaluate whether the existing generators and the facilities that are equipped for the generators are adequate.



# Chapter 9
# Rattlesnake Dams Feasibility Study

2018 Water System Master Plan

*Missoula, Montana*

## 9.1 Introduction

Between 1911 and 1923, 10 dams were built on eight high mountain lakes in the present-day Rattlesnake Wilderness Area to augment water supply for the City of Missoula, see Figure 9-1. The City of Missoula acquired the dams and associated water rights from Mountain Water Company in 2017. The City of Missoula is now the owner and caretaker of these assets for the community. The purpose of this feasibility study is to determine the range of available options for the dams moving forward, and evaluate those options in terms of the relevant criteria including capital costs, life cycle costs, water rights, climate change, long-term community needs, regulatory agency requirements and goals, and environmental impacts among other benefits.

## 9.2 History

Rattlesnake Creek was the original water supply for the early settlers in Missoula, providing water for lumber mills and homesteaders, and because of the early water rights filing the City of Missoula now holds some of the most senior, year-round water rights in the basin dating back to 1866, a full 23 years before Montana became a state. The flow on Rattlesnake Creek is variable and between 1911 and 1923 10 dams were constructed on eight high mountain lakes in order to augment the water supply, which dwindled in late summer and early fall.

In the 1930s, Montana Power Company purchased most of the privately held land in the drainage on the west side of Rattlesnake Creek in order to protect the watershed. In 1980, the land was designated as the Rattlesnake Wilderness and National Recreation Area.

The Rattlesnake Creek portion of the water system was discontinued as a daily water supply source after *Giardia* was discovered in 1983. Since then, the intake dam, caretaker's house (which has since been demolished), the present-day log cabin, and the Rattlesnake dams themselves have been maintained as part of an emergency backup water supply system. The Rattlesnake Creek water is separated from the present-day distribution system via an above-ground air gap. The City estimates that water from Rattlesnake Creek could be connected to the distribution system in about 30 minutes if necessary; however, because there is no mechanism for treating the water, appropriate precautions would need to be taken, including placing the system under an order to boil the water.

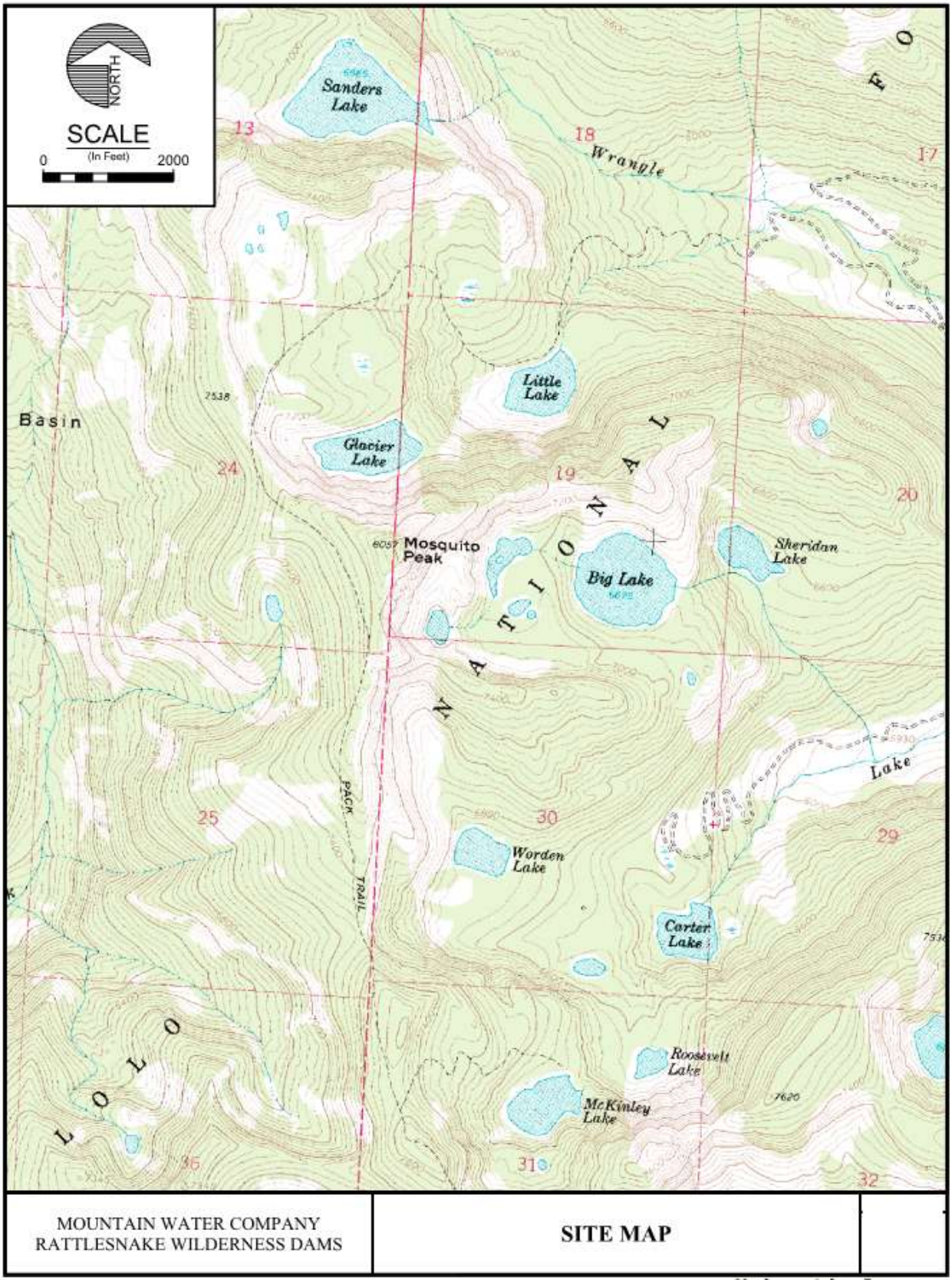



**Figure 9-1. Site Map, Rattlesnake Wilderness Dams**

## 9.3 Regulatory Framework

### 9.3.1 Special Use Permit and Easement

The regulatory environment for these dams has changed over the years, and may currently be in flux. Under the current version of the Forest Service Manual (FSM), the Forest Service (FS) has authority over all dams having Special Use Permits, which includes five dams owned by the City. The current FSM also states that the FS has no authority over "…dams authorized by a pre-Federal Land Policy Management Act right-of-way or to congressionally withdrawn water projects." This provision includes the remaining five City dams located on easements. However, the FS has requested to be involved in actions associated with the easement dams because most dam-related actions directly or indirectly immediately affect FS resources and public values. The State of Montana permits high hazard dams only and does not regulate dams located on federal property, so currently the regulatory authority of the right-of-way, or "easement," dams is unclear. The FS and Montana DNRC are in the process of developing a Memorandum of Understanding regarding regulatory authority over Special Use and Easement dams. The selection of Special Use and Easement dams to be regulated by the DNRC would be done on a case by case basis.

This section summarizes the requirements of the Special Use Permit (Appendix L), the requirements for the easement dams, and the dam safety standards used for evaluation as well as guidance for other alternatives including decommissioning of the dams.

The Rattlesnake Wilderness dams are listed in **Error! Reference source not found.**.

**Table 9-1. Rattlesnake Wilderness Dams**

| Name of Lake | Permit or Easement[a] | Hazard Classification | Maximum Storage Volume (acre-feet)[b] | Drainage |
|---|---|---|---|---|
| Big Lake | Easement | Significant | 621 | Lake Creek |
| Carter Lake | Permit | Low | 161 | Lake Creek |
| Glacier Lake | Easement | Significant | 240 | Wrangle Creek |
| Little Lake | Easement | Significant | 298 | Wrangle Creek |
| McKinley Lake | Easement | Significant | 168 | Lake Creek |
| Sanders South Lake | Permit | Significant | 897 | Wrangle Creek |
| Sanders North Lake | Easement | Significant | 897 | Wrangle Creek |
| Sheridan East Lake | Permit | Significant | 130 | Lake Creek |
| Sheridan West Lake | Permit | Significant | 130 | Lake Creek |
| Worden Lake | Permit | Significant | 70 | Lake Creek |
| | TOTAL | | 2,585 | |

**Table 9-1. Rattlesnake Wilderness Dams**

| Name of Lake | Permit or Easement[a] | Hazard Classification | Maximum Storage Volume (acre-feet)[b] | Drainage |
|---|---|---|---|---|

[a] *Permit* refers to a special-use permit from the U.S. Forest Service, which authorizes specific use of the land for a period of time. The current special-use permit expires in 2036.

*Easement* refers to an easement that was granted from the U.S. Forest Service.

[b] This volume refers to the maximum storage volume available. The storage volume according to the water right may be different.

## 9.3.2 Special Use Permit

The City of Missoula is authorized to use and occupy National Forest lands in the Rattlesnake vicinity of the Lolo National Forest, subject to the terms and conditions of their special use permit. The permit covers 22 flooded acres and 3.14 miles of road. Of the ten dams owned by the City, five are administered under the special use permit and five exist under easements and are not under the direct jurisdiction of the US Forest Service.

The purpose of the special use permit is to authorize the operation and maintenance of the five existing dams on National Forest land, as well as to maintain and use existing roads and trails for access to the water storage sites. The current permit expires on December 31, 2036. Key information from the special use permit is summarized below.

### General Terms

- Permit issued pursuant to Federal Land Policy and Management Act, amended 1976.
- Dam/Reservoir management in compliance with the Rattlesnake National Recreation Area and Wilderness Act of 1980.
- The permit is not renewable. Prior to the permit expiration, the City of Missoula may apply for a new permit no less than six months prior to the permit expiration. The type of use and occupancy to be authorized by a potential new permit should be consistent with the prior permit.
- The existing permit may be amended by the FS to incorporate new laws and directives as deemed necessary by the authorized officer.
- The use or occupancy authorized by this permit is not exclusive. The lands and waters covered by this permit shall remain open to the public for all lawful purposes.

### Improvements

- The permit does not give or imply permission to build or maintain any structure not specifically authorized by the permit.
- Any plans for the development or construction of improvements in the permit area must have written approval from the authorized officer before they are implemented.

## Operations

- Use or occupancy of the permit area shall be exercised every day of the year.
- The permit holder shall maintain the permit area to standards of repair and orderliness acceptable to the authorized officer and consistent with the provisions of the permit.
- The City shall prepare and annually revise by June 1 an Operating and Maintenance Plan. The plan shall outline steps the permit holder will take to protect public health, safety, and the environment, and shall include sufficient detail and standards to enable the FS to monitor the City's operations for compliance.
- The FS reserves the right to inspect the permit area and transmission facilities at any time for compliance with the terms of the permit.

## Rights and Liabilities

- The permit constitutes a federal license.
- The permit does not provide for the furnishing of road or trail maintenance, water, fire protection, or any other such service by a government agency, association or individual.
- The permit holder assumes all risk of loss associated with use or occupancy of the permit area, including theft, vandalism, fire and fire-fighting activities, avalanches, or other forces of nature. If substantial damage occurs to facilities within the permit area and rebuilding is not deemed allowable, the permit will terminate.
- The permit holder has a duty to protect the property of the United States from damage. The permit holder shall avoid damaging or contaminating the environment, including the soil, vegetation, surface water, and groundwater, and will be liable for any damage that they cause.
- The permit holder shall immediately repair inflicted damage to the permit area at no expense to the United States.
- The permit holder shall plan to prevent the establishment and spread of invasive species.
- The permit holder shall indemnify the United States for any costs or damages arising from past, present, and future acts or omissions of the holder in connection with the use or occupancy authorized by this permit.
- The permit holder shall be strictly liable to the United States for $1 million per occurrence for any injury, loss, or damage arising in tort under the permit.
- The permit holder shall furnish proof of insurance to the authorized officer prior to issuance of this permit and each year thereafter that this permit is in effect. Minimum amounts of coverage and other insurance requirements are subject to change.

## Resource Protection

- The permit holder shall comply with all applicable federal, state, and local environmental laws and regulations.

- Pesticides may not be used outside of buildings without prior written approval from the authorized officer.
- The permit holder shall notify the authorized officer of all antiquities or other objects of historic or scientific interest discovered in the permit area.
- The holder shall not store any hazardous materials at the site without prior written approval from the authorized officer.
- The permit holder shall clean up or otherwise remediate any release, threat of release, or discharge of hazardous materials that occurs in the permit area.

## Land Use Fee and Accounting Issues

- The use or occupancy authorized by this permit is exempt from a land use fee or the land use fee has been waived in full.
- The land use fee may be revised whenever necessary to reflect the market value of the authorized use. If that is the case, payments would be subject to interest rates and late fees.

## Revocation, Suspension, and Termination

- The authorized officer may revoke or suspend this permit in whole or in part:
  - For noncompliance with federal, state, or local law.
  - For noncompliance with the terms of the permit.
  - For abandonment or other failure of the permit holder to exercise the privileges granted.
  - With the consent of the holder.
  - For specific and compelling reasons in the public interest.
- The authorized officer may immediately suspend this permit in whole or in part when necessary to protect public health, safety, or the environment.
- Upon revocation or termination of the permit without renewal of the authorized use, the permit holder shall remove all structures and improvements, except those owned by the United States, and shall restore the site to the satisfaction of the authorized officer.

## Miscellaneous Provisions

- The permit holder shall assure that the discharge from the project area is a continuous, minimum flow pursuant to state water rights. No diversion of water will be permitted contrary to state water rights.
- The special use permit does not confer any water rights on the holder. Any necessary water rights must be acquired by the permit holder in accordance with state law.
- The FS reserves the right to issue additional authorizations to other applicants to increase the storage capacity of this site if such action proves feasible.

- The permit holder shall be responsible for the prevention and control of noxious weeds in the permit area, and will submit a control plan subject to FS approval.
- The authorized officer may order an immediate temporary suspension of all human activities permitted by this authorization and, if needed, suspend or revoke the special use authorization when such action is necessary to prevent conflict between humans and grizzly bears.
- The permit holder must comply with the requirements of the Grizzly Bear Management and Protection Plan for the permit area.
- Acts by the permit holder that result in the injury or death of a grizzly bear will be cause for suspension or revocation of this authorization in whole or in part.
- The permit holder shall submit a Reservoir/Dam Operation and Maintenance Plan consisting of the following sections:
  - Water storage and releases, including dates and/or criteria for filling and release.
  - Procedures for flood conditions.
  - Inspection and safety requirements.
  - Erosion prevention in reservoir area and spillway channel.
  - Trash and debris removal.
  - Maintenance requirements as necessary.
  - Date of plan and relevant signatures.
- Beginning in 2017 and every five years thereafter, the permit holder shall have a dam safety evaluation performed by a professional engineer to verify the safety of the dam.
- The permit holder shall have operation and maintenance inspections of the dams and appurtenant structures conducted in accordance with Table 9-2. A summary of the existing dams can be seen in Tables 9-3 and 9-4.

**Table 9-2. Dam Inspection Requirements**

| Hazard Assessment Classification[d] | Inspection Type | Inspection Frequency (Years) | Level of Expertise Required |
|---|---|---|---|
| Low | O & M | 10 | Qualified Engineer |
| | Hazard Assessment | 10[a] | Qualified Engineer |
| | Special | b. | Qualified Engineer |
| Significant | O & M | 5 | Qualified Engineer |
| | Hazard Assessment | 5[a] | Qualified Engineer |
| | Special | b. | Qualified Engineer |
| High | O & M | 1 | Qualified Engineer[c] |
| | Safety | 5[a] | Qualified Engineer |
| | Special | b. | Qualified Engineer |

a. Perform hazard assessment more frequently if downstream development is observed.

b. A special inspection must be performed by a qualified engineer.

c. A qualified engineer must review and approve in writing the annual O & M inspection reports for dams with a high hazard assessment classification. At a minimum, the annual onsite inspection must be completed by someone familiar with the operation of the dam.

d. FSM 7500: Hazard Potential Classification. A system that categorizes dams according to the degree of adverse incremental consequences from their failure or misoperation, that does not reflect in any way on their current condition (that is, their safety, structural integrity, or flood routing capacity), and that includes the following categories:

1. Low. A classification that includes dams whose failure, malfunction, or misoperation would result in no probable loss of human life and minor damages limited to undeveloped or agricultural lands and for which significant improvements are not planned in the foreseeable future.
2. Significant. A classification that includes dams whose failure, malfunction, or misoperation would result in no probable loss of human life but could cause economic loss, disruption of lifeline facilities, or other significant impacts and would result in non-recoverable environmental damage.
3. High. A classification that includes dams whose failure, malfunction, or misoperation would result in a probable loss of human life.

**Table 9-3. Hazard Assessment Classification Permit Dams**

| Name | Hazard Assessment Classification | Dam Type |
|---|---|---|
| Sanders #2 (South) | Significant | Earthen with Rock Crib |
| Sheridan #1 (East) | Significant | Earthen with Rock Crib |
| Sheridan #2 (West) | Significant | Earthen with Rock Crib |
| Worden | Significant | Earthen* |
| Carter | Low | Earthen with Rock Crib** |

*Original construction drawings indicate no rock crib. This has not been verified.

**Original construction drawings indicate no rock crib but a subsequent investigation indicated the presence of a crib structure.

**Table 9-4. Hazard Assessment Classification Easement Dams**

| Name | Hazard Assessment Classification | Dam Type |
|---|---|---|
| Big Lake | Significant | Rock Crib |
| Glacier Lake | Significant | Rock Crib |
| Little Lake | Significant | Rock Crib |
| McKinley Lake | Significant | Earthen* |
| Sanders Lake (North) | Significant | Rock Crib |

*Original construction drawings indicate no rock crib. This has not been verified.

### 9.3.3 Dam Safety Regulations

As stated above, according to the current version of the Forest Service Manual (FSM), the FS has authority over all dams having Special Use Permits, which includes five dams owned by the City.

The State of Montana permits high hazard dams only and does not regulate dams located on federal property, so the regulatory authority of the easement dams is unclear.

In the absence of clear direction and authority on the easement dams, it is logical to look to the FSM for dam safety criteria. Historically, the dams have been operated and maintained in accordance with FS regulatory criteria which are found in FSM 7500. As the City evaluates alternatives for the dams, there may be areas where the distinction becomes important and these shall be noted throughout the evaluation.

## 9.4 Water Rights

The City of Missoula has partnered with Trout Unlimited to remove the Rattlesnake intake dam. This dam is located on Rattlesnake Creek, below the Rattlesnake Wilderness and National Recreation Area. See Figure 9-2. While the intake dam is not a subject of this chapter, a cursory water rights evaluation was conducted by Trout Unlimited and WGM Group. These evaluations provide some insight and guidance on the Rattlesnake Wilderness Dams water rights. This section provides a summary of those evaluations.

### 9.4.1 Overview of Rattlesnake Water Rights

The Rattlesnake Creek water rights include Statements of Claim for surface water from Rattlesnake Creek, eight Statements of Claim to store water in the lakes near the headwaters of Rattlesnake Creek, and seven Statements of Claim for water directly diverted from the creek without storage. The storage and direct- flow water rights, combined in their use, provided a reliable year-round source of supply for several decades as the city of Missoula grew in population and water demands. All Rattlesnake water rights have a period of use from January 1 to December 31. A summary of these water rights is provided in Table 10-5 below.

In 1983, the water system moved to groundwater wells due to contamination concerns (giardia) in the Rattlesnake Creek surface water. In an effort to protect the senior water rights from non-use and potential abandonment concerns, the seven direct-flow rights were changed in 1998 to add eight wells (3A, 3B, 21, 30, 31, 32, 33, and 24) as additional points of diversion that are hydrologically connected to surface water. The eight lake storage rights were not changed to allow diversion from the hydrologically connected wells, but it remains an option to do so.

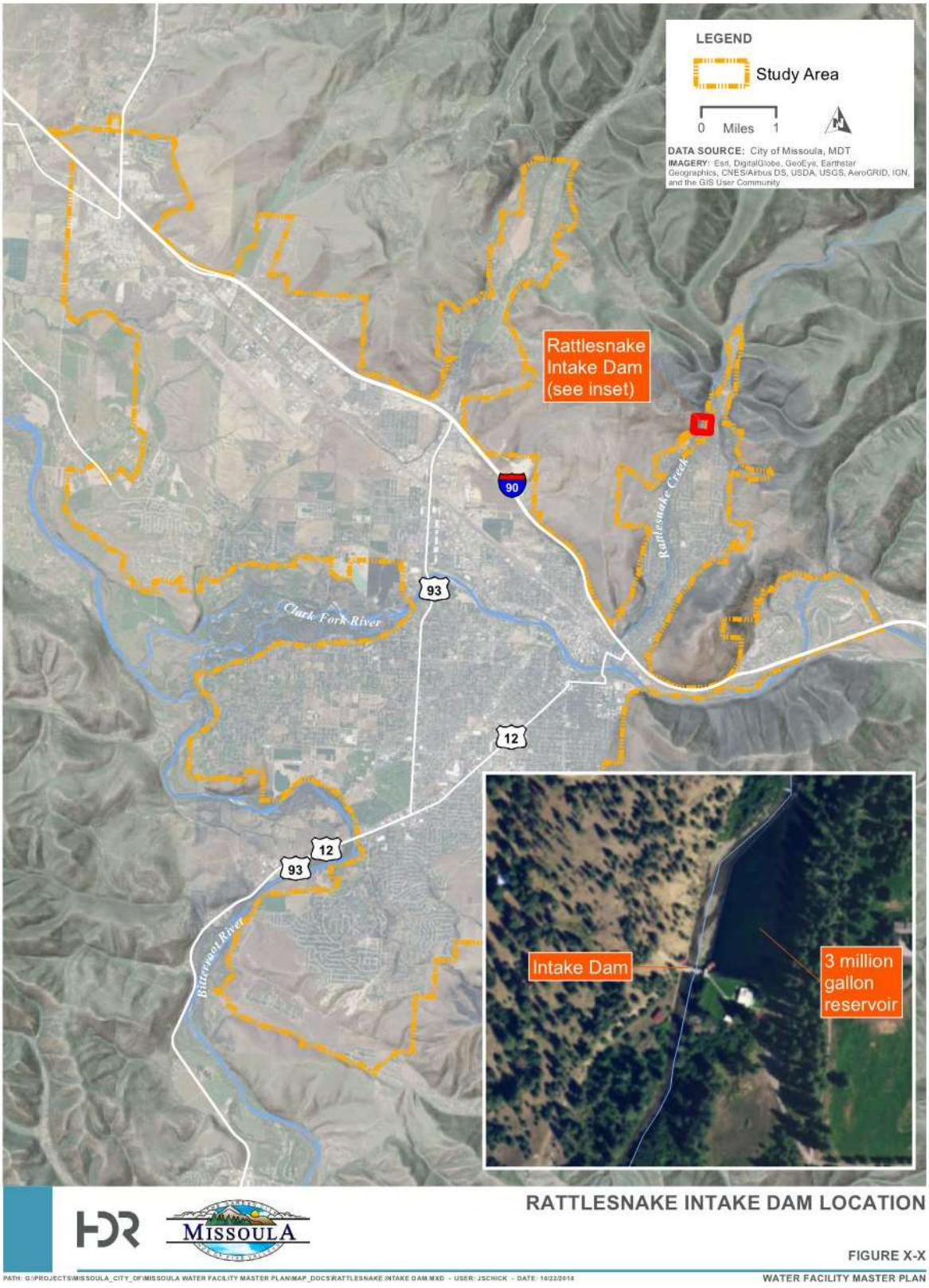



**Figure 9-2. Rattlesnake Intake Dam**

**Table 9-5. Rattlesnake Dams Water Rights Summary**

| Diversion | Water Right | Priority Date | Claimed Flow Rate | Claimed Volume (AF) |
|---|---|---|---|---|
| Little Lake Dam | 76M 26358 00 | 8/30/1919 | 2.50 cfs | 300 |
| Sanders Lake Dam | 76M 26361 00 | 8/30/1919 | 7.54 cfs | 905 |
| Glacier Lake Dam | 76M 26362 00 | 8/30/1919 | 1.76 cfs | 212 |
| Sheridan Lake Dam | 76M 26363 00 | 8/30/1919 | 431 gpm | 115 |
| Big Lake Dam | 76M 26364 00 | 8/30/1919 | 5.22 cfs | 623 |
| Carter Lake Dam | 76M 26365 00 | 11/6/1923 | 1.43 cfs | 170 |
| Worden Lake Dam | 76M 26366 00 | 9/8/1923 | 398 gpm | 104 |
| McKinley Lake Dam | 76M 26367 00 | 8/13/1923 | 1.64 cfs | 195 |
| Intake Dam/Wells | 76M 40170 00 | 4/1/1866 | 23.65 cfs | 17,165 |
| Intake Dam/Wells | 76M 40171 00 | 11/16/1868 | 4 cfs | 2,903 |
| Intake Dam/Wells | 76M 40172 00 | 4/1/1871 | 152.6 gpm | 246 |
| Intake Dam/Wells | 76M 40173 00 | 5/1/1871 | 1.62 cfs | 1,176 |
| Intake Dam/Wells | 76M 40174 00 | 4/1/1881 | 1.16 cfs | 842 |
| Intake Dam/Wells | 76M 40175 00 | 5/1/1881 | 8.7 cfs | 6,314 |
| Intake Dam/Wells | 76M 40176 00 | 6/1/1877 | 16.13 cfs | 11,707 |

The essence of the DNRC change authorization for the seven direct-flow rights is to allow the use of water rights with priority dates that are relatively senior in the Clark Fork Basin to be pumped from wells instead of from Rattlesnake Creek. As part of the change authorization, the flows in Rattlesnake Creek were measured just below the intake dam and the flows in each of the wells was measured with in-line flow meters. When the well flow rates are less than or equal to the creek flows, the wells are deemed to be pumping only creek water. When the well flow rates exceeded creek flows, the wells are pumping creek water up to the creek flow rate and any excess is attributed to the junior water right permits for the wells.

According to records that were submitted for the year 2000, a total volume of 13,266 ac-ft of water was attributed to the Rattlesnake Creek senior water rights that year. The current water rights allow up to a total of 40,588 ac-ft of direct flow Rattlesnake Creek water to be used annually. In addition, the storage rights allow for an annual volume of 2,624 ac-ft. Recent decisions from the Montana Water Court and the Montana Supreme Court may provide protection for any portion of these water rights that may have gone unused in recent years.

### 9.4.2 Rattlesnake Water Rights Evaluation

As part of the Rattlesnake Intake Dam removal project, Trout Unlimited conducted an overview of the status of the City's water rights, and offered several recommendations for

how best to protect the existing storage water rights in the Rattlesnake vicinity against abandonment. Montana water law is subject to the "Prior Appropriation Doctrine", and if one's water rights are not put to beneficial use over a period of time, they could be deemed abandoned.

Montana water law has consistently struggled to classify what exactly constitutes abandonment[1]. A 2005 Montana Supreme Court case, *City of Helena v. Community of Rimini*, set a low standard for municipal water rights holders to reach in order to create a presumption of non-abandonment. However, it is possible that this favorable ruling for municipal water rights holders will be challenged in coming years as water demands increase.

*Downstream hydropower corporations own water rights that pre-date the City's well water rights, but do not pre-date the Rattlesnake Wilderness water rights.*

Consequently, it would be prudent for the City of Missoula to take proactive measures to guard against non-use of its Rattlesnake Dam water rights and for a number of years, the use of the dams has been limited.

With this in mind, several options were outlined by Trout Unlimited for the City to move forward to maximize its water rights and protect against abandonment. The first option outlined, considered to be the City's best by Trout Unlimited, was to remove the mainstem dam on Rattlesnake Creek as well as the non-functional mountain lakes dam infrastructure. The use of the mountain lakes rights would then be changed to instream flow through an Application to Change with DNRC. Trout Unlimited considered this approach to be the best way to maximize the benefit of the water right assets while legally protecting their full use. Limitations regarding the historical period of use may decrease the amount of water that could be protected under this type of change.

The second option outlined was to remove the mainstem dam, repair the dam/storage infrastructure on the mountain lakes, and add instream flow and/or mitigation as a beneficial use to the mountain lake rights. This would allow the City to release storage water into Rattlesnake Creek during periods of low flow and would provide legal security

1 MCA85-2-227 states that a water right that is claimed for municipal use by a city, town, or other public or private entity that operates a public water supply system, as defined in 75-6-102, is presumed to not be abandoned if the city, town, or other private or public entity has used any part of the water right or municipal water supply and there is admissible evidence that the city, town, or other public or private entity also has:

(a) obtained a filtration waiver under the federal Safe Drinking Water Act, 42 U.S.C. 300(f), et seq.;

(b) acquired, constructed, or regularly maintained diversion or conveyance structures for the future municipal use of the water right;

(c) conducted a formal study, prepared by a registered professional engineer or qualified consulting firm, that includes a specific assessment that using the water right for municipal supply is feasible and that the amount of the water right is reasonable for foreseeable future needs; or

(d) maintained facilities connected to the municipal water supply system to apply the water right to:

(i) an emergency municipal water supply;

(ii) a supplemental municipal water supply; or

(iii) any other use approved by the department under Title 85, chapter 2, part 4.

against any claims of abandonment. However, restoring the dam/storage infrastructure of the mountain lakes would likely cost several million dollars. Several other options were outlined by Trout Unlimited that were some combination of these two options.

The letter and accompanying recommendations from Trout Unlimited were subsequently reviewed by WGM Group, and they provided their analysis in a memorandum to the City of Missoula (Appendix J). WGM generally agreed with Trout Unlimited's assessment that steps should be taken to protect the City's existing water rights against abandonment. In addition to this concern, the concern of priority was raised by WGM.

Downstream hydropower corporations hold large power-generation water rights on the Clark Fork River. These power-generation rights pre-date several of the City's well water rights, but not the rights from Rattlesnake Creek. Consequently, it may be in the City's best interest to prioritize protection of its most senior water rights associated with the Rattlesnake lake dams. One way to do this is through an Application to Change similar to the one filed for the direct flow rights.

With the storage rights authorized to be diverted from the wells, the City is exercising its senior Rattlesnake Creek rights whenever creek water is available in excess of the pumping rate of the wells. When the amount of water drops below that threshold, then the City is exercising both its senior creek rights and junior well rights. Those junior rights could be potentially called by downstream hydropower interests.

*Without the wilderness dams in place, historically stored water would be lost during the spring runoff period and would not be available later in the year to counteract diminished flows.*

With that in mind, concerns were raised by WGM regarding Trout Unlimited's preference to remove the mountain lakes infrastructure. It was noted by WGM that without the wilderness dams in place as control structures, it would not be possible to exercise the existing water rights during periods of low flow. While the existing storage rights list year-round use and diversion, the historical practice was likely to store water in the spring for release during low flow periods later in the year. Without the wilderness dams in place, historically stored water would be lost during the spring runoff period and would not be available later in the year to counteract diminished flows. Several other concerns were raised pertaining to changing the designation of the water rights (storage, mitigation, instream, etc.).

Given these concerns, it was concluded by WGM that a variation on Trout Unlimited's second option should be considered. It was suggested by WGM that the mainstem dam and intake be removed, the wilderness dam/dams in the worst condition be removed, the wilderness dam/dams in better condition be rehabilitated, and the existing storage rights be changed to add the valley wells as points of diversion.

Several benefits are offered by this variation. The ability to release water to supplement low flow conditions would be maintained. More importantly, maintaining the existing dams would allow the City to continue to store water under the historical priority dates of the storage rights, providing a level of protection against other water claims that can't be obtained any other way. It was additionally emphasized by WGM that if the wilderness dams were removed, it is unlikely that they could ever be rebuilt.

## 9.5 Environmental Review and Permitting

Regardless of the recommendations, some form of permitting, agency coordination, and NEPA review will be required for raising the dam(s), removing dams, or performing significant rehabilitation or repair work.

### 9.5.1 National Environmental Policy Act (NEPA)

NEPA, the National Environmental Policy Act (42 U.S.C. 4321), requires federal agencies to fully consider the impacts of any of their proposals that carry the potential to affect the human environment. Under the law, the environmental impacts of any proposed federal actions must be evaluated before any further action is taken. These requirements are summarized in the following paragraphs.

### 9.5.2 Montana Environmental Policy Act

The Montana Environmental Policy Act (MEPA), requires state agencies to evaluate the environmental impacts of state proposals before any action can take place. MEPA was patterned after NEPA, and contains three parts. Part One declares Montana's environmental policies, Part Two stipulates how state agencies are to carry out the policies of Part One through environmental review, and Part Three establishes the Environmental Quality Council (EQC).

The fundamental sentiment of MEPA is that one should think before acting. In that regard, MEPA requires state agencies to prepare environmental reviews whenever any of the following three conditions are satisfied:

- The action may impact the human environment.
- The agency intends to take an action, as defined by MEPA and the MEPA Model Rules.
- The action is not an EXEMPT ACTION or excluded from MEPA review.

The degree and intensity of any potential impacts determines the type of environmental review necessary. However, the degree or intensity of any potential impacts is irrelevant in determining whether environmental reviews must be conducted.

MEPA specifies three different levels of environmental review contingent on the magnitude of potential impacts. The levels are Categorical Exclusion (CE), Environmental Assessment (EA), and Environmental Impact Statement (EIS). If it is unclear whether a proposed action carries significant impacts, then an EA may be conducted to determine potential significance. If the EA shows that the proposed action will have significant impacts, then either an Environmental Impact Statement (EIS) must be written or the effects of any proposed action must be mitigated below the level of significance.

The only substantive differences between an EA and an EIS lie in the scope and depth of the analysis.

Actions that seldom cause significant impacts to the human environment may qualify for a categorical exclusion. No further environmental review is required for an action that is deemed to meet the criteria for exclusion by a state agency.

Other actions that do not require review under MEPA include but are not necessarily limited to:

- Administrative Actions
- Ministerial actions
- Actions primarily social or economic in nature that do not otherwise affect the human environment
- Specific actions exempted by the legislature

It's likely that some level of NEPA/MEPA analysis would be required for increasing the reservoir storage levels or decommissioning a dam. Further study is necessary to determine if NEPA/MEPA would be required for the dam rehabilitation options.

### 9.5.3 Wilderness Act

The Wilderness Act of 1964, as enacted September 3, 1964, and amended October 21, 1978 (16 U.S.C. 1131-1136), specifies congressional policy to secure for the American people an enduring resource of wilderness for the enjoyment of present and future generations. With certain exceptions, the Act prohibits motorized equipment, structures, installations, roads, commercial enterprises, aircraft landings, and mechanical transport. The Act permits mining on valid claims, access to private lands, fire control, insect and disease control, grazing, water resource structures (upon the approval of the President), and visitor use.

The Wilderness designation constrains not only how the public may use the lands (e.g., no off-road vehicles, no bicycles) but also how the agency administers it. In other words, the Wilderness designation intentionally constrains both the public and the federal manager. However, there are minimum requirements exceptions that can be identified through a minimum requirements analysis which allows for certain activities. These are further described below.

#### Wilderness Act Minimum Requirements

Section 4(c) of the Wilderness Act of 1964 introduces the concept of 'minimum requirements' as shown below.

*4(c) Except as specifically provided for in this Act, and subject to existing private rights, there shall be no commercial enterprise and no permanent road within any wilderness area designated by this Act and except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area.*

Four federal agencies administer wilderness: the Bureau of Land Management (BLM), National Park Service (NPS), US Fish and Wildlife Service (USFWS), and US Forest Service (FS). Each agency has policies and procedures for determining when an otherwise prohibited activity may be employed because it may meet the minimum requirement exception. The agencies joined together to establish a national wilderness training center,

the Arthur Carhart Center, in Missoula, Montana. One important function of the Carhart Center is to develop a systematic and consistent standard for applying the exception across agency lines.

The Arthur Carhart National Wilderness Training Center has published the *Minimum Requirements Decision Guide* for the U.S. Forest Service Guidelines, which can be used when making a determination that one of the 'prohibited uses' is the minimum necessary requirement. Additional guidance can be found in FSM 2320 – Wilderness Management. Specific aspects that may be critical considerations moving forward include effects on the following wilderness qualities: untrammeled, natural, undeveloped, solitude or primitive and unconfined recreation, and historical value.

It should be noted that the water rights holder (Mountain Water Company until 2017, currently the City of Missoula) has been afforded specific provisions that were explicitly written into the 1980 Rattlesnake Wilderness designation (Appendix N) as follows:

Public Law 96-476 – Oct. 19, 1980, Section 2(d)(2) *Nothing in this Act shall be construed to permit the Secretary to affect or diminish any water right which is vested under either State or Federal law at the time of enactment of this Act, nor the rights of the owner of such water right to the customary and usual access, including necessary motorized use over and along existing roads and trails to any facilities used in connection therewith, and the right to operate and maintain such facilities.*

Dams related work is possible (and protected by law), and it is important to follow the guidance for work in the wilderness area and engage the lead agency, FS, and the public on proposed major work and changes to the dams using the NEPA process.

*The City has the following rights described in Public Law 96-476; "…rights of the owner of such water right to the customary and usual access, including necessary motorized use over and along existing roads and trails to any facilities used in connection therewith, and the right to operate and maintain such facilities."*

## 9.6 Additional Considerations

This section provides an initial overview of fisheries and Rattlesnake Creek flows.

### 9.6.1 Fisheries

The report titled *"Mountain Lake Surveys and Fisheries Management Recommendations – Rattlesnake Wilderness lakes"* published in 2013 is a good reference for lake information and fisheries/aquatic management considerations. In 2006-2010, Montana Fish Wildlife and Parks (MFWP) and volunteers surveyed nearly all fish-bearing and fishless mountain lakes in the Rattlesnake National Recreation Area and Wilderness (RNRAW) to describe physical and biological characteristics.

The study includes 45 lakes, sixteen of the lakes larger than one acre were found to support trout fisheries, some of which are maintained through stocking. The others are important for fish-less or amphibian/reptile ecosystems. Rattlesnake Creek is a high value fishery, particularly for bull trout, and it is utilized for fish migration. The smaller tributaries in the wilderness area are too steep for bull trout, but bull trout are known to occupy the upper portions of Rattlesnake Creek and tributaries where gradient is not limiting.

Dams and other infrastructure were installed on at least ten of the Rattlesnake unit lakes to enhance storage capacity. These modifications typically exaggerate annual water level fluctuations at these lakes. In the Lake Creek drainage, Big Lake and Sheridan Lake support self-sustaining rainbow trout populations and are likely the primary sources of this species in upper Rattlesnake Creek.

Descriptions given for the Rattlesnake Lakes with dams owned by the City are provided below, and summarized in Table 9-6.

- Big Lake is a large glacial cirque lake that was artificially impounded by a dam at the outlet in 1915. This structure elevates the normal surface water elevation, but may also increase annual water level fluctuations.
- Carter Lake is a relatively small glacial cirque lake that was artificially impounded by a dam at the outlet in 1921. This structure elevates the normal surface water elevation, but may also increase annual water level fluctuations. Carter Lake supports an abundant, stunted population (10 inch max length) of wild westslope cutthroat trout.
- Glacier Lake is a relatively large glacial cirque lake that was artificially impounded by a dam at the outlet in 1911. This structure elevates the normal surface water elevation, but may also increase annual water level fluctuations.
- Little Lake is a moderately sized glacial cirque lake that has been artificially impounded by a dam at the outlet. This structure elevates the normal surface water elevation, but may also increase annual water level fluctuations. Little Lake supports the only Yellowstone cutthroat trout population in the project study area and is likely the source of Yellowstone cutthroat trout hybridization with native westslope cutthroat trout stocks in Rattlesnake Creek.
- McKinley Lake is a moderately sized glacial cirque lake that has been artificially impounded by a dam at the outlet. This structure elevates the normal surface water elevation, but may also increase annual water level fluctuations.
- Sanders Lake is a large glacial cirque lake that has been artificially impounded by a dam at the outlet. This structure elevates the normal surface water elevation, but may also increase annual water level fluctuations.
- Sheridan Lake is a moderate sized glacial cirque lake that has been artificially impounded by a dam at the outlet. This structure elevates the normal surface water elevation, but may also increase annual water level fluctuations.
- Worden Lake is a small glacial cirque lake that has been artificially impounded by a dam at the outlet. This structure elevates the normal surface water elevation, but may also increase annual water level fluctuations. Worden Lake contains wild westslope cutthroat trout.

Table 9-6. Fisheries Data on Rattlesnake Wilderness Dams, According to FWP

| Lake | Elevation (ft) | Surface Acres | Max Depth (ft) | Lake Volume (acre-ft) | Dam Infrastructure Present? | Current Fishery | Recommended Future Actions |
|---|---|---|---|---|---|---|---|
| Big Lake | 6,875 | 40.2 | 136 | 2,255 | Yes | Wild rainbow trout | Maintain wild fishery; evaluate removal of rainbow trout and conversion to westslope cutthroat trout fishery |
| Carter Lake | 6,300 | 12.9 | 31 | 171 | Yes | Wild westslope cutthroat trout | Maintain westslope cutthroat trout fishery; confirm that population is self-sustaining |
| Glacier Lake | 6,980 | 18.4 | 71 | - | Yes | fishless | Maintain fishless status: identify any unauthorized fish introductions |
| Little Lake | 6,425 | 13.9 | 52 | 309 | Yes | Wild Yellowstone Cutthroat Trout | Maintain wild fishery; Evaluate removal of YCT and conversion to WCT fishery. |
| McKinley Lake | 6,860 | 15.8 | 28 | 211 | Yes | Wild rainbow trout | Maintain wild fishery; evaluate removal of rainfow trout and conversion to westslope cutthroat trout fishery |
| Sanders Lake | 6,885 | 47.5 | 217 | 3,543 | Yes | Wild westslope cutthroat trout | Maintain westslope cutthroat trout fishery; confirm that population is self-sustaining |
| Sheridan Lake | 6,535 | 9.8 | 33 | 168 | Yes | Wild rainbow trout | Maintain wild fishery; evaluate removal of rainbow trout and conversion to westslope cutthroat fishery |
| Worden Lake | 6,700 | 9.1 | 23 | 112 | Yes | Wild westslope cutthroat trout | Maintain westslope cutthroat trout fishery; confirm that population is self-sustaining |

Source: Mountain Lake Surveys and Fisheries Management Recommendations – Rattlesnake Wilderness lakes, Montana Fish Wildlife and Parks, 2013

## 9.6.2 Rattlesnake Creek

It has been noted that one advantage of the Rattlesnake Wilderness Dams is the ability to store spring runoff and release it for late season flows in Rattlesnake Creek, which has been shown to be important habitat for Bull Trout, a threatened species. In order to understand if the flows would be significant enough to have a noted benefit to Bull Trout, historic stream flow data was evaluated.

The 10 dams owned by the City flow into either the Lake Creek or Wrangle Creek drainages, then into Rattlesnake Creek and ultimately to the Clark Fork River. These impoundments are capable of storing 2,585 acre-feet total or 112,602,600 cubic feet. If the total

*If the total storage volume was released over the course of one month, that would equate to about 43 cubic feet per second (cfs) over the entire month. Rattlesnake Creek low flows have been less than 10 cfs.*

storage volume was released over the course of one month, that would equate to about 43 cfs over the entire month.

The USGS gathered streamflow data on Rattlesnake Creek as far back as 1899, then consistently from 1957 through 1968. This data is shown in Figure 9-3. A new gage was installed and started reporting streamflow data in the fall of 2017, and this data is shown in Figure 9-4.

The minimum stream flow measured by the USGS gage was less than 1 cfs, and 8 cfs by the newly installed stream gage.

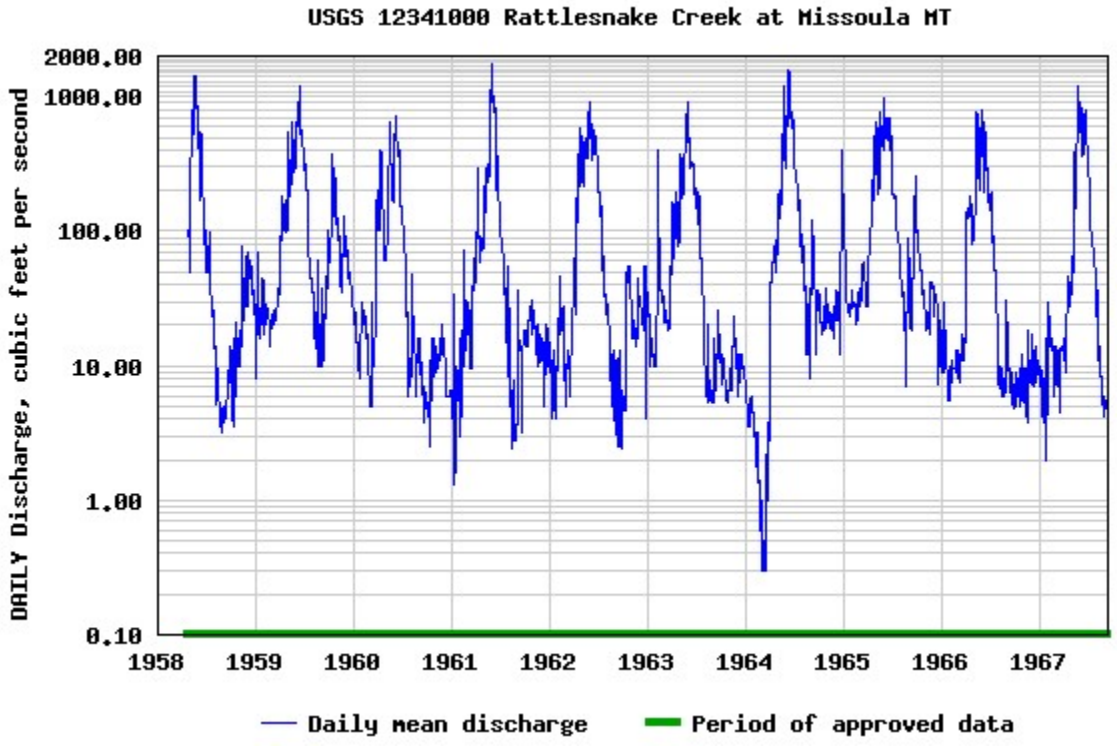



**Figure 9-3. Historic Rattlesnake Creek Flow**

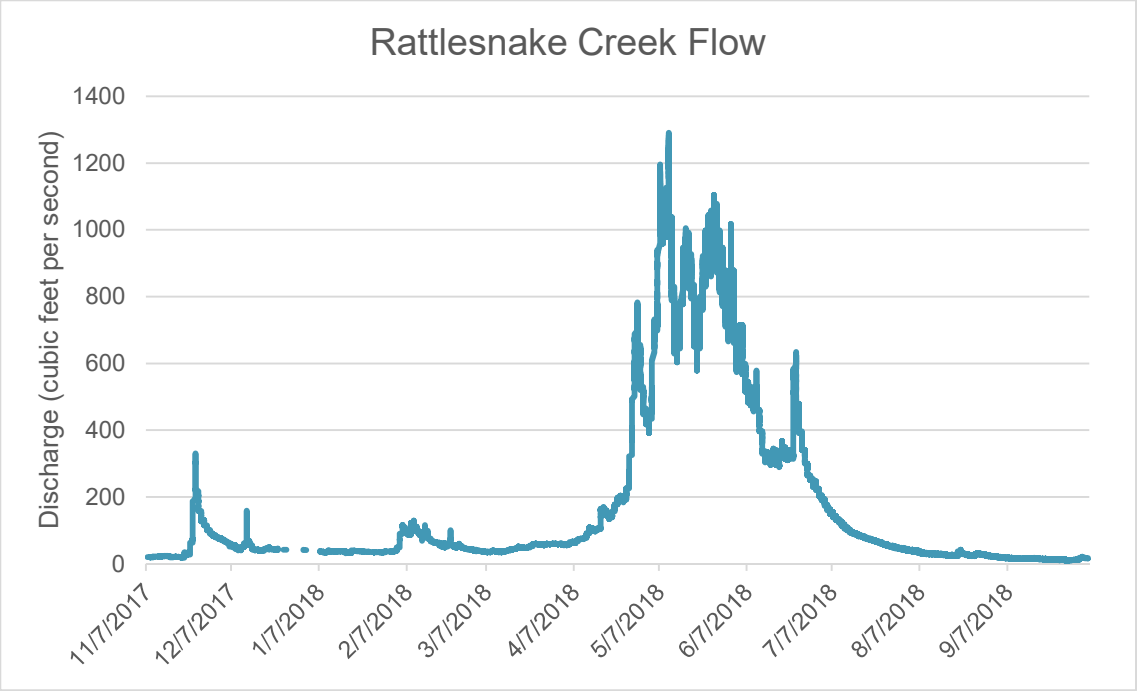



**Figure 9-4. Recent Rattlesnake Creek Flow**

## 9.7 Dam Evaluations

This section describes the existing conditions followed by four general alternatives including no action, rehabilitation, increased storage, and decommissioning.

### 9.7.1 Big Lake Dam

#### Current Conditions

A Project Information Sheet for Big Lake Dam is located in Appendix K, which provides detailed information about the dam and reservoir; a summary of current conditions related to different components of the dam and appurtenances; a summary of needed short-term repairs; and a conceptual-level cost estimate for completing short-term repairs.

Big Lake Dam impounds approximately 621 acre-feet of water (the second-largest reservoir in the Wilderness owned by the City of Missoula (out of eight total)). It is an easement dam, meaning the dam and appurtenances are located on a pre-Federal Land Policy Management Act right-of-way. It does not fall under direct FS authority; however the FS has reserved the right to have input regarding actions taken on and around the dam. The dam is classified as having a “Significant” hazard classification, meaning that failure of the dam for any reason results in no probable human loss of life, but can cause non-recoverable environmental damage. A breach failure could result in erosion and sediment transfer to Lake Creek and ultimately to Rattlesnake Creek where bull trout (a threatened species) are present, which is the basis for the dam’s current Significant hazard rating.

The dam was originally built in 1915 as an earthen embankment with a rock timber crib core. The original construction sketches indicate the dam was widened on the downstream side from its initial configuration. As a result the crest of the dam is very wide

(approximately 30 feet). Sinkholes have appeared on the crest, aligned with the edge of the timber crib core, and are being monitored. There are also nine water-level measurement piezometers on the crest that are monitored. The upstream slope has a slope of 2:1, is lined with riprap, and is in good condition. The downstream slope is steep with slopes of 0.3 to 0.7:1, but appears to be stable except for an area near the center where erosion occurred due to overtopping during spring runoff. The spillway was enlarged and reinforced with riprap in 2010 and it currently meets FS design criteria.

Foundation seepage is evident in the downstream toe area of the dam. Seepage flows are being monitored by two v-notch weirs and two shallow piezometers in the toe area. The dam has two pipe outlets. The south outlet is a low-level steel pipe that has a corrosion hole with leakage flowing through it. The upstream valve access tower and walkway are in disrepair and need fixing. The north outlet is situated below the spillway. It is a corrugated metal pipe (CMP) with heavy corrosion and some leakage. The control valve on the upstream end is currently operable. Both outlet pipes are 12-inch diameter.

## Alternatives

The following alternatives are presented to aid in deciding the eventual disposition of Big Lake Dam. The actions and costs of each alternative are based on the best available data at this time. Costs and tasks to complete each alternative may change as new information becomes available.

## No Action

The No Action alternative is to keep the dam and appurtenances in their current state with no improvements anticipated for the foreseeable future. The City would continue to monitor the dam, make minor repairs as needed, and take preventative action only if conditions indicate the dam would be in danger of failing.

Advantages:

This alternative does not include initial capital improvement costs. There would still be annual costs for maintenance and owner inspections and a cost every five years for a periodic O&M engineer inspection and hazard assessment, as required by FS regulations.

Disadvantages:

The effects of aging on an already one hundred year old dam will continue. It is impossible to know when serious symptoms related to dam safety may appear, but they would be inevitable in the future. Costs to repair, replace or decommission the dam would eventually have to be expended at the time that serious deficiencies arise. Performing a structural stability analysis of an earthen dam requires a slope stability analysis. Although the FS does not have agency-specific guidance on conducting a structural analysis of an earthen dam, it references other suitable federal agency guidance. FSM 7525.42 states that the design of earthen side slopes can be accomplished using guidelines developed by the U.S. Army Corps of Engineers (USACOE) or U.S. Bureau of Reclamation (USBR). Criteria found in USDA-Natural Resources Conservation Service (NRCS) Technical Release 60 (TR-60) are consistent with USACOE and USBR criteria and is used often on FS dams. A report prepared by GMT Consultants in 1997 (Preliminary Geotechnical Evaluation and Slope Stability Analysis, 6 Dam Sites - Rattlesnake Wilderness) found that the downstream slope produced a safety factor of less than one for one loading condition that included

ponded water on the crest and with assumed soil properties. At this time, in the absence of a more detailed slope stability analysis, the downstream slope does not meet FS criteria for slope stability. Therefore, under the No Action alternative the dam would be out of compliance with dam safety regulations and thus increase the City's risk and liability.

Estimated Costs:

No capital improvement costs for this alternative $0

(It should be noted that under the no action alternative, regular operations and maintenance costs would still be required, and would likely increase over time.)

## Rehabilitate to Meet Forest Service Standards

The rehabilitation alternative would address deficiencies on the existing dam, as described previously, and bring the dam into compliance with FS standards. Proposed repairs would include:

- Performing a geotechnical investigation and analysis;
- Addressing seepage issues by lining the upstream slope with an impermeable liner;
- Addressing slope stability concerns by adding fill on the downstream slope;
- Slip-lining both outlets with HDPE pipe;
- Replacing the north outlet valve;
- Repairing the south outlet intake tower and walkway;
- Extending the south outlet pipe to accommodate the added fill on the downstream slope; and
- Repairing voids on the dam crest.

The embankment materials at Big Lake Dam are prone to seepage, which can result in embankment piping (internal erosion). The embankment could be reconstructed with suitable embankment materials, but that would be expensive and potentially problematic due to the limited soil resources at the site.

A more reasonable solution to eliminate the piping concern is lining the upstream embankment slope with an impermeable geomembrane liner. This option would require temporarily removing the upstream riprap, preparing the liner subgrade, installing a geomembrane liner with cushion geotextile on both sides, and replacing the upstream riprap.

The photos below provide a visual example of the work necessary to install a geomembrane liner on the upstream dam face.

**Figure 9-5. Mill Lake Dam, Geomembrane Liner Installation**

**Figure 9-6. Mill Lake Dam, Geomembrane Liner and Riprap Installation**

In addition, the steep downstream embankment slope (0.3 to 0.7:1) could be flattened to produce a more stable embankment. The steep slope could be buttressed with new fill consisting of coarse gravel and sand obtained from within the reservoir footprint. Flattening the downstream slope would significantly increase stability, especially in combination with an upstream liner that eliminates the high phreatic surface in the embankment, potential issues from rapid drawdown, and other concerns that earthen embankment dam standards take into consideration. At this time, it is recommended that the downstream slope would be flattened to 1.5:1, based on experience with repairs on similar wilderness dams. The existing 2:1 upstream and proposed 1.5:1 downstream slopes are steeper than recommended in the NRCS Conservation Practice Standard POND (No.) CODE 378. but slope stability analyses would be conducted to verify that the combination of slopes (2:1 upstream and 1.5:1 downstream) with an upstream liner under various loading conditions meet FS criteria. If not, then the downstream slope would be adjusted until criteria are met. The south outlet would need to be extended approximately 20 feet to reach the new dam toe, if a 1.5:1 downstream slope is used.

Advantages:

This alternative would address long-term concerns at the dam and would bring the dam into compliance with FS standards. The improvements proposed for rehabilitation would likely be necessary to even consider raising the dam to increase storage capacity.

Disadvantages:

This alternative would require a large capital improvement investment as well as ongoing operation and maintenance costs. While most seepage would be blocked, foundation seepage could continue, which has the potential to pipe foundation material and undermine the dam.

Estimated Costs:

Rehabilitation costs are estimated using unit costs from recent wilderness dams repair work. Remote access necessitates helicopter transportation for personnel, equipment and construction materials. Construction costs for remote access dams can be five to ten times that of conventional construction. Estimated costs presented here include mobilization and demobilization costs, engineering and construction management fees, and a contingency of 30 percent. The estimated costs are as follows:

| | |
|---|---|
| Capital improvement costs | $1,312,000 |
| Existing Water Right | 623 ac-ft |
| Cost per acre-foot | $2,106 |

## Increase Storage

The alternative to increase storage would be a combination of raising the embankment height and completing rehabilitation items discussed above. With a surface area of approximately 38 acres, raising Big Lake Dam even a few feet could result in a significant increase in storage capacity. This alternative would be combined with the decommissioning of one or more other dams and would offset the lost storage volume.

Based on the existing crest width of 30 feet, 2:1 upstream slope, and proposed 1.5:1 downstream slope, the dam could be raised 4.5 feet and still have a 14-foot crest width.

The modification would increase the dam height from 19 feet to 23.5 feet and add approximately 175 acre-feet, a 28% increase in storage. FSM recommends a minimum crest width of 12 feet for a 23.5-foot high dam.

Advantages:

This alternative would offset potential loss of storage volume by decommissioning other City-owned dams in the Wilderness, and the City could potentially retain existing water storage and water rights while reducing the number of dams that require future maintenance.

Disadvantages:

There is an initial capital improvement cost associated with this alternative, and the alternative cannot be implemented without completing rehabilitation work. Some cost efficiency would be realized by increasing storage at the time rehabilitation work is completed. Increasing the dam storage capacity would also increase the peak flow in the event of a dam breach, and a revised hazard assessment would be required. An evaluation would be needed to determine the amount of increased storage that could be added without changing the current dam hazard classification.

Estimated Costs:

Costs for Increased Storage are based on the same assumptions as used for the Rehabilitation option. The estimated costs are as follows:

| | |
|---|---|
| Capital improvement costs for this alternative alone* | $472,000 |
| Increased water storage | 175 ac-ft |
| Cost per acre-foot for this alternative alone | $2,696 |
| Capital improvement costs including rehabilitation* | $1,784,000 |
| Existing water right plus increased storage | 798 ac-ft |
| Cost per acre-foot including rehabilitation alternative | $2,235 |

*Costs do not account for potential savings achieved by eliminating repair costs at other dam(s)

## Decommission

The alternative to decommission the dam would involve breaching a portion of the dam and constructing a channel to route flows past the dam to an outlet channel. Breaching the dam would eliminate its storage capacity. A stable breach channel would be excavated through the dam embankment to safely route a 100-year or larger inflow design flood and to avoid any backwater impoundment against the remaining portion of the dam. The channel could feature a control sill to reduce sediment releases until the reservoir beach stabilizes. Excavated material could be dispersed to blend within the surrounding ground in the reservoir footprint. The existing outlet gates and gate tower would be removed. The remaining beach between the current reservoir shore and the remaining natural lake would be seeded. See Figure 9-7 for a conceptual drawing of a dam decommissioning.

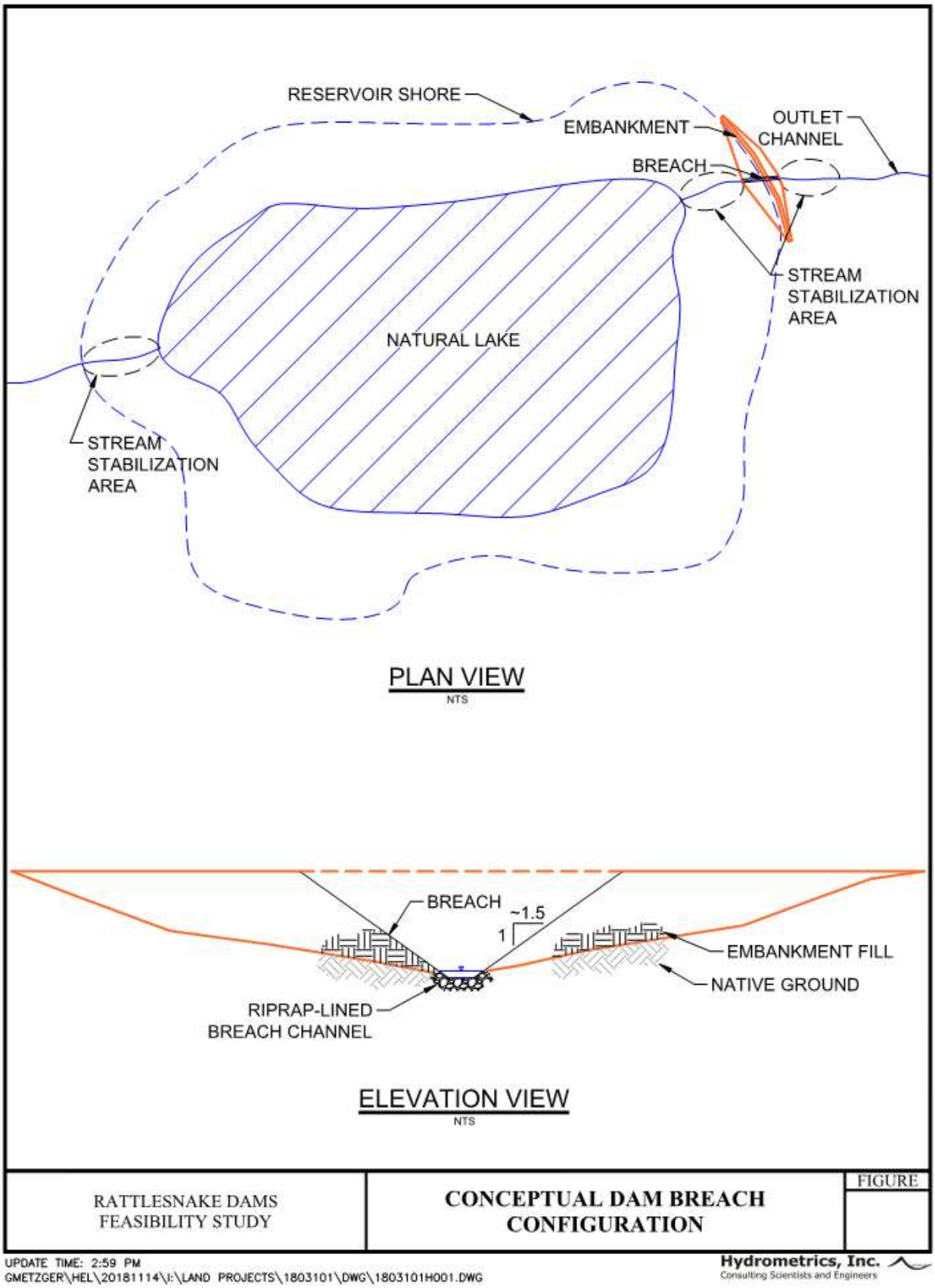



**Figure 9-7. Conceptual Dam Breach Configuration**

The description above presents the probable minimum requirements for decommissioning the dam. A larger effort may be required to satisfy outside interests. This could involve reconstructing a natural channel upstream and downstream of the dam, completely removing the embankment material, or other major construction tasks.

The cost estimate assumes a breach channel would be excavated through the embankment capable of passing a 500-year flood with a peak flow of 88 cubic feet per second (cfs). Designing to this flood event would result in a stable channel during extreme flood events and minimize the potential for backwater impoundment against the dam. Changing the design flood would not significantly affect costs. The channel would be armored with riprap, and 5 acres of reservoir beach would be seeded. The seeding and re-vegetation plan would be prepared to minimize the introduction of invasive species and could incorporate seed collected on site.

According to the Forest Service, a dam is 'any artificial barrier, including appurtenant works, that impounds or diverts water, either temporarily or long term, but not including a facility that is 6 feet or less in height or that impounds no more than 15 acre-feet of water', and is classified as low hazard. The decommissioning alternative could be modified such that some combination of dam height reduction and storage reduction essentially turned the dam into a pond. This sub-alternative may have advantages in terms of cost, aquatic life, and re-vegetation limits and could be further developed in the next phase of overall project development and analysis.

Advantages:

This alternative would eliminate current and future maintenance requirements, except for possible short-term maintenance while conditions equilibrate. The easement could be relinquished and ownership of the former dam and reservoir could be returned to the FS. Decommissioning costs would likely be lower than rehabilitation costs, although that could depend on the scope of decommissioning work and FS requirements for restoration to simulate natural conditions.

Disadvantages:

With its water storage capacity eliminated, the water rights associated with Big Lake Dam would need to be modified or abandoned. Reestablishing vegetation on the reservoir beach would take years, and the remaining embankment section could be considered an aesthetic drawback. Potential late-season flow releases to Rattlesnake Creek would be lost, and the overall recreational appeal of the dam site could decrease.

Estimated Costs:

Costs for the Decommission option are based on the same assumptions as used for the Rehabilitation option. The estimated costs are as follows:

| | |
|---|---|
| Capital costs for this alternative | $401,000 |

## 9.7.2 Carter Lake Dam

### Current Conditions

A Project Information Sheet for Carter Lake Dam is located in Appendix K of this report, which provides detailed information about the dam and reservoir; a summary of current

conditions related to different components of the dam and appurtenances; a summary of needed short-term repairs; and a conceptual-level cost estimate for completing short-term repairs.

Carter Lake Dam impounds approximately 161 acre-feet of water (the sixth-largest reservoir (out of eight total)) in the Wilderness owned by the City of Missoula). It operates under a Special Use Permit issued by the Lolo National Forest of the U.S. FS. It is regulated under the authority of the FS dam safety laws. The dam is classified as having a "Low" hazard classification, the only City-owned dam in the Wilderness with this classification. All others are "Significant" hazard dams. A Low hazard classification means that failure of the dam for any reason results in no probable loss of human life and no significant environmental damage. Carter Lake Dam's classification was changed from Significant to Low in (date) by a FS reclassification study that found that Lake Creek, the drainage on which the dam is located, does not have bull trout residing within it. Bull trout are a threatened species. From dam breach modeling, it was shown that the breach failure flood from Carter Dam attenuates to a peak flow below the 100-year flood level of Rattlesnake Creek (which is inhabited by bull trout) by the time it reaches the confluence of Lake Creek and Rattlesnake Creek. According to FS criteria, damage or danger to potential hazards from a breach flood is considered until it reaches the level of a 100-year flood.

The dam was originally built in 1921 as an earthen embankment, as shown on the dam's original construction drawings, with no cribbing in the core. A subsequent geophysical investigation by Glacier Engineering, P.C. in 1999 indicated that imaging showed material anomalies consistent with a timber rock crib core in the dam. The dam's crest is narrow (approximately 5 feet wide) which does not meet FS criteria. There is one area on the downstream shoulder of the crest that indicates erosion from overtopping during spring runoff. There is no instrumentation, such as piezometers, on the dam.

The upstream slope ranges from 3:1 to 4:1, is lined with riprap, and is in good condition. The downstream slope is steep with a slope of 0.3:1, but appears to be stable except for the small erosion area mentioned above. Excessive vegetation is growing through the rock on the downstream slope that needs to be cut. The upstream section of the spillway is in good condition. Annual maintenance is needed to clear logs and other debris from the spillway approach channel. The downstream section is a timber corduroy structure that was completely rebuilt several years ago, but is a continual maintenance concern with replacing displaced riprap downstream of the timber structure and with replacing timbers that have been damaged. It currently meets FS design criteria, which was set specifically for this dam and established when the dam reclassification was completed.

The reclassification analysis established that the spillway design flow shall be 200 cubic feet per second (cfs), which is approximately equal to the 500-year return period flood for Lake Creek at the dam. This is higher than the normal FS spillway flood criteria for low hazard dams, which is the 100-year return period flood. Foundation seepage is evident in the downstream toe area of the dam by ponding water. No seepage flows have been observed. The dam has one pipe outlet, which is a corrugated metal pipe (CMP) with heavy corrosion and deterioration. The control valve on the upstream end operates but remains open to keep the reservoir level low.

## Alternatives

The following alternatives are presented to aid in deciding the eventual disposition of Carter Lake Dam. The actions and costs of each alternative are based on the best available data at this time. Costs and tasks to complete each alternative may change as new information becomes available. Costs include construction and engineering design and construction oversight.

## No Action

The No Action alternative is to keep the dam and appurtenances in their current state with no improvements anticipated for the foreseeable future. The City would continue to monitor the dam, make minor repairs as needed, and take preventative action only if conditions indicate the dam would be in danger of failing.

Advantages:

This alternative does not include initial capital improvement costs. There would still be annual costs for maintenance and owner inspections and a cost for a periodic O&M engineer inspection which according to the dam's Special Use Permit and FSM 7514.5 is every ten years, but the City may opt to perform an engineer's periodic O&M inspection once every five years to match the schedule for the other Significant hazard dam, and hazard assessment, as required by FS regulations.

Disadvantages:

The effects of aging on a nearly one hundred year old dam will continue. It is impossible to know when serious symptoms related to dam safety may appear, but they would be inevitable in the future. Costs to repair, replace or decommission the dam would eventually have to be expended at the time that serious deficiencies arise. Performing a structural stability analysis of an earthen dam requires a slope stability analysis. Although the FS does not have agency-specific guidance on conducting a structural analysis of an earthen dam, it references other suitable federal agency guidance. FSM 7525.42 states that the design of earthen side slopes can be accomplished using guidelines developed by the U.S. Army Corps of Engineers (USACOE) or U.S. Bureau of Reclamation (USBR). Criteria found in USDA-Natural Resources Conservation Service (NRCS) Technical Release 60 (TR-60) are consistent with USACOE and USBR criteria and is used often on FS dams. A report prepared by GMT Consultants in 1997 (*Preliminary Geotechnical Evaluation and Slope Stability Analysis, 6 Dam Sites - Rattlesnake Wilderness*) evaluated the downstream slope and it produced a safety factor of 1.20. However, the report indicated that the slope was input to the model as 0.9:1 which is flatter than the actual slope, and that it was modeled as a stacked-rock slope, which may be accurate. In 2002, another slope stability analysis *Carter Lake Dam Stability Evaluation* was conducted by Portage, Inc. Portage found a lower factor of safety (1.0) for the same downstream slope analysis conducted by GMT because Portage used steeper slopes that were closer to actual. The factor of safety increased if it was assumed the internal rock core served as a drain to lower the phreatic surface in the dam, which is possible. Both Portage and GMT assumed soil properties for the embankment. In the absence of a more detailed geotechnical investigation and slope stability analysis, the actual downstream slope stability is unknown. Considering the narrow width of the crest and the uncertainty of the 1997 and 2002 slope stability analyses,

the no action alternative for the dam would be out of compliance with dam safety regulations and thus increase the City's risk and liability.

Estimated Costs:

No capital improvement costs for this alternative $0

(It should be noted that under the no action alternative, regular operations and maintenance costs would still be required, and would likely increase over time.)

## Rehabilitate to Meet Forest Service Standards

The rehabilitation alternative would address deficiencies on the existing dam, as previously described, and bring the dam into compliance with FS standards. Proposed repairs would include:

- Performing a geotechnical investigation and analysis;
- Addressing seepage issues by lining the upstream slope with an impermeable liner;
- Addressing the narrow crest and slope stability concerns by adding fill on the downstream slope;
- Full replacement of the outlet pipe;
- Replacing the outlet valve;
- Rebuilding the outlet intake tower;
- Extending the outlet pipe to accommodate the added fill on the downstream slope; and
- Repairing the spillway.

The embankment materials at Carter Lake Dam are prone to seepage, which can result in embankment piping (internal erosion). The embankment could be reconstructed with suitable embankment materials, but that would be expensive and potentially problematic due to the limited soil resources at the site.

A more reasonable solution to eliminate the piping concern is lining the upstream embankment slope with an impermeable geomembrane liner. This option would require temporarily removing the upstream riprap, preparing the liner subgrade, installing a geomembrane liner with cushion geotextile on both sides, and replacing the upstream riprap.

In addition, the crest is narrow and needs to be widened to a minimum of 10 feet in order to meet FS criteria. Along with this, the steep downstream embankment slope (0.3:1) could be flattened to produce a more stable embankment. The new fill material could be coarse gravel and sand obtained from within the reservoir footprint. Flattening the downstream slope would significantly increase stability, especially in combination with an upstream liner that eliminates the high phreatic surface in the embankment, potential issues from rapid drawdown, and other concerns that earthen embankment dam standards take into consideration. At this time, it is recommended that the downstream slope would be flattened to 1.5:1, based on experience with repairs on similar wilderness dams. The proposed 1.5:1 downstream slope is steeper than recommended in the NRCS Conservation Practice Standard POND (No.) CODE 378, while the 3:1 or flatter upstream

slope meets the NRCS recommendation. Slope stability analyses would be conducted to verify that the combination of slopes (3:1 upstream and 1.5:1 downstream) with an upstream liner under various loading conditions meet FS criteria. If not, then the downstream slope would be flattened until criteria are met. The new outlet pipe would need to be extended approximately 21 feet longer than the existing pipe to reach the new dam toe, if a 1.5:1 downstream slope is used. A blanket filter along the rehabilitated toe is also recommended as a preventative measure against piping from foundation seepage. The filter material would consist of soil meeting a gradation that prevents soil migration while allowing foundation seepage to drain.

Spillway repair would consist of abandoning the log corduroy structure and constructing an engineered spillway channel that would have erosion control features determined during analysis. The area near the dam has significant riprap rock available that hopefully could be utilized. The channel would have to be designed to pass the required flow and at the same time prevent headcutting.

Advantages:

This alternative would address long-term concerns at the dam and would bring the dam into compliance with FS standards. The improvements proposed for rehabilitation would likely be necessary to even consider raising the dam to increase storage capacity.

Disadvantages:

This alternative would require a large capital improvement investment as well as ongoing operation and maintenance costs. Even with a blanket filter in place, it is possible that foundation seepage could continue, which has the potential to pipe foundation material and undermine the dam.

Estimated Costs:

Rehabilitation costs are estimated using unit costs from recent wilderness dams repair work. Remote access necessitates helicopter transportation for personnel, equipment and construction materials. However, Carter Lake is within a quarter of a mile to a maintenance access road used by the City only for periodic maintenance. It is possible that some personnel or small equipment transport could occur via the maintenance access road if it meets FS requirements. Construction costs for remote access dams can be five to ten times that of conventional construction. Estimated costs presented here include mobilization and demobilization costs, engineering and construction management fees, and a contingency of 30 percent. The estimated costs are as follows:

| | |
|---|---|
| Capital improvement costs | $706,000 |
| Existing Water Right | 170 ac-ft |
| Cost per acre-foot | $4,155 |

## Increase Storage

The alternative to increase storage would be a combination of raising the embankment height and completing rehabilitation items discussed above. With a surface area of approximately 14.6 acres, raising Carter Lake Dam even a few feet could result in a significant increase in storage capacity. This alternative would be combined with the decommissioning of one or more other dams and would offset the lost storage volume.

Because of the already narrow dam crest, raising the dam approximately 4 feet (which is estimated only for purposes of this analysis – actual increase in height would be based on a cost:benefit analysis) would require additional fill beyond that estimated for rehabilitation. Raising the dam 4 feet would increase the height from 14 to 18 feet, which requires a minimum crest width of 10.6 feet to meet FS standards. Additional required embankment material was estimated assuming an 11-foot crest width, 3:1 upstream slope, and 1.5:1 downstream slope. The outlet pipe would need to be extended 20 feet. The modification would increase reservoir storage approximately 59 acre-feet, a 37% increase.

Advantages:

This alternative would offset potential loss of storage volume by decommissioning other City-owned dams in the Wilderness, and the City could potentially retain existing water storage and water rights while reducing the number of dams that require future maintenance.

Disadvantages:

There is an initial capital improvement cost associated with this alternative, and the alternative cannot be implemented without completing rehabilitation work. Some cost efficiency would be realized by increasing storage at the time rehabilitation work is completed. Increasing the dam storage capacity would also increase the peak flow in the event of a dam breach, and a revised hazard assessment would be required. An evaluation would be needed to determine the effect on the current dam hazard classification. Since the current classification and spillway capacity criteria are based on the effect from dam failure, the amount of increased storage that could be added without changing the current dam hazard classification would have to be examined closely.

Estimated Costs:

Costs for Increased Storage are based on the same assumptions as used for the Rehabilitation option. The estimated costs are as follows:

| | |
|---|---|
| Capital improvement costs for this alternative alone* | $428,000 |
| Increased water storage | 60 ac-ft |
| Cost per acre-foot for this alternative alone | $7,133 |
| Capital improvement costs including rehabilitation* | $1,134,000 |
| Total water storage with increase | 230 ac-ft |
| Cost per acre-foot including rehabilitation alternative | $4,932 |

**Costs do not account for potential savings achieved by eliminating repair costs at other dam(s)*

## Decommission

The alternative to decommission the dam would involve breaching a portion of the dam and constructing a channel to route flows past the dam to an outlet channel. Breaching the dam would eliminate its storage capacity. A stable breach channel would be excavated through the dam embankment to safely route a 100-year or larger inflow design flood and to avoid any backwater impoundment against the remaining portion of the dam. The channel could feature a control sill to reduce sediment releases until the reservoir beach stabilizes. Excavated material could be dispersed to blend within the surrounding ground in

the reservoir footprint. The existing outlet gates and gate tower would be removed. The beach between the current reservoir shore and the remaining natural lake would be seeded.

The description above presents the probable minimum requirements for decommissioning the dam. A larger effort may be required to satisfy outside interests. This could involve reconstructing a natural channel upstream and downstream of the dam, completely removing the embankment material, or other major construction tasks.

The cost estimate assumes a breach channel would be excavated through the embankment capable of passing a 500-year flood with a peak flow of 127 cubic feet per second (cfs). Designing to this flood event would result in a stable channel during extreme flood events and minimize the potential for backwater impoundment against the dam. Changing the design flood would not significantly affect costs. The channel would be armored with riprap, and 5 acres of reservoir beach would be seeded. The seeding and re-vegetation plan would be prepared to minimize the introduction of invasive species and could incorporate seed collected on site.

According to FSM 2709.11, Dam Safety Definitions, a dam is ‘any artificial barrier, including appurtenant works, that impounds or diverts water, either temporarily or long term, but not including a facility that is 6 feet or less in height or that impounds no more than 15 acre-feet of water’. The decommissioning alternative could be modified such that some combination of dam height reduction and storage reduction essentially turned the dam into a pond. This sub-alternative may have advantages in terms of cost, aquatic life, and re-vegetation limits and could be further developed in the next phase of overall project development and analysis.

Advantages:

This alternative would eliminate current and future maintenance requirements, except for possible short-term maintenance while conditions equilibrate. Ownership of the former dam and reservoir could be returned to the FS. Decommissioning costs would likely be lower than rehabilitation costs, although that could depend on the scope of decommissioning work and FS requirements for restoration to simulate natural conditions.

Disadvantages:

With its water storage capacity eliminated, the water rights associated with Carter Lake Dam would need to be modified or abandoned. Reestablishing vegetation on the reservoir beach would take years, and the remaining embankment section could be considered an aesthetic drawback. Potential late-season flow releases to Rattlesnake Creek would be lost, and the overall recreational appeal of the dam site could decrease.

Estimated Costs:

Costs for the Decommission option are based on the same assumptions as used for the Rehabilitation option. The estimated costs are as follows:

| | |
|---|---|
| Capital costs for this alternative | $180,000 |

### 9.7.3 Glacier Lake Dam

#### Current Conditions

A Project Information Sheet for Glacier Lake Dam is located in Appendix K of this report, which provides detailed information about the dam and reservoir; a summary of current conditions related to different components of the dam and appurtenances; a summary of needed short-term repairs; and a conceptual-level cost estimate for completing short-term repairs.

Glacier Lake Dam impounds approximately 240 acre-feet of water the fourth-largest reservoir out of eight total in the Wilderness owned by the City of Missoula. It is an easement dam, meaning the dam and appurtenances are located on a pre-Federal Land Policy Management Act right-of-way. It does not fall under direct U.S. FS authority; however, the FS has reserved the right to have input regarding actions taken on and around the dam. The dam is classified as having a "Significant" hazard classification, meaning that failure of the dam for any reason results in no probable human loss of life, but can cause non-recoverable environmental damage. A breach failure could result in erosion and sediment transfer to Little Lake and then possibly Wrangle Creek and ultimately to Rattlesnake Creek where bull trout (a threatened species) are present, which is the basis for the dam's current Significant hazard rating. The dam was originally built in 1911 as an earthen embankment with a timber rock crib core, as shown on the dam's original construction drawings. The embankment crest is narrow (approximately 5 feet wide) which does not meet FS criteria. There is no instrumentation, such as piezometers, on the dam.

The upstream and downstream slopes are approximately 2:1 each. The upstream slope is lined with riprap, and is in good condition. The downstream slope has intermittent rock and vegetative cover. The embankment does not exhibit signs of instability. Some excessive vegetation on all surfaces needs to be cut. The spillway channel has a headcut that is currently being monitored for movement using set rebar monuments and measuring any erosion progress. Annual maintenance is needed to clear logs and other debris from the spillway approach channel. It currently meets FS design criteria for significant hazard dams. Foundation seepage has been observed in the past near the outlet during high reservoir levels. The dam has one pipe outlet, which is a corrugated metal pipe (CMP) with heavy corrosion. The control valve on the upstream end operates but remains open to keep the reservoir level low. The valve access timber structure is heavily damaged and needs replacement.

#### Alternatives

The following alternatives are presented to aid in deciding the eventual disposition of Glacier Lake Dam. The actions and costs of each alternative are based on the best available data at this time. Costs and tasks to complete each alternative may change as new information becomes available. Costs include construction, engineering design and construction oversight.

## No Action

The No Action alternative is to keep the dam and appurtenances in their current state with no improvements anticipated for the foreseeable future. The City would continue to monitor the dam, make minor repairs as needed, and take preventative action only if conditions indicate the dam would be in danger of failing.

Advantages:

The No Action alternative does not include initial capital improvement costs. There would still be annual costs for maintenance and owner inspections, and a cost for a periodic O&M engineer inspection once every five years and hazard assessment, as required by FS regulations.

Disadvantages:

The effects of aging on a dam over one hundred years old will continue. It is impossible to know when serious symptoms related to dam safety may appear, but they would be inevitable in the future. Costs to repair, replace or decommission the dam would eventually have to be expended at the time that serious deficiencies arise. Performing a structural stability analysis of an earthen dam requires a slope stability analysis. Although the FS does not have agency-specific guidance on conducting a structural analysis of an earthen dam, it references other suitable federal agency guidance. FSM 7525.42 states that the design of earthen side slopes can be accomplished using guidelines developed by the U.S. Army Corps of Engineers (USACOE) or U.S. Bureau of Reclamation (USBR). Criteria found in USDA-Natural Resources Conservation Service (NRCS) Technical Release 60 (TR-60) are consistent with USACOE and USBR criteria and is used often on FS dams. No geotechnical investigations or analyses have been completed on the dam. Even with 2:1 slopes on both the upstream and downstream sides, which are flatter than many of the City wilderness dams, the fact that the crest does not meet FS standards means it is out of compliance. The no action alternative for the dam would increase the City's risk and liability.

Estimated Costs:

No capital improvement costs for this alternative $0

(It should be noted that under the no action alternative, regular operations and maintenance costs would still be required, and would likely increase over time.)

## Rehabilitate to Meet Forest Service Standards

The rehabilitation alternative would address deficiencies on the existing dam, as described previously, and bring the dam into compliance with FS standards. Proposed repairs would include:

- Performing a geotechnical investigation and analysis;
- Addressing any seepage issues by lining the upstream slope with an impermeable liner;
- Addressing the narrow crest and potential slope stability concerns by adding fill on the downstream slope;
- Slip-lining of the outlet pipe and extending to accommodate added fill;

- Rebuilding the outlet intake tower;
- Extending the outlet pipe to accommodate the added fill on the downstream slope; and
- Repairing the spillway.

The embankment materials at Glacier Lake Dam are prone to seepage, which can result in embankment piping (internal erosion). The embankment could be reconstructed with more suitable embankment materials, but that would be expensive and potentially problematic due to the limited soil resources at the site.

A more reasonable solution to eliminate the piping concern is lining the upstream embankment slope with an impermeable geomembrane liner. This option would require temporarily removing the upstream riprap, preparing the liner subgrade, installing a geomembrane liner with cushion geotextile on both sides, and replacing the upstream riprap.

In addition, the crest is narrow and needs to be widened to a minimum of 10 feet in order to meet FS criteria. In order to accomplish this, fill would be placed on the downstream slope. The current downstream slope could likely remain the same (2:1) and still maintain a stable embankment. The new fill material could be coarse gravel and sand obtained from within the reservoir footprint. Maintaining the downstream slope, in combination with an upstream liner that eliminates a high phreatic surface in the embankment, would address potential issues from rapid drawdown, and other concerns that earthen embankment dam standards take into consideration. The existing 2:1 upstream slope is steeper than recommended in the NRCS Conservation Practice Standard POND (No.) CODE 378. Slope stability analyses would be conducted to verify that the combination of slopes (2:1 for both upstream and downstream) with an upstream liner under various loading conditions meet FS criteria. If not, then the downstream slope would be flattened until criteria are met. The slip-lined outlet pipe would need to be extended approximately 5 feet longer than the existing pipe to reach the new dam toe, if the crest is widened another 5 feet.

Spillway repair would consist of replacing eroded material in the area of the headcut with large riprap or other erosion-resistant material, and grading to transition to the natural channel. Another option would be to design and construct a stable drop structure that would dissipate the energy of spillway flows prior to entering the natural channel. The area near the dam or around the reservoir has significant riprap rock available that hopefully could be utilized. The channel would have to be designed to pass the required flow and at the same time prevent erosion and headcutting.

Advantages:

This alternative would address long-term concerns at the dam and would bring the dam into compliance with FS standards. The improvements proposed for rehabilitation would likely be necessary to even consider raising the dam to increase storage capacity.

Disadvantages:

This alternative would require a large capital improvement investment as well as ongoing operation and maintenance costs. While most seepage would be blocked, it is possible

that foundation seepage could occur, which has the potential to pipe foundation material and undermine the dam.

Estimated Costs:

Rehabilitation costs are estimated using unit costs from recent wilderness dams repair work. Remote access necessitates helicopter transportation for personnel, equipment and construction materials. Construction costs for remote access dams can be five to ten times that of conventional construction. Estimated costs presented here include mobilization and demobilization costs, engineering and construction management fees, and a contingency of 30 percent. The estimated costs are as follows:

| | |
|---|---|
| Capital improvement costs | $475,000 |
| Existing Water Right | 212 ac-ft |
| Cost per acre-foot | $2,240 |

## Increase Storage

The alternative to increase storage would be a combination of raising the embankment height and completing rehabilitation items discussed above. With a surface area of approximately 20.4 acres, raising Glacier Lake Dam even a few feet could result in a significant increase in storage capacity. This alternative would be combined with the decommissioning of one or more other dams and would offset the lost storage volume.

Because of the already narrow dam crest, raising the dam approximately 4 feet (which is estimated only for purposes of this analysis – actual increase in height would be based on a cost:benefit analysis) would require additional fill beyond that estimated for rehabilitation. Raising the dam 4 feet would increase the height from 12 to 16 feet, which requires a minimum crest width of 10.2 feet to meet FS standards. Additional required embankment material was estimated assuming a 10.2-foot crest width, 2:1 upstream slope, and 2:1 downstream slope. The outlet pipe would need to be extended 16 feet. The modification would increase reservoir storage approximately 84 acre-feet, a 39% increase.

Advantages:

This alternative would offset potential loss of storage volume by decommissioning other City-owned dams in the Wilderness, and the City could potentially retain existing water storage and water rights while reducing the number of dams that require future maintenance.

Disadvantages:

There is an initial capital improvement cost associated with this alternative, and the alternative cannot be implemented without completing rehabilitation work. Some cost efficiency would be realized by increasing storage at the time rehabilitation work is completed. Increasing the dam storage capacity would also increase the peak flow in the event of a dam breach, and a revised hazard assessment would be required. An evaluation would be needed to determine the effect on the current dam hazard classification. Since the current classification and spillway capacity criteria are based on the effect from dam failure, the amount of increased storage that could be added without changing the current dam hazard classification would have to be examined closely.

Estimated Costs:

Costs for Increased Storage are based on the same assumptions as used for the Rehabilitation option. The estimated costs are as follows:

| | |
|---|---|
| Capital improvement costs for this alternative alone* | $343,000 |
| Increased water storage | 84 ac-ft |
| Cost per acre-foot for this alternative alone | $4,086 |
| Capital improvement costs including rehabilitation* | $818,000 |
| Existing water right plus increased storage | 296 ac-ft |
| Cost per acre-foot including rehabilitation alternative | $2,764 |

**Costs do not account for potential savings achieved by eliminating repair costs at other dam(s)*

## Decommission

The alternative to decommission the dam would involve breaching a portion of the dam and constructing a channel to route flows past the dam to an outlet channel. Breaching the dam would eliminate its storage capacity. A stable breach channel would be excavated through the dam embankment to safely route a 100-year or larger inflow design flood and to avoid any backwater impoundment against the remaining portion of the dam. The channel could feature a control sill to reduce sediment releases until the reservoir beach stabilizes. Excavated material could be dispersed to blend within the surrounding ground in the reservoir footprint. The existing outlet gates and gate tower would be removed. The beach between the current reservoir shore and the remaining natural lake would be seeded.

The description above presents the probable minimum requirements for decommissioning the dam. A larger effort may be required to satisfy outside interests. This could involve reconstructing a natural channel upstream and downstream of the dam, completely removing the embankment material, or other major construction tasks.

The cost estimate assumes a breach channel would be excavated through the embankment capable of passing a 500-year flood with a peak flow of 76 cubic feet per second (cfs). Designing to this flood event would result in a stable channel during extreme flood events and minimize the potential for backwater impoundment against the dam. Changing the design flood would not significantly affect costs. The channel would be armored with riprap, and 2 acres of reservoir beach would be seeded. The seeding and re-vegetation plan would be prepared to minimize the introduction of invasive species and could incorporate seed collected on site.

According to FSM 2709.11, Dam Safety Definitions, a dam is ‘any artificial barrier, including appurtenant works, that impounds or diverts water, either temporarily or long term, but not including a facility that is 6 feet or less in height or that impounds no more than 15 acre-feet of water’. The decommissioning alternative could be modified such that some combination of dam height reduction and storage reduction essentially turned the dam into a pond. This sub-alternative may have advantages in terms of cost, aquatic life, and re-vegetation limits and could be further developed in the next phase of overall project development and analysis.

Advantages:

This alternative would eliminate current and future maintenance requirements, except for possible short-term maintenance while conditions equilibrate. Ownership of the former dam and reservoir could be returned to the FS. Decommissioning costs would likely be lower than rehabilitation costs, although that could depend on the scope of decommissioning work and FS requirements for restoration to simulate natural conditions.

Disadvantages:

With its water storage capacity eliminated, the water rights associated with Glacier Lake Dam would need to be modified or abandoned. Reestablishing vegetation on the reservoir beach would take years, and the remaining embankment section could be considered an aesthetic drawback. Potential late-season flow releases to Rattlesnake Creek would be lost, and the overall recreational appeal of the dam site could decrease.

Estimated Costs:

Costs for the Decommission option are based on the same assumptions as used for the Rehabilitation option. The estimated costs are as follows:

| | |
|---|---|
| Capital costs for this alternative | $127,000 |

## 9.7.4 Little Lake Dam

### Current Conditions

A Project Information Sheet for Little Lake Dam is located in Appendix K of this report, which provides detailed information about the dam and reservoir; a summary of current conditions related to different components of the dam and appurtenances; a summary of needed short-term repairs; and a conceptual-level cost estimate for completing short-term repairs.

Little Lake Dam impounds approximately 298 acre-feet of water (the third-largest reservoir (out of eight total) in the Wilderness owned by the City of Missoula). It is an easement dam, meaning the dam and appurtenances are located on a pre-Federal Land Policy Management Act right-of-way. It does not fall under direct U.S. Forest Service authority; however, the FS has reserved the right to have input regarding actions taken on and around the dam. The dam is classified as having a “Significant” hazard classification, meaning that failure of the dam for any reason results in no probable human loss of life, but can cause non-recoverable environmental damage. A breach failure could result in erosion and sediment transfer to a tributary of Wrangle Creek, main stem Wrangle Creek, and ultimately to Rattlesnake Creek where bull trout (a threatened species) are present, which is the basis for the dam’s current Significant hazard rating.

The dam was originally built in 1912 as an earthen embankment with a timber rock crib core, as shown on the dam’s original construction drawings. The embankment crest is narrow (approximately 4 feet wide) which does not meet FS criteria. There is no instrumentation, such as piezometers, on the dam. The upstream slope is approximately 2:1 and is lined with riprap. It is in generally good condition except for evidence of a sinkhole that developed in 1996. The downstream slope is steep with slopes of 1 to 1.5:1 above a toe berm that was constructed as an emergency measure to stabilize the dam

when the sinkhole developed. The steep slope portion has minor sloughing in places. Some excessive vegetation on all surfaces needs to be cut.

The spillway channel is in generally in good condition. The spillway was excavated to a low elevation in 1996 to prevent the reservoir from reaching the sinkhole elevation. Annual maintenance is needed to clear logs and other debris from the spillway channel and address minor erosion. It currently meets Forest Service design criteria for significant hazard dams. Seepage has not been observed recently because the reservoir is maintained at a low level. The dam has one pipe outlet, which is a smooth metal pipe with corrosion. The control valve is located on the downstream end, and the pipe also has a large bulge near the downstream end due to back pressure from the valve.

*Little Lake Dam developed a sinkhole in 1996 and the spillway was excavated at that time to prevent the reservoir from reaching the sinkhole elevation. Therefore, the dam currently impounds little beyond the natural lake level.*

## Alternatives

The following alternatives are presented to aid in deciding the eventual disposition of Little Lake Dam. The actions and costs of each alternative are based on the best available data at this time. Costs and tasks to complete each alternative may change as new information becomes available. Costs include construction and engineering design and construction oversight.

## No Action

The No Action alternative is to keep the dam and appurtenances in their current state with no improvements anticipated for the foreseeable future. The City would continue to monitor the dam, make minor repairs as needed, and take preventative action only if conditions indicate the dam would be in danger of failing.

Advantages:

The No Action alternative does not include initial capital improvement costs. There would still be annual costs for maintenance and owner inspections, and a cost for a periodic O&M engineer inspection once every five years and hazard assessment, as required by FS regulations.

Disadvantages:

The effects of aging on a dam over one hundred years old will continue. It is impossible to know when serious symptoms related to dam safety may appear, but they would be inevitable in the future. Due to current deficiencies, the ability of the dam to impound water is very limited. Costs to repair, replace or decommission the dam would eventually have to be expended in order to make the dam serviceable or address continued deterioration. Performing a structural stability analysis of an earthen dam requires a slope stability analysis. Although the FS does not have agency-specific guidance on conducting a structural analysis of an earthen dam, it references other suitable federal agency guidance. FSM 7525.42 states that the design of earthen side slopes can be accomplished using

guidelines developed by the U.S. Army Corps of Engineers (USACOE) or U.S. Bureau of Reclamation (USBR). Criteria found in USDA-Natural Resources Conservation Service (NRCS) Technical Release 60 (TR-60) are consistent with USACOE and USBR criteria and is used often on FS dams. No geotechnical investigations or analyses have been completed on the dam. Sloughing on the downstream slope indicates the dam is not stable in its current condition, and the crest width is not in compliance with FS standards. The no action alternative for the dam would increase the City's risk and liability.

Estimated Costs:

No capital improvement costs for this alternative $0

(It should be noted that under the no action alternative, regular operations and maintenance costs would still be required, and would likely increase over time.)

## Rehabilitate to Meet Forest Service Standards

The rehabilitation alternative would address deficiencies on the existing dam, as described in the Current Conditions section, and bring the dam into compliance with FS standards. Proposed repairs would include:

- Performing a geotechnical investigation and analysis;
- Addressing any seepage issues by lining the upstream slope with an impermeable liner;
- Addressing the narrow crest and potential slope stability concerns by adding fill on the downstream slope;
- Replacing the outlet valve;
- Slip-lining of the outlet pipe;
- Extending the outlet pipe to accommodate the added fill on the downstream slope; and
- Repairing the spillway.

The embankment materials at Little Lake Dam are prone to seepage, which can result in embankment piping (internal erosion). The embankment could be reconstructed with more suitable embankment materials, but that would be expensive and potentially problematic due to the limited soil resources at the site.

A more reasonable solution to eliminate the piping concern is lining the upstream embankment slope with an impermeable geomembrane liner. This option would require temporarily removing the upstream riprap, preparing the liner subgrade, installing a geomembrane liner with cushion geotextile on both sides, and replacing the upstream riprap.

In addition, the crest is narrow and needs to be widened to a minimum of 12 feet in order to meet FS criteria. In order to accomplish this, fill would be placed on the downstream slope. The new fill material could be coarse gravel and sand obtained from within the reservoir footprint. At this time, it is recommended that the downstream slope would be flattened to 1.5:1, based on experience with repairs on similar wilderness dams. The existing 2:1 upstream and proposed 1.5:1 downstream slopes are steeper than recommended in the NRCS Conservation Practice Standard POND (No.) CODE 378;

however, the upstream liner would eliminate the high phreatic surface in the embankment and address potential issues from rapid drawdown and other concerns that earthen embankment dam standards take into consideration. Slope stability analyses would be conducted to verify that the combination of slopes (2:1 upstream and 1.5:1 downstream) with an upstream liner under various loading conditions meet FS criteria. If not, then the downstream slope would be adjusted until criteria are met. The new material on the downstream slope would effectively cover the existing toe berm. The outlet would need to be extended approximately 10 feet to reach the new dam toe, depending on the actual downstream slope and a new valve would need to be installed on the downstream side.

Spillway repair would consist of rebuilding the portion of the spillway that was excavated as an emergency measure in 1996. The new portion could be constructed with earthen fill and lined with local riprap for channel stability. The modified spillway would be designed to pass the required flow with a stable transition into the natural channel.

Advantages:

The rehabilitation alternative would address long-term concerns at the dam and would bring the dam into compliance with FS standards. With a stable dam embankment and a higher spillway crest, the reservoir impoundment volume will be increased to the level it was prior to the 1996 emergency repairs. The improvements proposed for rehabilitation would likely be necessary to even consider raising the dam to increase storage capacity.

Disadvantages:

The rehabilitation alternative would require a large capital improvement investment as well as ongoing operation and maintenance costs. While most seepage would be blocked, it is possible that foundation seepage could occur, which has the potential to pipe foundation material and undermine the dam.

Estimated Costs:

Rehabilitation costs are estimated using unit costs from recent wilderness dams repair work. Remote access necessitates helicopter transportation for personnel, equipment and construction materials. Construction costs for remote access dams can be five to ten times that of conventional construction. Estimated costs presented here include mobilization and demobilization costs, engineering and construction management fees, and a contingency of 30 percent. The estimated costs are as follows:

| | |
|---|---|
| Capital improvement costs | $1,125,000 |
| Existing Water Right | 300 ac-ft |
| Cost per acre-foot | $3,751 |

## Increase Storage

The alternative to increase storage would be a combination of raising the embankment height and completing rehabilitation items discussed above. With a surface area of approximately 17.9 acres, raising Little Lake Dam even a few feet could result in a significant increase in storage capacity. This alternative would be combined with the decommissioning of one or more other dams and would offset the lost storage volume.

Because of the already narrow dam crest, raising the dam approximately 4 feet (which is estimated only for purposes of this analysis – actual increase in height would be based on a cost:benefit analysis) would require additional fill beyond that estimated for rehabilitation. Raising the dam 4 feet would increase the height from 25 to 29 feet, which requires a minimum crest width of 12.8 feet to meet FS standards. Additional required embankment material was estimated assuming a 13-foot crest width, 2:1 upstream slope, and 1.5:1 downstream slope. The outlet pipe would need to be extended 15 feet. The modification would add approximately 74 acre-feet of reservoir storage, a 25% increase.

Advantages:

The Increase Storage alternative would offset potential loss of storage volume by decommissioning other City-owned dams in the Wilderness, and the City could potentially retain existing water storage and water rights while reducing the number of dams that require future maintenance.

Disadvantages:

There is an initial capital improvement cost associated with this alternative, and the alternative cannot be implemented without completing rehabilitation work. Some cost efficiency would be realized by increasing storage at the time rehabilitation work is completed. Increasing the dam storage capacity would also increase the peak flow in the event of a dam breach, and a revised hazard assessment would be required. An evaluation would be needed to determine the effect on the current dam hazard classification. Since the current classification and spillway capacity criteria are based on the effect from dam failure, the amount of increased storage that could be added without changing the current dam hazard classification would have to be examined closely.

Estimated Costs:

Costs for Increased Storage are based on the same assumptions as used for the Rehabilitation option. The estimated costs are as follows:

| | |
|---|---|
| Capital improvement costs for this alternative alone* | $895,000 |
| Increased water storage | 74 ac-ft |
| Cost per acre-foot for this alternative alone | $12,096 |
| Capital improvement costs including rehabilitation* | $2,020,000 |
| Existing water right plus increased storage | 374 ac-ft |
| Cost per acre-foot including rehabilitation alternative | $5,402 |

**Costs do not account for potential savings achieved by eliminating repair costs at other dam(s)*

## Decommission

The alternative to decommission the dam would involve breaching a portion of the dam and constructing a channel to route flows past the dam to an outlet channel. Breaching the dam would eliminate its storage capacity. A stable breach channel would be excavated through the dam embankment to safely route a 100-year or larger inflow design flood and to avoid any backwater impoundment against the remaining portion of the dam. The channel could feature a control sill to reduce sediment releases until the reservoir beach stabilizes. Excavated material could be dispersed to blend within the surrounding ground in

the reservoir footprint. The existing outlet gates and gate tower would be removed. The beach between the current reservoir shore and the remaining natural lake would be seeded.

The description above presents the probable minimum requirements for decommissioning the dam. A larger effort may be required to satisfy outside interests. This could involve reconstructing a natural channel upstream and downstream of the dam, completely removing the embankment material, or other major construction tasks.

The cost estimate assumes a breach channel would be excavated through the embankment capable of passing a 500-year flood with a peak flow of 100 cubic feet per second (cfs). Designing to this flood event would result in a stable channel during extreme flood events and minimize the potential for backwater impoundment against the dam. Changing the design flood would not significantly affect costs. The channel would be armored with riprap, and 2 acres of reservoir beach would be seeded. The seeding and re-vegetation plan would be prepared to minimize the introduction of invasive species and could incorporate seed collected on site.

According to FSM 2709.11, Dam Safety Definitions, a dam is 'any artificial barrier, including appurtenant works, that impounds or diverts water, either temporarily or long term, but not including a facility that is 6 feet or less in height or that impounds no more than 15 acre-feet of water'. The decommissioning alternative could be modified such that some combination of dam height reduction and storage reduction essentially turned the dam into a pond. This sub-alternative may have advantages in terms of cost, aquatic life, and re-vegetation limits and could be further developed in the next phase of overall project development and analysis.

Advantages:

The Decommission alternative would eliminate current and future maintenance requirements, except for possible short-term maintenance while conditions equilibrate. Ownership of the former dam and reservoir could be returned to the FS. Decommissioning costs would likely be lower than rehabilitation costs, although that could depend on the scope of decommissioning work and FS requirements for restoration to simulate natural conditions.

Disadvantages:

With its water storage capacity eliminated, the water rights associated with Little Lake Dam would need to be modified or abandoned. Reestablishing vegetation on the reservoir beach would take years, and the remaining embankment section could be considered an aesthetic drawback. Potential late-season flow releases to Rattlesnake Creek would be lost, and the overall recreational appeal of the dam site could decrease.

Estimated Costs:

Costs for the Decommission option are based on the same assumptions as used for the Rehabilitation option. The estimated costs are as follows:

| | |
|---|---|
| Capital costs for this alternative | $473,000 |

## 9.7.5 McKinley Lake Dam

### Current Conditions

A Project Information Sheet for McKinley Lake Dam is located in Appendix K of this report, which provides detailed information about the dam and reservoir; a summary of current conditions related to different components of the dam and appurtenances; a summary of needed short-term repairs; and a conceptual-level cost estimate for completing short-term repairs.

McKinley Lake Dam impounds approximately 168 acre-feet of water (the fifth-largest reservoir (out of eight total) in the Wilderness owned by the City of Missoula). It is an easement dam, meaning the dam and appurtenances are located on a pre-Federal Land Policy Management Act right-of-way. It does not fall under direct U.S. Forest Service authority; however, the FS has reserved the right to have input regarding actions taken on and around the dam. The dam is classified as having a "Significant" hazard classification, meaning that failure of the dam for any reason results in no probable human loss of life, but can cause non-recoverable environmental damage. A breach failure could result in erosion and sediment transfer to Roosevelt Lake and then Carter Lake and possibly to Lake Creek and ultimately to Rattlesnake Creek where bull trout (a threatened species) are present, which is the basis for the dam's current Significant hazard rating.

The dam was originally built in 1923 as an earthen embankment. The construction drawings do not show a timber rock crib core, but this has not yet been verified. The embankment crest is 12 feet wide, which meets FS criteria for the approximately 15-foot dam height. There is no instrumentation, such as piezometers, on the dam. The upstream slope varies from around 1:1 to 2:1, while the downstream slope is very steep and estimated at 0.3:1. The upstream slope is lined with riprap and shows some signs of erosion, mostly in the area of the outlet. The crest has been observed in the past to slope slightly to the upstream side in the area of the outlet and has been monitored for many years, however no movement has been observed in recent years. The downstream slope is constructed with stacked rock. With the exception of the crest area near the outlet, the embankment does not exhibit signs of instability. Some excessive vegetation on all surfaces needs to be cut.

*The spillway channel has eroded much of the hillside and a severe headcut is continuing to advance toward the reservoir. Under all alternatives, re-routing the spillway back to the natural channel should be evaluated to eliminate future erosion.*

The existing spillway channel leads to a steep slope that drops over 100 feet before rejoining the main stream channel. As a result, the spillway channel has eroded much of the hillside on which it flows and there is a severe headcut in the spillway channel that is continuing to advance toward the reservoir. The headcut is currently being monitored for movement using set rebar monuments to measure erosion progress. Annual maintenance is needed to clear logs and other debris from the spillway approach channel.

Spillway capacity currently meets FS design criteria for an existing significant hazard dam but would need to be increased if the dam is rehabilitated. Significant seepage has been observed in the past along the dam toe during high reservoir levels. The dam has one pipe outlet, which is a corrugated metal pipe (CMP) with heavy corrosion. The control valve on the upstream end is left open to keep the reservoir level low and minimize flow through the eroding spillway. The valve is protected by a metal structure that is continually damaged by ice and needs replacement.

## Alternatives

The following alternatives are presented to aid in deciding the eventual disposition of McKinley Lake Dam. The actions and costs of each alternative are based on the best available data at this time. Costs and tasks to complete each alternative may change as new information becomes available. Costs include construction and engineering design and construction oversight.

## No Action

The No Action alternative is to keep the dam and appurtenances in their current state with no improvements anticipated for the foreseeable future. The City would continue to monitor the dam, make minor repairs as needed, and take preventative action only if conditions indicate the dam would be in danger of failing.

Advantages:

The No Action alternative does not include initial capital improvement costs. There would still be annual costs for maintenance and owner inspections, and a cost for a periodic O&M engineer inspection and hazard assessment once every five years, as required by FS regulations.

Disadvantages:

The effects of aging on a dam nearly one hundred years old will continue. It is impossible to know when serious symptoms related to dam safety may appear, but they would be inevitable in the future. Costs to repair, replace or decommission the dam would eventually have to be expended at the time that serious deficiencies arise. Performing a structural stability analysis of an earthen dam requires a slope stability analysis. Although the FS does not have agency-specific guidance on conducting a structural analysis of an earthen dam, it references other suitable federal agency guidance. FSM 7525.42 states that the design of earthen side slopes can be accomplished using guidelines developed by the U.S. Army Corps of Engineers (USACOE) or U.S. Bureau of Reclamation (USBR). Criteria found in USDA-Natural Resources Conservation Service (NRCS) Technical Release 60 (TR-60) are consistent with USACOE and USBR criteria and is used often on FS dams. A report prepared by GMT Consultants in 1997 (*Preliminary Geotechnical Evaluation and Slope Stability Analysis, 6 Dam Sites - Rattlesnake Wilderness*) evaluated the downstream slope and it produced a safety factor of 1.20. However, the report indicated that the slope was input to the model as 0.9:1, which is flatter than the actual slope, and that it was modeled as a stacked-rock slope, which may be accurate. The GMT report also noted that a “critical condition could occur” if the reservoir reaches the spillway level in its current condition. The no action alternative for the dam would increase the City’s risk and liability.

Estimated Costs:

No capital improvement costs for this alternative $0

(It should be noted that under the no action alternative, regular operations and maintenance costs would still be required, and would likely increase over time.)

## Rehabilitate to Meet Forest Service Standards

The rehabilitation alternative would address deficiencies on the existing dam, as described in the Current Conditions section, and bring the dam into compliance with FS standards. Proposed repairs would include:

- Performing a geotechnical investigation and analysis;
- Addressing any seepage issues by lining the upstream slope with an impermeable liner;
- Addressing potential slope stability concerns by adding fill on the upstream and downstream slopes;
- Removing and replacing the outlet pipe and extending to accommodate added fill;
- Rebuilding the outlet intake tower;
- Replacing the outlet valve; and
- Repairing the spillway.

The embankment materials at McKinley Lake Dam are prone to seepage, which can result in embankment piping (internal erosion). The embankment could be reconstructed with more suitable embankment materials, but that would be expensive and potentially problematic due to the limited soil resources at the site.

A more reasonable solution to eliminate the piping concern is lining the upstream embankment slope with an impermeable geomembrane liner. This option would require temporarily removing the upstream riprap, preparing the liner subgrade, installing a geomembrane liner with cushion geotextile on both sides, and replacing the upstream riprap.

In addition, both the upstream and downstream embankment slopes are steep and probably need to be flattened to meet slope stability criteria. The new fill material could be coarse gravel and sand obtained from within the reservoir footprint. An upstream slope of 2:1 and downstream slope of 1.5:1 are proposed conceptually. The existing and proposed slopes are steeper than recommended in the NRCS Conservation Practice Standard POND (No.) CODE 378. Flattening the embankment slopes, in combination with an upstream liner that eliminates a high phreatic surface in the embankment, would address potential issues from rapid drawdown and other concerns that earthen embankment dam standards take into consideration. Slope stability analyses would be conducted to verify that the proposed combination of slopes with an upstream liner under various loading conditions meet FS criteria. If not, then the downstream slope would be flattened until criteria are met. The replacement outlet pipe would be slightly longer than the existing slope because of the added fill.

Spillway repair would consist of either repairing and stabilizing the existing spillway or constructing a new spillway along a new alignment to the natural stream channel. The repair alternative would involve replacing eroded material in the area of the headcut with

native borrow material and stabilizing with erosion resistant material. One possible solution is the installation of an articulated concrete block mat. Mobilizing the material to the site would be expensive but may be an effective tool to stabilize the spillway. If a new spillway channel is constructed to tie in to the stream channel, it would likely include riprap stabilization or a drop structure to dissipated energy. The new or repaired channel would be designed to pass the required flow and at the same time prevent erosion and headcutting.

Advantages:

The rehabilitation alternative would address long-term concerns at the dam and would bring the dam into compliance with FS standards. The improvements proposed for rehabilitation would likely be necessary to even consider raising the dam to increase storage capacity.

Disadvantages:

The rehabilitation alternative would require a large capital improvement investment as well as ongoing operation and maintenance costs. While most seepage would be blocked, it is possible that foundation seepage could occur, which has the potential to pipe foundation material and undermine the dam.

Estimated Costs:

Rehabilitation costs are estimated using unit costs from recent wilderness dams repair work. Remote access necessitates helicopter transportation for personnel, equipment and construction materials. Construction costs for remote access dams can be five to ten times that of conventional construction. Estimated costs presented here include mobilization and demobilization costs, engineering and construction management fees, and a contingency of 30 percent. The estimated costs are as follows:

| | |
|---|---|
| Capital improvement costs | $1,084,000 |
| Existing Water Right | 195 ac-ft |
| Cost per acre-foot | $5,577 |

## Increase Storage

The alternative to increase storage would be a combination of raising the embankment height and completing rehabilitation items discussed above. With a surface area of approximately 17.6 acres, raising McKinley Lake Dam even a few feet could result in a significant increase in storage capacity. This alternative would be combined with the decommissioning of one or more other dams and would offset the lost storage volume.

Because of the already narrow dam crest, raising the dam approximately 4 feet (which is estimated only for purposes of this analysis – actual increase in height would be based on a cost:benefit analysis) would require additional fill beyond that estimated for rehabilitation. Raising the dam 4 feet would increase the height from 15 to 19 feet, which requires a minimum crest width of 10.8 feet to meet FS standards. Additional required embankment material was estimated assuming an 11-foot crest width, 2:1 upstream slope, and 1.5:1 downstream slope. The outlet pipe would need to be extended 14 feet. The modification would increase reservoir storage approximately 72 acre-feet, a 37% increase.

Advantages:

The Increase Storage alternative would offset potential loss of storage volume by decommissioning other City-owned dams in the Wilderness, and the City could potentially retain existing water storage while reducing the number of dams that require future maintenance.

Disadvantages:

There is an initial capital improvement cost associated with this alternative, and the alternative cannot be implemented without completing rehabilitation work. Some cost efficiency would be realized by increasing storage at the time rehabilitation work is completed. Increasing the dam storage capacity would also increase the peak flow in the event of a dam breach, and a revised hazard assessment would be required. An evaluation would be needed to determine the effect on the current dam hazard classification. Since the current classification and spillway capacity criteria are based on the effect from dam failure, the amount of increased storage that could be added without changing the current dam hazard classification would have to be examined closely.

Estimated Costs:

Costs for Increased Storage are based on the same assumptions as used for the Rehabilitation option. The estimated costs are as follows:

| | |
|---|---|
| Capital improvement costs for this alternative alone* | $706,000 |
| Increased water storage | 72 ac-ft |
| Cost per acre-foot for this alternative alone | $9,800 |
| Capital improvement costs including rehabilitation* | $1,789,000 |
| Existing water right plus increased storage | 267 ac-ft |
| Cost per acre-foot including rehabilitation alternative | $6,701 |

**Costs do not account for potential savings achieved by eliminating repair costs at other dam(s)*

## Decommission

The alternative to decommission the dam would involve breaching a portion of the dam and constructing a channel to route flows past the dam to an outlet channel. Breaching the dam would eliminate its storage capacity. A stable breach channel would be excavated through the dam embankment to safely route a 100-year or larger inflow design flood and to avoid any backwater impoundment against the remaining portion of the dam. The channel could feature a control sill to reduce sediment releases until the reservoir beach stabilizes. Excavated material could be dispersed to blend within the surrounding ground in the reservoir footprint. The existing outlet gates and gate tower would be removed. The beach between the current reservoir shore and the remaining natural lake would be seeded. Erosion along the existing spillway immediately downstream of the dam would be backfilled and seeded as a stabilization measure.

The description above presents the probable minimum requirements for decommissioning the dam. A larger effort may be required to satisfy outside interests. This could involve reconstructing a natural channel upstream and downstream of the dam, completely

removing the embankment material, a greater rehabilitation effort along the existing spillway channel, or other major construction tasks.

The cost estimate assumes a breach channel would be excavated through the embankment capable of passing a 500-year flood with a peak flow of 65 cubic feet per second (cfs). Designing to this flood event would result in a stable channel during extreme flood events and minimize the potential for backwater impoundment against the dam. Changing the design flood would not significantly affect costs. The channel would be armored with riprap, and 5 acres of reservoir beach would be seeded. The seeding and re-vegetation plan would be prepared to minimize the introduction of invasive species and could incorporate seed collected on site.

According to FSM 2709.11, Dam Safety Definitions, a dam is 'any artificial barrier, including appurtenant works, that impounds or diverts water, either temporarily or long term, but not including a facility that is 6 feet or less in height or that impounds no more than 15 acre-feet of water'. The decommissioning alternative could be modified such that some combination of dam height reduction and storage reduction essentially turned the dam into a pond. This sub-alternative may have advantages in terms of cost, aquatic life, and re-vegetation limits and could be further developed in the next phase of overall project development and analysis.

Advantages:

The Decommission alternative would eliminate current and future maintenance requirements, except for possible short-term maintenance while conditions equilibrate. Ownership of the former dam and reservoir could be returned to the FS. Decommissioning costs would likely be lower than rehabilitation costs, although that could depend on the scope of decommissioning work and FS requirements for restoration to simulate natural conditions.

Disadvantages:

With its water storage capacity eliminated, the water rights associated with McKinley Lake Dam would need to be modified or abandoned. Reestablishing vegetation on the reservoir beach would take years, and the remaining embankment section could be considered an aesthetic drawback. Potential late-season flow releases to Rattlesnake Creek would be lost, and the overall recreational appeal of the dam site could decrease.

Estimated Costs:

Costs for the Decommission option are based on the same assumptions as used for the Rehabilitation option. The estimated costs are as follows:

| | |
|---|---|
| Capital costs for this alternative | $173,000 |

## 9.7.6 Sanders North and South Dams

### Current Conditions

Project Information Sheets for Sanders Lake North Dam and South Dam are located in Appendix K of this report, which provide detailed information about the dams and reservoir; a summary of current conditions related to different components of the dams and

appurtenances; a summary of needed short-term repairs; and a conceptual-level cost estimate for completing short-term repairs.

The reservoir at Sanders Lake is created by two dams – the North Dam (Dam No. 1) and South Dam (Dam No. 2). The Sanders Lake dams impound approximately 897 acre-feet of water (the largest reservoir in the Wilderness owned by the City of Missoula (out of 8 total)). The North Dam is an easement dam, meaning the dam and appurtenances are located on a pre-Federal Land Policy Management Act right-of-way. The dam does not fall under direct U.S. Forest Service authority; however, the FS has reserved the right to have input regarding actions taken on and around the dam. The South Dam operates under a Special Use Permit issued by the Lolo National Forest of the U.S. Forest Service and is regulated under the authority of the FS dam safety laws. Both dams are classified as having a “Significant” hazard classification, meaning that failure of a dam for any reason results in no probable human loss of life, but can cause non-recoverable environmental damage. A breach failure could result in erosion and sediment transfer to Wrangle Creek and ultimately to Rattlesnake Creek where bull trout (a threatened species) are present, which is the basis for the current Significant hazard ratings. The North and South dams were originally built in 1913 and 1915, respectively, as earthen embankments with rock timber crib cores.

The smaller North Dam is approximately 10 feet high with a crest width of 7 feet, which does not meet FS criteria of 10 feet minimum. There is no instrumentation, such as piezometers, on the dam. The upstream slope is approximately 2:1, is lined with riprap, and is in good condition. The downstream slope is approximately 1.5:1 and appears stable. Vegetation is growing on much of the embankment that needs to be trimmed. Rodent damage is also prevalent on the embankment. The spillway is in good condition and meets FS design criteria. Significant seepage has been documented in the downstream toe area of the dam with a high reservoir pool. The dam features a downstream weir for measuring seepage flows, but the weir misses some seepage and also captures some of the outlet pipe discharge when the valve is open. A portion of the seepage flow may originate from a spring rather than the dam. The dam has one pipe outlet, which is a corrugated metal pipe (CMP). The pipe is corroded and has several visible cracks near the upstream end. The control valve is located on the upstream end of the pipe and is left open due to difficult access.

The larger South Dam is approximately 14 feet high with a crest width of 5 feet, which also does not meet FS criteria of 10 feet minimum. There is no instrumentation, such as piezometers, on the dam. The upstream slope is approximately 2:1, lined with riprap, and is in fair condition with some wave erosion evident. The rock-lined downstream slope is steep with a slope of 0.3:1. The downstream slope features one notable bulge and areas where rock has fallen from the slope. Woody debris and vegetation on the upstream slope and crest require removal. No seepage is evident downstream of the dam. The Sanders Lake spillway is associated with the North Dam. The South Dam also has one pipe outlet, which is a corrugated metal pipe (CMP) with a 5-foot PVC extension. The pipe is corroded and has one visible hole near the upstream end. The control valve is located on the upstream end of the pipe and is left open. The valve is inaccessible because ice has destroyed the timber access structure.

## Alternatives

The following alternatives are presented to aid in deciding the eventual disposition of the Sanders Lake dams. The actions and costs of each alternative are based on the best available data at this time. Costs and tasks to complete each alternative may change as new information becomes available. Costs include construction and engineering design and construction oversight.

## No Action

The No Action alternative is to keep the dams and appurtenances in their current state with no improvements anticipated for the foreseeable future. The City would continue to monitor the dams, make minor repairs as needed, and take preventative action only if conditions indicate a dam is in danger of failing.

Advantages:

The No Action alternative does not include initial capital improvement costs. There would still be annual costs for maintenance and owner inspections, and a cost for a periodic O&M engineer inspection and hazard assessment once every five years, as required by FS regulations.

Disadvantages:

The effects of aging on the one hundred year old dams will continue. It is impossible to know when serious symptoms related to dam safety may appear, but they would be inevitable in the future. Costs to repair, replace or decommission the dams would eventually have to be expended to address deficiencies. Performing a structural stability analysis of an earthen dam requires a slope stability analysis. Although the FS does not have agency-specific guidance on conducting a structural analysis of an earthen dam, it references other suitable federal agency guidance. FSM 7525.42 states that the design of earthen side slopes can be accomplished using guidelines developed by the U.S. Army Corps of Engineers (USACOE) or U.S. Bureau of Reclamation (USBR). Criteria found in USDA-Natural Resources Conservation Service (NRCS) Technical Release 60 (TR-60) are consistent with USACOE and USBR criteria and is used often on FS dams. A report prepared by GMT Consultants in 1997 (*Preliminary Geotechnical Evaluation and Slope Stability Analysis, 6 Dam Sites - Rattlesnake Wilderness*) evaluated the downstream slope of both dams. In the most conservative case, the report produced a safety factor of 1.62 for the North Dam and 1.25 for the South Dam. However, the report indicated that the South Dam slope was input to the model as 1.1:1, which is flatter than the actual slope. The crest width is also out of compliance with FS standards on both dams. The no action alternative for the dams would increase the City's risk and liability.

Estimated Costs:

No capital improvement costs for this alternative $0

(It should be noted that under the no action alternative, regular operations and maintenance costs would still be required, and would likely increase over time.)

## Rehabilitate to Meet Forest Service Standards

The rehabilitation alternative would address deficiencies on the existing dams, as described in the Current Conditions section, and bring the dams into compliance with FS standards. Proposed repairs would include:

- Performing a geotechnical investigation and analysis;
- Addressing seepage issues by lining the upstream slopes with an impermeable liner;
- Addressing the narrow crests and slope stability concerns by adding fill on the downstream slopes;
- Slip-lining the outlet pipes;
- Constructing new outlet access towers;
- Extending the outlet pipe to accommodate the added fill on the downstream slope; and
- Repairing the spillway.

The embankment materials at both Sanders Lake dams are prone to seepage, which can result in embankment piping (internal erosion). The embankments could be reconstructed with suitable embankment materials, but that would be expensive and potentially problematic due to the limited soil resources at the site.

A more reasonable solution to eliminate the piping concern is lining the upstream embankment slopes with an impermeable geomembrane liner. This option would require temporarily removing the upstream riprap, preparing the liner subgrade, installing a geomembrane liner with cushion geotextile on both sides, and replacing the upstream riprap.

In addition, the dam crests are narrow and needs to be widened to a minimum of 10 feet in order to meet FS criteria. Along with this, the steep downstream embankment slope on the South Dam could be flattened to produce a more stable embankment. The new fill material could be coarse gravel and sand obtained from within the reservoir footprint. Additional embankment fill could significantly increase stability, especially in combination with an upstream liner that eliminates the high phreatic surface in the embankment, potential issues from rapid drawdown, and other concerns that earthen embankment dam standards take into consideration. At this time, it is recommended that the downstream slope would be flattened to 1.5:1, based on experience with repairs on similar wilderness dams. The proposed 1.5:1 downstream slopes and existing 2:1 upstream slopes are steeper than recommended in the NRCS Conservation Practice Standard POND (No.) CODE 378. Slope stability analyses would be conducted to verify that the combination of slopes with an upstream liner under various loading conditions meet FS criteria. If not, then the downstream slope would be flattened until criteria are met. The slip-lined outlet pipes would each need to be extended beyond the existing pipe to reach the new dam toe. If a 1.5:1 downstream slope is used, the north outlet would be extended about 4 feet and the south outlet would be extended about 20 feet. At the South Dam, downstream side of the widened embankment could be limited by the cliff located just downstream of the dam. Some fill may also need to be added to the upstream slope to achieve the minimum crest width and flatter downstream slope. Rodent holes would be filled when new embankment material was placed. No spillway improvements are proposed.

Advantages:

The rehabilitation alternative would address long-term concerns at Sanders Lake and would bring the dams into compliance with FS standards. The improvements proposed for rehabilitation would likely be necessary to even consider raising the dam to increase storage capacity.

Disadvantages:

The rehabilitation alternative would require a large capital improvement investment as well as ongoing operation and maintenance costs. While most seepage would be blocked, it is possible that foundation seepage could occur, which has the potential to pipe foundation material and undermine the dam.

Estimated Costs:

Rehabilitation costs are estimated using unit costs from recent wilderness dams repair work. Remote access necessitates helicopter transportation for personnel, equipment and construction materials. Construction costs for remote access dams can be five to ten times that of conventional construction. Estimated costs presented here include mobilization and demobilization costs, engineering and construction management fees, and a contingency of 30 percent. The estimated costs are as follows:

| | |
|---|---|
| Capital improvement costs for North Dam | $388,000 |
| Capital improvement costs for South Dam | $783,000 |
| Total capital improvement costs | $1,171,000 |
| Existing Water Right | 905 ac-ft |
| Cost per acre-foot | $1,294 |

## Increase Storage

*Sanders Dam is the largest impoundment owned by the City, and raising the embankment 4 feet would increase the storage approximately 200 ac-ft.*

The alternative to increase storage would be a combination of raising the embankment crests and completing rehabilitation items discussed above. With a surface area of approximately 47.3 acres, Sanders Lake is the largest of the wilderness reservoirs by area. Raising the Sanders Lake dams a few feet could result in a significant increase in storage capacity. This alternative would be combined with the decommissioning of one or more other dams and would offset the lost storage volume.

Because of the already narrow dam crests, raising the dam approximately 4 feet (which is estimated only for purposes of this analysis – actual increase in height would be based on a cost:benefit analysis) would require additional fill beyond that estimated for rehabilitation. Raising the dams 4 feet would increase the North and South dam heights to 14 and 18 feet, respectively. Crest widths of 10 feet for the North Dam and 11 feet for the South Dam are proposed to meet FS standards. Additional fill would be placed on the downstream slope of the North Dam, but fill would need to be placed on the upstream slope of the South Dam because of the limited downstream space. Required embankment volume was

estimated assuming 2:1 upstream slopes and 1.5:1 downstream slopes. The outlet pipes would need to be extended about 15 feet each. The modification would increase reservoir storage approximately 193 acre-feet, a 21% increase.

Advantages:

The Increase Storage alternative would offset potential loss of storage volume by decommissioning other City-owned dams in the Wilderness, and the City could potentially retain existing water storage and water rights while reducing the number of dams that require future maintenance.

Disadvantages:

There is an initial capital improvement cost associated with this alternative, and the alternative cannot be implemented without completing rehabilitation work. Some cost efficiency would be realized by increasing storage at the time rehabilitation work is completed. Increasing the dam storage capacity would also increase the peak flow in the event of a dam breach, and a revised hazard assessment would be required. An evaluation would be needed to determine the effect on the current dam hazard classification. Since the current classification and spillway capacity criteria are based on the effect from dam failure, the amount of increased storage that could be added without changing the current dam hazard classification would have to be examined closely.

Estimated Costs:

Costs for Increased Storage are based on the same assumptions as used for the Rehabilitation option. The estimated costs are as follows:

| | |
|---|---|
| Capital improvement costs for this alternative alone (both dams)* | $1,118,000 |
| Increased water storage | 193 ac-ft |
| Cost per acre-foot for this alternative alone | $5,792 |
| Capital improvement costs including rehabilitation (both dams)* | $2,289,000 |
| Existing water right plus increased storage | 1,098 ac-ft |
| Cost per acre-foot including rehabilitation alternative | $2,084 |

**Costs do not account for potential savings achieved by eliminating repair costs at other dam(s)*

## Decommission

The alternative to decommission the dams would involve breaching a portion of the South Dam and constructing a channel to route flows past the dam to the outlet channel. It appears the South Dam toe is lower than the North Dam, so if it were breached the North Dam would no longer impound water. The South Dam also aligns with the natural channel. Breaching the South Dam would eliminate the reservoir storage capacity. This proposal would keep the North Dam in its current condition. A stable breach channel would be excavated through the dam embankment to safely route a 100-year or larger inflow design flood and to avoid any backwater impoundment against the remaining portion of the dam. The channel could feature a control sill to reduce sediment releases until the reservoir beach stabilizes. Excavated material could be dispersed to blend within the surrounding ground in the reservoir footprint. The existing outlet gate and access structures would be

removed. The beach between the current reservoir shore and the remaining natural lake would be seeded.

The description above presents the probable minimum requirements for decommissioning the dam. A larger effort may be required to satisfy outside interests. This could involve reconstructing a natural channel upstream and downstream of the dam, completely removing the embankment material, or other major construction tasks.

The cost estimate assumes a breach channel would be excavated through the embankment capable of passing a 500-year flood with a peak flow of 90 cubic feet per second (cfs). Designing to this flood event would result in a stable channel during extreme flood events and minimize the potential for backwater impoundment against the dam. Changing the design flood would not significantly affect costs. The channel would be armored with riprap, and 7 acres of reservoir beach would be seeded. The seeding and re-vegetation plan would be prepared to minimize the introduction of invasive species and could incorporate seed collected on site.

According to FSM 2709.11, Dam Safety Definitions, a dam is ‘any artificial barrier, including appurtenant works, that impounds or diverts water, either temporarily or long term, but not including a facility that is 6 feet or less in height or that impounds no more than 15 acre-feet of water’. The decommissioning alternative could be modified such that some combination of dam height reduction and storage reduction essentially turned the dam into a pond. This sub-alternative may have advantages in terms of cost, aquatic life, and re-vegetation limits and could be further developed in the next phase of overall project development and analysis.

Advantages:

The Decommission alternative would eliminate current and future maintenance requirements for both dams, except for possible short-term maintenance while conditions equilibrate. Ownership of the former dams and reservoir could be returned to the FS. Decommissioning costs would likely be lower than rehabilitation costs, although that could depend on the scope of decommissioning work and FS requirements for restoration to simulate natural conditions.

Disadvantages:

With its water storage capacity eliminated, the water rights associated with the Sanders Lake Dams would need to be modified or abandoned. Reestablishing vegetation on the reservoir beach would take years, and the remaining embankment section could be considered an aesthetic drawback. Potential late-season flow releases to Rattlesnake Creek would be lost, and the overall recreational appeal of the dam site could decrease.

Estimated Costs:

Costs for the Decommission option are based on the same assumptions as used for the Rehabilitation option. The estimated costs are as follows:

| | |
|---|---|
| Capital costs for this alternative | $159,000 |

## 9.7.7 Sheridan East and West Dams

### Current Conditions

Project Information Sheets for Sheridan Lake East Dam and West Dam are located in Appendix K of this report, which provide detailed information about the dams and reservoir; a summary of current conditions related to different components of the dams and appurtenances; a summary of needed short-term repairs; and a conceptual-level cost estimate for completing short-term repairs.

The reservoir at Sheridan Lake is created by two dams – the East Dam and West Dam. The Sheridan Lake Dams impound approximately 130 acre-feet of water (the second-smallest reservoir in the Wilderness owned by the City of Missoula (out of 8 total)). The dams operate under Special Use Permits issued by the Lolo National Forest of the U.S. Forest Service. The dams are regulated under the authority of the FS dam safety laws. The dams are classified as having a "Significant" hazard classification, meaning that failure of a dam for any reason results in no probable human loss of life, but can cause non-recoverable environmental damage. A breach failure could result in erosion and sediment transfer to Lake Creek and ultimately to Rattlesnake Creek where bull trout (a threatened species) are present, which is the basis for the dam's current Significant hazard rating. The dams were originally built in 1915 as earthen embankments with rock timber crib cores.

The larger East Dam is approximately 8 feet high with a crest width of 8 feet, which does not meet FS criteria of 10 feet minimum. The dam crest features two piezometers near the outlet pipe. The upstream slope is approximately 3:1, is lined with riprap, and is in good condition. The downstream slope is steep with a slope of 0.3:1 and is lined with stacked rock. Vegetation is growing on much of the embankment that needs to be trimmed. The spillway is in good condition. Annual maintenance is needed to clear logs and other debris from the spillway approach channel. Spillway capacity currently meets FS design criteria for an existing significant hazard dam but would need to be increased if the dam is rehabilitated. Significant seepage has been documented through the embankment and in the downstream toe area of the dam with a high reservoir pool. Because of this, a low pool has been maintained in recent years. The dam has one pipe outlet, which is a corrugated metal pipe (CMP). The pipe is severely corroded with many large holes. The control valve is located on the upstream end of the pipe, and the timber access structure is damaged and requires repair.

*The outlet pipe is corrugated metal pipe (CMP), approximately 100 years old. The useful life of CMP typically ranges from 20-40 years.*

The smaller West Dam is approximately 6 feet high with a crest width of 5 feet, which also does not meet FS criteria of 10 feet minimum. There is no instrumentation, such as piezometers, on the dam. The upstream slope is approximately 2:1, is lined with riprap, and is in good condition. The rock-lined downstream slope is steep with a slope of 0.5:1 but also in good condition. Vegetation is growing on much of the embankment that needs to be trimmed. Seepage is evident in the downstream toe area, even with a low reservoir pool. A nearby stream may be the source of the seepage, rather than the reservoir, but the source is not clear. The Sheridan Lake spillway and outlet are associated with the East Dam.

## Alternatives

The following alternatives are presented to aid in deciding the eventual disposition of the Sheridan Lake dams. The actions and costs of each alternative are based on the best available data at this time. Costs and tasks to complete each alternative may change as new information becomes available. Costs include construction and engineering design and construction oversight.

## No Action

The No Action alternative is to keep the dams and appurtenances in their current state with no improvements anticipated for the foreseeable future. The City would continue to monitor the dams, make minor repairs as needed, and take preventative action only if conditions indicate a dam is in danger of failing.

Advantages:

The No Action alternative does not include initial capital improvement costs. There would still be annual costs for maintenance and owner inspections, and a cost for a periodic O&M engineer inspection and hazard assessment once every five years, as required by FS regulations.

Disadvantages:

The effects of aging on the one hundred year old dams will continue. Significant seepage at high pool is already a concern, and additional dam safety issues would be inevitable in the future. Costs to repair, replace or decommission the dams would eventually have to be expended to address deficiencies. Performing a structural stability analysis of an earthen dam requires a slope stability analysis. Although the FS does not have agency-specific guidance on conducting a structural analysis of an earthen dam, it references other suitable federal agency guidance. FSM 7525.42 states that the design of earthen side slopes can be accomplished using guidelines developed by the U.S. Army Corps of Engineers (USACOE) or U.S. Bureau of Reclamation (USBR). Criteria found in USDA-Natural Resources Conservation Service (NRCS) Technical Release 60 (TR-60) are consistent with USACOE and USBR criteria and is used often on FS dams. No geotechnical investigations or analyses have been completed on the dams. The downstream slopes currently appear stable, but are much steeper than typically recommended. The crest width is also out of compliance with FS standards on both dams. The no action alternative for the dams would increase the City's risk and liability.

Estimated Costs:

No capital improvement costs for this alternative $0

(It should be noted that under the no action alternative, regular operations and maintenance costs would still be required, and would likely increase over time.)

## Rehabilitate to Meet Forest Service Standards

The rehabilitation alternative would address deficiencies on the existing dams, as described in the Current Conditions section, and bring the dams into compliance with FS standards. Proposed repairs would include:

- Performing a geotechnical investigation and analysis;

- Addressing seepage issues by lining the upstream slopes with an impermeable liner;
- Addressing the narrow crests and slope stability concerns by adding fill on the downstream slopes;
- Replacing the outlet pipe and valve;
- Rebuilding the outlet intake tower;
- Extending the outlet pipe to accommodate the added fill on the downstream slope; and
- Repairing the spillway.

The embankment materials at Sheridan Lake Dam are prone to seepage, which can result in embankment piping (internal erosion). The embankments could be reconstructed with suitable embankment materials, but that would be expensive and potentially problematic due to the limited soil resources at the site.

A more reasonable solution to eliminate the piping concern is lining the upstream embankment slopes with an impermeable geomembrane liner. This option would require temporarily removing the upstream riprap, preparing the liner subgrade, installing a geomembrane liner with cushion geotextile on both sides, and replacing the upstream riprap.

In addition, the dam crests are narrow and needs to be widened to a minimum of 10 feet in order to meet FS criteria. Along with this, the steep downstream embankment slopes could be flattened to produce a more stable embankment. The new fill material could be coarse gravel and sand obtained from within the reservoir footprint. Flattening the downstream slopes would significantly increase stability, especially in combination with an upstream liner that eliminates the high phreatic surface in the embankment, potential issues from rapid drawdown, and other concerns that earthen embankment dam standards take into consideration. At this time, it is recommended that the downstream slope would be flattened to 1.5:1, based on experience with repairs on similar wilderness dams. The proposed 1.5:1 downstream slopes, as well as the 2:1 upstream slope on the West Dam, are steeper than recommended in the NRCS Conservation Practice Standard POND (No.) CODE 378. Slope stability analyses would be conducted to verify that the combination of slopes with an upstream liner under various loading conditions meet FS criteria. If not, then the downstream slope would be flattened until criteria are met. The replacement outlet pipe would need to be extended approximately 10 feet longer than the existing pipe to reach the new dam toe, if a 1.5:1 downstream slope is used.

Spillway improvements would consist of enlarging the spillway channel and/or lowering the spillway crest to meet required design capacity and stabilizing the channel with riprap. The area near the dam or around the reservoir has significant riprap rock available that hopefully could be utilized. The channel would have to be designed to pass the required flow and at the same time prevent erosion and headcutting.

Advantages:

The rehabilitation alternative would address long-term concerns at Sheridan Lake and would bring the dams into compliance with FS standards. The improvements proposed for rehabilitation would likely be necessary to even consider raising the dam to increase storage capacity.

Disadvantages:

The rehabilitation alternative would require a large capital improvement investment as well as ongoing operation and maintenance costs. While most seepage would be blocked, it is possible that foundation seepage could occur, which has the potential to pipe foundation material and undermine the dam.

Estimated Costs:

Rehabilitation costs are estimated using unit costs from recent wilderness dams repair work. Remote access necessitates helicopter transportation for personnel, equipment and construction materials. Construction costs for remote access dams can be five to ten times that of conventional construction. Estimated costs presented here include mobilization and demobilization costs, engineering and construction management fees, and a contingency of 30 percent. The estimated costs are as follows:

| | |
|---|---|
| Capital improvement costs for East Dam | $452,000 |
| Capital improvement costs for West Dam | $96,000 |
| Total capital improvement costs | $548,000 |
| Existing Water Right | 115 ac-ft |
| Cost per acre-foot | $4,763 |

## Increase Storage

The alternative to increase storage would be a combination of raising the embankment crests and completing rehabilitation items discussed above. With a surface area of approximately 10.8 acres, raising the Sheridan Lake dams a few feet could result in a modest increase in storage capacity. This alternative would be combined with the decommissioning of one or more other dams and would offset the lost storage volume.

Because of the already narrow dam crest, raising the dam approximately 4 feet (which is estimated only for purposes of this analysis – actual increase in height would be based on a cost:benefit analysis) would require additional fill beyond that estimated for rehabilitation. Raising the dams 4 feet would increase the East and West dam heights to 12 and 10 feet, respectively, which requires a minimum crest width of 10 feet to meet FS standards. Additional required embankment material was estimated assuming 10-foot crest widths, 3:1 upstream slope (East Dam), 2:1 upstream slope (West Dam), and 1.5:1 downstream slopes. The outlet pipe would need to be extended 18 feet. The modification would increase reservoir storage approximately 45 acre-feet, a 39% increase.

Advantages:

The Increase Storage alternative would offset potential loss of storage volume by decommissioning other City-owned dams in the Wilderness, and the City could potentially retain existing water storage while reducing the number of dams that require future maintenance.

Disadvantages:

There is an initial capital improvement cost associated with this alternative, and the alternative cannot be implemented without completing rehabilitation work. Some cost efficiency would be realized by increasing storage at the time rehabilitation work is

completed. Increasing the dam storage capacity would also increase the peak flow in the event of a dam breach, and a revised hazard assessment would be required. An evaluation would be needed to determine the effect on the current dam hazard classification. Since the current classification and spillway capacity criteria are based on the effect from dam failure, the amount of increased storage that could be added without changing the current dam hazard classification would have to be examined closely.

Estimated Costs:

Costs for Increased Storage are based on the same assumptions as used for the Rehabilitation option. The estimated costs are as follows:

| | |
|---|---|
| Capital improvement costs for this alternative alone (both dams)* | $557,000 |
| Increased water storage | 45 ac-ft |
| Cost per acre-foot for this alternative alone | $12,372 |
| Capital improvement costs including rehabilitation (both dams)* | $1,105,000 |
| Existing water right plus increased storage | 160 ac-ft |
| Cost per acre-foot including rehabilitation alternative | $6,903 |

**Costs do not account for potential savings achieved by eliminating repair costs at other dam(s)*

## Decommission

The alternative to decommission the dams would involve breaching a portion of the East Dam and constructing a channel to route flows past the dam to an outlet channel. The smaller West Dam would remain in place because it is not on a natural stream channel. Breaching the dam would eliminate the reservoir storage capacity. A stable breach channel would be excavated through the dam embankment to safely route a 100-year or larger inflow design flood and to avoid any backwater impoundment against the remaining portion of the dam. The channel could feature a control sill to reduce sediment releases until the reservoir beach stabilizes. Excavated material could be dispersed to blend within the surrounding ground in the reservoir footprint. The existing outlet gate and access structure would be removed. The beach between the current reservoir shore and the remaining natural lake would be seeded.

The description above presents the probable minimum requirements for decommissioning the dam. A larger effort may be required to satisfy outside interests. This could involve reconstructing a natural channel upstream and downstream of the dam, completely removing the embankment material, or other major construction tasks.

The cost estimate assumes a breach channel would be excavated through the embankment capable of passing a 500-year flood with a peak flow of 73 cubic feet per second (cfs). Designing to this flood event would result in a stable channel during extreme flood events and minimize the potential for backwater impoundment against the dam. Changing the design flood would not significantly affect costs. The channel would be armored with riprap, and 4 acres of reservoir beach would be seeded. The seeding and re-vegetation plan would be prepared to minimize the introduction of invasive species and could incorporate seed collected on site.

According to FSM 2709.11, Dam Safety Definitions, a dam is 'any artificial barrier, including appurtenant works, that impounds or diverts water, either temporarily or long term, but not including a facility that is 6 feet or less in height or that impounds no more than 15 acre-feet of water'. The decommissioning alternative could be modified such that some combination of dam height reduction and storage reduction essentially turned the dam into a pond. This sub-alternative may have advantages in terms of cost, aquatic life, and re-vegetation limits and could be further developed in the next phase of overall project development and analysis.

Advantages:

The Decommission alternative would eliminate current and future maintenance requirements for both dams, except for possible short-term maintenance while conditions equilibrate. Ownership of the former dams and reservoir could be returned to the FS. Decommissioning costs would likely be lower than rehabilitation costs, although that could depend on the scope of decommissioning work and FS requirements for restoration to simulate natural conditions.

Disadvantages:

With its water storage capacity eliminated, the water rights associated with the Sheridan Lake Dams would need to be modified or abandoned. Reestablishing vegetation on the reservoir beach would take years, and the remaining embankment section could be considered an aesthetic drawback. Potential late-season flow releases to Rattlesnake Creek would be lost, and the overall recreational appeal of the dam site could decrease.

Estimated Costs:

Costs for the Decommission option are based on the same assumptions as used for the Rehabilitation option. The estimated costs are as follows:

| | |
|---|---|
| Capital costs for this alternative | $100,000 |

## 9.7.8 Worden Dam

*Worden Lake Dam is the smallest impoundment owned by the City.*

### Current Conditions

A Project Information Sheet for Worden Lake Dam is located in Appendix K of this report, which provides detailed information about the dam and reservoir; a summary of current conditions related to different components of the dam and appurtenances; a summary of needed short-term repairs; and a conceptual-level cost estimate for completing short-term repairs.

Worden Lake Dam impounds approximately 70 acre-feet of water (the smallest reservoir in the Wilderness owned by the City of Missoula). It operates under a Special Use Permit issued by the Lolo National Forest of the U.S. Forest Service. It is regulated under the authority of the FS dam safety laws. The dam is classified as having a "Significant" hazard classification, meaning that failure of the dam for any reason results in no probable human loss of life, but can cause non-recoverable environmental damage. A breach failure could result in erosion and sediment transfer to Carter Lake and possibly to Lake Creek and ultimately to Rattlesnake Creek where bull trout (a threatened species) are present, which

is the basis for the dam's current Significant hazard rating. The dam was originally built in 1921 as an earthen embankment. The original construction drawings do not show a timber rock crib core, but this has not yet been verified. The dam's crest is approximately 9 feet wide which does not meet FS criteria of 10 feet minimum. The dam features one piezometer near the outlet pipe.

The upstream slope is approximately 2:1, is lined with riprap, and is in good condition. The downstream slope is steep with a slope of 0.3:1. Vegetation is growing on much of the embankment that needs to be trimmed. The spillway features a headcut approximately 200 feet downstream of the dam that is being monitored. Annual maintenance is needed to clear logs and other debris from the spillway approach channel. Spillway capacity currently meets FS design criteria for an existing significant hazard dam but would need to be increased if the dam is rehabilitated. Wet areas have been documented near the dam toe, but no seepage flows have been observed. The dam has one pipe outlet, which is a corrugated metal pipe (CMP). The pipe has not been inspected by video, but it is assumed it is in a similar deteriorated condition as the other dams. The control valve is located on the upstream end of the pipe, and the timber access structure is damaged and requires repair.

## Alternatives

The following alternatives are presented to aid in deciding the eventual disposition of Worden Lake Dam. The actions and costs of each alternative are based on the best available data at this time. Costs and tasks to complete each alternative may change as new information becomes available. Costs include construction and engineering design and construction oversight.

## No Action

The No Action alternative is to keep the dam and appurtenances in their current state with no improvements anticipated for the foreseeable future. The City would continue to monitor the dam, make minor repairs as needed, and take preventative action only if conditions indicate the dam would be in danger of failing.

Advantages:

The No Action alternative does not include initial capital improvement costs. There would still be annual costs for maintenance and owner inspections, and a cost for a periodic O&M engineer inspection and hazard assessment once every five years, as required by FS regulations.

Disadvantages:

The effects of aging on a nearly one hundred year old dam will continue. It is impossible to know when serious symptoms related to dam safety may appear, but they would be inevitable in the future. Costs to repair, replace or decommission the dam would eventually have to be expended at the time that serious deficiencies arise. Performing a structural stability analysis of an earthen dam requires a slope stability analysis. Although the FS does not have agency-specific guidance on conducting a structural analysis of an earthen dam, it references other suitable federal agency guidance. FSM 7525.42 states that the design of earthen side slopes can be accomplished using guidelines developed by the U.S. Army Corps of Engineers (USACOE) or U.S. Bureau of Reclamation (USBR). Criteria

found in USDA-Natural Resources Conservation Service (NRCS) Technical Release 60 (TR-60) are consistent with USACOE and USBR criteria and is used often on FS dams. A report prepared by GMT Consultants in 1997 (*Preliminary Geotechnical Evaluation and Slope Stability Analysis, 6 Dam Sites - Rattlesnake Wilderness*) evaluated the downstream slope and it produced a safety factor of 1.6. However, the report indicated that the slope was input to the model as 1:1, which is flatter than the actual slope. In the absence of a more detailed geotechnical investigation and slope stability analysis, the actual downstream slope stability is unknown. Considering the width of the crest and the uncertainty of the previous slope stability analysis, the no action alternative for the dam would be out of compliance with dam safety regulations and thus increase the City's risk and liability.

Estimated Costs:

No capital improvement costs for this alternative $0

(It should be noted that under the no action alternative, regular operations and maintenance costs would still be required, and would likely increase over time.)

## Rehabilitate to Meet Forest Service Standards

The rehabilitation alternative would address deficiencies on the existing dam, as described in the Current Conditions section, and bring the dam into compliance with FS standards. Proposed repairs would include:

- Performing a geotechnical investigation and analysis;
- Addressing seepage issues by lining the upstream slope with an impermeable liner;
- Addressing the narrow crest and slope stability concerns by adding fill on the downstream slope;
- Slip-lining the outlet pipe;
- Rebuilding the outlet intake tower;
- Extending the outlet pipe to accommodate the added fill on the downstream slope; and
- Repairing the spillway.

The embankment materials at Worden Lake Dam may be prone to seepage, which can result in embankment piping (internal erosion). However, actively flowing seepage has not been observed at the dam and seepage does not seem to be a concern. But, as mentioned below, the embankment crest and slopes do not meet FS criteria, and added material is needed to bring it into compliance. If this is done, and equipment is already on site, it makes sense to provide added protection and reduce the risk of future seepage issues by lining the upstream embankment slope with an impermeable geomembrane liner. This option would require temporarily removing the upstream riprap, preparing the liner subgrade, installing a geomembrane liner with cushion geotextile on both sides, and replacing the upstream riprap.

An alternative to lining the upstream embankment slope could be to flatten the downstream embankment to a 2:1 slope. Slope stability analysis would be required to determine whether 2:1 slopes upstream and downstream are appropriate. A filter diaphragm is also

recommended around the outlet pipe if the upstream liner is omitted. This alternative could reduce construction costs by about 30% but would result in a higher risk of seepage and piping issues in the future.

As mentioned above, the crest needs to be widened to a minimum of 10 feet in order to meet FS criteria. Along with this, the steep downstream embankment slope (0.3:1) could be flattened to produce a more stable embankment. The new fill material could be coarse gravel and sand obtained from within the reservoir footprint. Flattening the downstream slope would significantly increase stability, especially in combination with an upstream liner that eliminates the high phreatic surface in the embankment, potential issues from rapid drawdown, and other concerns that earthen embankment dam standards take into consideration. At this time, it is recommended that the downstream slope would be flattened to 1.5:1, based on experience with repairs on similar wilderness dams. The existing 2:1 upstream slope and proposed 1.5:1 downstream slope are steeper than recommended in the NRCS Conservation Practice Standard POND (No.) CODE 378. Slope stability analyses would be conducted to verify that the combination of slopes with an upstream liner under various loading conditions meet FS criteria. If not, then the downstream slope would be flattened until criteria are met. The slip-lined outlet pipe would need to be extended approximately 8 feet longer than the existing pipe to reach the new dam toe, if a 1.5:1 downstream slope is used.

Spillway repair would consist of replacing eroded material in the area of the headcut with large riprap or other erosion-resistant material, and grading to transition to the natural channel. The area near the dam or around the reservoir has significant riprap rock available that hopefully could be utilized. The channel would have to be designed to pass the required flow and at the same time prevent erosion and headcutting.

Advantages:

The rehabilitation alternative would address long-term concerns at the dam and would bring the dam into compliance with FS standards. The improvements proposed for rehabilitation would likely be necessary to even consider raising the dam to increase storage capacity.

Disadvantages:

The rehabilitation alternative would require a large capital improvement investment as well as ongoing operation and maintenance costs. While most seepage would be blocked, it is possible that foundation seepage could occur, which has the potential to pipe foundation material and undermine the dam.

Estimated Costs:

Rehabilitation costs are estimated using unit costs from recent wilderness dams repair work. Remote access necessitates helicopter transportation for personnel, equipment and construction materials. Construction costs for remote access dams can be five to ten times that of conventional construction. Estimated costs presented here include mobilization and demobilization costs, engineering and construction management fees, and a contingency of 30 percent. The estimated costs are as follows:

| | |
|---|---|
| Capital improvement costs | $601,000 |
| Existing Water Right | 104 ac-ft |

| | |
|---|---|
| Cost per acre-foot | $5,777 |

## Increase Storage

The alternative to increase storage would be a combination of raising the embankment height and completing rehabilitation items discussed above. With a surface area of approximately 9.9 acres, raising Worden Lake Dam a few feet could result in a modest increase in storage capacity. This alternative would be combined with the decommissioning of one or more other dams and would offset the lost storage volume.

Because of the already narrow dam crest, raising the dam approximately 4 feet (which is estimated only for purposes of this analysis – actual increase in height would be based on a cost:benefit analysis) would require additional fill beyond that estimated for rehabilitation. Raising the dam 4 feet would increase the height from 11 to 15 feet, which requires a minimum crest width of 10 feet to meet FS standards. Additional required embankment material was estimated assuming a 10-foot crest width, 2:1 upstream slope, and 1.5:1 downstream slope. The outlet pipe would need to be extended 14 feet. The modification would increase reservoir storage approximately 41 acre-feet, a 39% increase.

Advantages:

The Increase Storage alternative would offset potential loss of storage volume by decommissioning other City-owned dams in the Wilderness, and the City could potentially retain existing water storage and water rights while reducing the number of dams that require future maintenance.

Disadvantages:

There is an initial capital improvement cost associated with this alternative, and the alternative cannot be implemented without completing rehabilitation work. Some cost efficiency would be realized by increasing storage at the time rehabilitation work is completed. Increasing the dam storage capacity would also increase the peak flow in the event of a dam breach, and a revised hazard assessment would be required. An evaluation would be needed to determine the effect on the current dam hazard classification. Since the current classification and spillway capacity criteria are based on the effect from dam failure, the amount of increased storage that could be added without changing the current dam hazard classification would have to be examined closely.

Estimated Costs:

Costs for Increased Storage are based on the same assumptions as used for the Rehabilitation option. The estimated costs are as follows:

| | |
|---|---|
| Capital improvement costs for this alternative alone* | $560,000 |
| Increased water storage | 41 ac-ft |
| Cost per acre-foot for this alternative alone | $13,665 |
| Capital improvement costs including rehabilitation* | $1,161,000 |
| Existing water right plus increased storage | 145 ac-ft |
| Cost per acre-foot including rehabilitation alternative | $8,007 |

**Costs do not account for potential savings achieved by eliminating repair costs at other dam(s)*

## Decommission

The alternative to decommission the dam would involve breaching a portion of the dam and constructing a channel to route flows past the dam to an outlet channel. Breaching the dam would eliminate its storage capacity. A stable breach channel would be excavated through the dam embankment to safely route a 100-year or larger inflow design flood and to avoid any backwater impoundment against the remaining portion of the dam. The channel could feature a control sill to reduce sediment releases until the reservoir beach stabilizes. Excavated material could be dispersed to blend within the surrounding ground in the reservoir footprint. The existing outlet gate and access structure would be removed. The beach between the current reservoir shore and the remaining natural lake would be seeded.

The description above presents the probable minimum requirements for decommissioning the dam. A larger effort may be required to satisfy outside interests. This could involve reconstructing a natural channel upstream and downstream of the dam, completely removing the embankment material, or other major construction tasks.

The cost estimate assumes a breach channel would be excavated through the embankment capable of passing a 500-year flood with a peak flow of 101 cubic feet per second (cfs). Designing to this flood event would result in a stable channel during extreme flood events and minimize the potential for backwater impoundment against the dam. Changing the design flood would not significantly affect costs. The channel would be armored with riprap, and 3 acres of reservoir beach would be seeded. The seeding and re-vegetation plan would be prepared to minimize the introduction of invasive species and could incorporate seed collected on site.

According to FSM 2709.11, Dam Safety Definitions, a dam is ‘any artificial barrier, including appurtenant works, that impounds or diverts water, either temporarily or long term, but not including a facility that is 6 feet or less in height or that impounds no more than 15 acre-feet of water’. The decommissioning alternative could be modified such that some combination of dam height reduction and storage reduction essentially turned the dam into a pond. This sub-alternative may have advantages in terms of cost, aquatic life, and re-vegetation limits and could be further developed in the next phase of overall project development and analysis.

Advantages:

The Decommission alternative would eliminate current and future maintenance requirements, except for possible short-term maintenance while conditions equilibrate. Ownership of the former dam and reservoir could be returned to the FS. Decommissioning costs would likely be lower than rehabilitation costs, although that could depend on the scope of decommissioning work and FS requirements for restoration to simulate natural conditions.

Disadvantages:

With its water storage capacity eliminated, the water rights associated with Worden Lake Dam would need to be modified or abandoned. Reestablishing vegetation on the reservoir beach would take years, and the remaining embankment section could be considered an aesthetic drawback. Potential late-season flow releases to Rattlesnake Creek would be lost, and the overall recreational appeal of the dam site could decrease.

Estimated Costs:

Costs for the Decommission option are based on the same assumptions as used for the Rehabilitation option. The estimated costs are as follows:

| | |
|---|---|
| Capital costs for this alternative | $115,000 |

## 9.8 Public Involvement

The City has been meeting with the FS, FWPs, and other City agencies and personnel throughout the process of this analysis to discuss alternatives and considerations. Meeting minutes are provided in Appendix O. At some point, after additional data has been collected and analyzed, the City will engage stakeholders in a robust public involvement process.

## 9.9 Summary and Recommendations

The following table includes a summary of planning level cost estimates for the alternatives presented.

## Table 9-7. Summary of Alternatives

| Lake | Rehab Cost ($) | Rehab Cost ($/ac-ft) | Rehab Cost Rank | Increase Storage ($/ac-ft) | Increase Storage Rank | Decommission ($) | Decommission Rank | Existing Storage (ac-ft) | Proposed Increase (ac-ft) | Proposed Final Storage (ac-ft) |
|---|---|---|---|---|---|---|---|---|---|---|
| Big Lake | $1,312,000 | $2,106 | 2 | $2,235 | 2 | $400,530 | 7 | 623 | 175 | 798 |
| Carter Lake | $706,396 | $4,155 | 5 | $4,932 | 4 | $179,985 | 6 | 170 | 60 | 230 |
| Glacier Lake | $474,830 | $2,240 | 3 | $2,764 | 3 | $126,987 | 3 | 212 | 84 | 296 |
| Little Lake | $1,125,346 | $3,751 | 4 | $5,402 | 5 | $473,200 | 8 | 300 | 74 | 374 |
| McKinley Lake | $1,083,533 | $5,557 | 7 | $6,701 | 6 | $172,591 | 5 | 195 | 72 | 267 |
| Sanders Lake | $1,170,884 | $1,294 | 1 | $2,084 | 1 | $159,388 | 4 | 905 | 193 | 1,098 |
| Sheridan Lake | $547,799 | $4,763 | 6 | $6,903 | 7 | $99,509 | 1 | 115 | 45 | 160 |
| Worden Lake | $600,811 | $5,777 | 8 | $8,007 | 8 | $114,672 | 2 | 104 | 41 | 145 |

In order to make recommendations, it's important to understand that there are a number of competing interests in terms of the future of the Rattlesnake Wilderness Dams. It is in the best interest of the City and the community to fully analyze and understand these constraints and work towards optimization of the project goals. These have been identified as follows:

1.) **Preserve the Water Supply for Emergency Backup:** The Rattlesnake Creek water source has been maintained as an emergency backup supply. It has limited value as a backup drinking water source because there is currently no means for water treatment, so any use of the source would require appropriate precautions.

   The City of Missoula is exclusively reliant on groundwater via the Missoula aquifer, which is an unconfined aquifer that is susceptible to contamination. However, the wells are geographically dispersed and widespread contamination is unlikely.

2.) **Store Water for Late Season Flows in Rattlesnake Creek:** Rattlesnake Creek is critical habitat for Bull Trout, which are a threatened species. Rattlesnake Creek flows are influenced by the snow pack and runoff from the watershed, and the flows diminish in late summer early fall, often to less than 10 cfs. The dams provide a means to store spring runoff for release later in the season, which is a benefit for aquatic species and recreation.

3.) **Wilderness Area Considerations:** As described in this report, the Wilderness Act of 1964 puts very strict limitations on wilderness areas in order to preserve the pristine, quiet, contemplative, and natural settings. In addition, the dams are also a part of the history of Missoula and were in place long before the designation of the Wilderness Area and may be considered a historic and cultural resource.

4.) **Financial:** The financial implications of the various alternatives are great. Historically, all the costs associated with the dams have been borne by the water system rate payers. In the future, other funding sources may need to be identified if the future benefits are to fisheries habitat and recreation and less to the water customers.

   Life-Cycle Costs – what are the total life-cycle costs of the alternative including capital costs, operation and maintenance costs, and opportunity costs in terms of preserved or lost water rights.

   Operation and Maintenance Costs – this includes ongoing costs to operate and maintain the dams.

   Rehabilitation or replacement Cost – these include short term capital costs to rehabilitate, replace, or decommission the dam.

5.) **Water Rights Seniority**: The City currently holds some of the most senior water rights in the basin at the Rattlesnake Dams. If the dams were decommissioned, those water right may be lost.

The recommendations of the feasibility study include the following;

Water rights are a major driver for decisions related to the dams because of the seniority and value of the water rights. The first step in the process of rehabilitation and decommissioning should be a thorough water rights evaluation to determine the best approach for a change application. The change application process can take 18 months to 2 years, and major actions, specifically including non-reversible actions such as decommissioning of a dam should not be done until the future of the water rights can be firmly established, thus preserving the senior water rights that can't be obtained any other way.

The value of increasing the dam height and adding storage capacity was not great enough to overcome the likely regulatory work required to permit an increase in dam height.

Preliminary results indicate that in terms of life cycle costs, water rights value, and environmental impacts Big Lake dam, Sanders Lake dams, and Glacier Lake dam are good candidates for rehabilitation as they have the largest storage capacities and the lowest cost / acre-foot to rehabilitate.

All other dams are recommended to be decommissioned. Sheridan Lake dam and Worden Lake dam are the top candidates for decommissioning as they store the least amount of water and have the lowest cost / acre-foot to decommission. In addition, McKinley Lake is another candidate for decommissioning because the spillway has caused erosion and a headcut is migrating towards the dam. Therefore, McKinley, Sheridan, and Worden Lake dams should be the first dams targeted for decommissioning.

The purpose of this feasibility study was to evaluate existing information to analyze basic alternatives for the dams. The next phase of this project should include further analysis of issues and opportunities identified, including the following;

Augmenting Rattlesnake Creek flows for Bull Trout: gather temperature, flow and other data to fully understand temporal and spatial aspects including the ability to meet fisheries goals.

Climate change: Evaluate potential impacts of climate change on stream temperatures, snow pack, runoff timing, stream baseflow, drought periods and other aspects to ensure a long-term strategy is achieved.

Stream morphology and aquatic resources: alternative impacts to erosion, fluvial geomorphic and/or environmental stream mechanics should be evaluated.

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# Chapter 10
# Capital Improvement Plan

2018 Water System Master Plan

*Missoula, Montana*

# 10.1 Introduction

The analysis completed in the previous chapters evaluated the water system's needs over the next 20 years, based on population growth and water use characterization. This chapter presents the recommended Capital Improvement Program (CIP) for the City and the methods used to determine the estimated cost of that program. The recommended projects allow the City to address the deficiencies that have been identified throughout this document that are necessary to adequately serve the current population and future growth.

# 10.2 Project Categorization and Prioritization

To promote an efficient master plan implementation, projects identified for the Capital Improvement Program (CIP) were divided into categories as summarized below.

- Growth and Development
- Rehabilitation and Replacement
- Supply
- Storage
- Optimization & Efficiency
- Risk and Reliability / Security
- Studies
- Condition Assessment

The development of these categories is designed to provide the conceptual framework for CIP development, project prioritization, project drivers, and timeframe progressions, and correlated projects to the City's present fiscal resources (i.e. what type of project makes the best use of the available capital improvement budget).

## 10.2.1 Planning Level Unit Costs

The planning level costs are based upon over a decade of bid tabulations from the City. The Construction Cost Index (CCI) was used to bring previous years' bids to present day values (2018). The following unit costs were used for the planning level cost estimates.

**Table 10-1. Planning Level Unit Costs**

| Project Type | Unit Cost |
|---|---|
| 24-inch ductile iron (total project costs) | $ 550 / LF |
| 12-inch ductile iron (total project costs) | $ 350 / LF |
| 8-inch ductile iron (total project costs) | $ 300 to 350 / LF |
| New Well (total project cost) | $ 680,000 |
| New PRV (total project cost, excluding SCADA) | $ 150,000 |

| Project Type | Unit Cost |
|---|---|
| New Storage Facility (greater than 2 MG) | $0.75 / gallon |

### 10.2.2 Demand-Based Implementation Plan

Demand-based implementation planning established planning guidelines for the water system based on actual growth conditions instead of arbitrary factors such as points in time budgeting. By doing so, the actual capital investments can be planned and implemented as needed. This demand-based approach is implemented by developing and incorporating a system trigger for each project in the CIP. These triggers have been identified on the individual project sheets. However, it may be necessary for the city to revisit the population projections (and water demand projections) as growth occurs to determine if adjustments need to be made.

### 10.2.3 Project Prioritization Findings and CIP

As previously discussed, the analysis of the City's water system identified a number of facilities that may need improvements to meet current and/or future system conditions. The facilities were categorized in groups to align expenditures by facility type to correlate with broad level of service goals and potential funding considerations. The CIP summary of findings is shown in Table 10-2 and Table 10-3 and pipe deficiencies are shown graphically on Figure 10-1.

Project prioritization shown in Table 10-2 and 10-3 is based on several key factors, with the primary factor being deficiency based on scenario time steps. These criteria are provided below:

- Timing of Identified Deficiency – One of the highest order project prioritization screening tools is based on when a system deficiency materializes relative to various demand scenarios. As such, projects that were identified to remediate deficiencies under current conditions would have the highest priority, as the performance and risks associated with these facilities tend to worsen with additional future demand. Similarly, the near-term projects would fall in the second highest priority group, with the facilities that may become deficient only under the future 20-year demand scenario would be the lowest priority items at this time.

In addition to timing, additional and often secondary prioritization considerations include:

- Funding Source – Development driven improvements tied to fully funded developer fees would be higher priority than rate based improvements at this time,
- Operational or Optimization Improvements –Improvements that may have a return on investment by reducing costs and/or meet Strategic Planning carbon footprint goals,
- Performance Risk –Improvements that may substantially reduce the risk of service outages or other level of service goals.

- Community Disruption Consideration – Improvements that when considered holistically with other utility needs may reduce the cost of installation and/or minimize community disruption with a “just dig once” approach to citywide pavement management and buried utility infrastructure investments.
- Regulatory – These factors would include items related to water quality or dam safety.

### 10.2.4 Pipeline Replacement Program

Table 10-2 includes a line item for ‘Additional Rehab & Replacement Projects (1% goal by 2024)’. This is a placeholder for a pipeline replacement program. To proactively plan for continued, long-term asset reliability, the City is continuing to implement a watermain rehabilitation and replacement program and will be increasing the program to achieve a 1% replacement rate in the next 5 to 10 years.

The primary focus of this program is to address the substantial amount of pipelines in the water system that are at or nearing the end of their useful life and thus their reliability is decreasing.

The broad purpose of this program is to maintain and/or enhance system reliability by replacing deteriorated and/or critical assets. Age and material is often used in the absence of actual condition assessment data to establish an initial pool of assets that are most apt to need additional attention and may be required for replacement. Since age in and of itself is not an appropriate predictor of pipeline performance, some additional general criteria is required to prioritize the vast number of pipelines that are greater than 75 years old, and effectively implement the capital replacement program. When practical, pipeline replacements should be implemented in groups rather than isolated pipelines in various streets within the community.

Table 10-2. Water Enterprise Fund CIP

| Project Name | Category (Rehab & Replacement, Storage, Supply, Optimization, Growth & Development, Treatment, Studies) | MW Category | Project Description | FY2020 | FY2021 | FY2022 | FY2023 | FY2024 |
|---|---|---|---|---|---|---|---|---|
| **Water Enterprise Fund CIP (No development funding)** | | | | | | | | |
| Upper Lincoln Hills Storage Tank | Storage | 50% Growth | Replace tank at the end of its useful life, increased storage volume. Project partially funded by development fund. Additional funds for the project will be provided by the growth and development fund. | $0 | $206,000 | $0 | $0 | $0 |
| Lower Lincoln Hills Storage Tank | Storage | 50% Growth | Replace tank at the end of its useful life, increased storage volume. Project partially funded by development fund. Additional funds for the project will be provided by the growth and development fund. | $0 | $206,000 | $0 | $0 | $0 |
| Redundant well on North Side | Supply | 50% Growth | Add a well redundant to Bank St. or Maurice. Adds to system resiliency. Additional funds for the project will be provided by the growth and development fund. | $0 | $0 | $350,000 | $0 | $0 |
| Stephen Well - New Pump | Supply | Improvement | New pump in Stephens Well. Move water rights from Pattee Creek well to Stephens well. | $257,500 | $0 | $0 | $0 | $0 |
| Crestline Tank Abandonment & associated water main project | Optimization | Improvement | Tanks are no longer in use and need to be abandoned. | $103,000 | $0 | $0 | $0 | $0 |
| Stephens PRV - eliminate | Optimization | Improvement | Stephens PRV and pressure zone can be eliminated by connecting existing water mains, thus eliminating the O & M required at Stephens PRV. | $0 | $21,200 | $0 | $0 | $0 |
| Stephen - tie to South System | Optimization | Improvement | Stephens PRV and pressure zone can be eliminated by connecting existing water mains, thus eliminating the O & M required at Stephens PRV. | $0 | $50,000 | $0 | $0 | $0 |
| Rattlesnake Wilderness Dams | Water Rights | 50% Growth | Rehab and Decommissioning. Project partially funded by development fund. Additional funds for the project will be provided by the growth and development fund. | $25,000 | $50,000 | $100,000 | $100,000 | $100,000 |
| New Hydrants | Operations | Improvement | | $51,500 | $55,120 | $58,860 | $62,720 | $66,700 |
| Replacement hydrants | Operations | Improvement | | $51,500 | $55,120 | $58,860 | $62,720 | $66,700 |
| SCADA Improvements | Operations | Improvement | | $103,000 | $109,180 | $115,540 | $122,080 | $128,800 |
| Pump Improvements | Operations | Improvement | | $154,500 | $164,300 | $174,400 | $184,800 | $195,500 |
| Meter Replacement and Fixed Base Installation | Operations | Improvement | Meters for new customers and replacement meters. | $800,000 | $850,000 | $900,000 | $950,000 | $1,000,000 |

| Project Name | Category (Rehab & Replacement, Storage, Supply, Optimization, Growth & Development, Treatment, Studies) | MW Category | Project Description | FY2020 | FY2021 | FY2022 | FY2023 | FY2024 |
|---|---|---|---|---|---|---|---|---|
| Vehicles | Operations | Improvement | Replace fleet vehicles for efficiency and safety. | $206,000 | $218,360 | $231,080 | $244,160 | $258,750 |
| Valve replacements | Operations | Improvement | | $51,500 | $55,120 | $58,860 | $62,720 | $66,700 |
| Blowoff replacements | Operations | Improvement | | $51,500 | $55,120 | $58,860 | $62,720 | $66,700 |
| Field equipment | Operations | Improvement | Field equipment includes water quality testing, hydrant flushing, tools, etc. | $20,600 | $22,260 | $23,980 | $25,760 | $27,600 |
| South Ave - Ronald to Maurice | Water Main Rehab & Replacement | Replacement | This project includes about 1,800 LF of 6” invasion steel main installed in 1947. This water main is beyond its useful life. It will be replaced with 8” DI. | $708,400 | $0 | $0 | $0 | $0 |
| Mount Ave (under railroad tracks) | Water Main Rehab & Replacement | Replacement | | $0 | $75,000 | $0 | $0 | $0 |
| 3rd Street - Orange to Ash | Water Main Rehab & Replacement | Replacement | This project include about 450 LF of 6” kalamein water main installed in 1914. This water main is beyond its useful life. It will be replaced with 8” DI. | $656,572 | $0 | $0 | $0 | $0 |
| Grant/Harve (no svcs) | Water Main Rehab & Replacement | Replacement | This project includes about 1,850 LF of 6” invasion steel main installed in 1947. This water main is beyond its useful life. It will be replaced with 8” DI. | $837,577 | $0 | $0 | $0 | $0 |
| Edith St (Just INV and adj pipe) | Water Main Rehab & Replacement | Replacement | | $400,000 | $0 | $0 | $0 | $0 |
| Additional Rehab & Replacement Projects (1% goal by FY2030) | Water Main Rehab & Replacement | Replacement | Rehabilitate or replace water mains nearing the end of their useful life. Project priorities are adjusted annually based upon prioritization criteria including coordinating projects. | | $3,000,000 | $4,000,000 | $4,000,000 | $4,500,000 |
| Wells | Facility Rehab and Replacement | Improvement | Improvements identified in the condition assessments. | | $381,100 | $392,200 | $403,300 | $414,400 |
| Storage Tanks | Facility Rehab and Replacement | Improvement | Improvements identified in the condition assessments. | | $19,364 | $19,928 | $20,492 | $21,056 |
| Booster Stations | Facility Rehab and Replacement | Improvement | Improvements identified in the condition assessments. | | $95,790 | $98,580 | $101,370 | $104,160 |
| Water Treatment equipment | Water Quality | | Includes chlorine dosing, sampling, testing, etc. | $10,300 | $10,600 | $10,900 | $11,200 | $11,500 |
| **Total** | | | | **$4,488,449** | **$5,699,634** | **$6,652,048** | **$6,414,042** | **$7,028,566** |

Table 10-3. Growth and Development CIP

| Project Name | Category (Rehab & Replacement, Storage, Supply, Optimization, Growth & Development, Treatment, Studies) | MW Category | Project Description | FY2020 | FY2021 | FY2022 | FY2023 | FY2024 |
|---|---|---|---|---|---|---|---|---|
| **Growth and Development CIP (Waiting for Development Fees)** | | | | | | | | |
| Relocate Kiwanis Well | Supply | Improvement | | $0 | $0 | $0 | $700,000 | $0 |
| Redundant well on North Side | Supply | 50% Growth | Add a well redundant to Bank St. or Maurice. Adds to system resiliency. | $0 | $0 | $350,000 | $0 | $0 |
| SOV at Waterworks | Supply | Growth | Install SOV in Rattlesnake booster (B13) | $24,720 | $0 | $0 | $0 | $0 |
| New well (44 Ranch or Airport) | Supply | Growth | New water supply well in north pressure zone | $0 | $0 | $0 | $0 | $782,000 |
| Upsize Palmer Well | Supply | Growth | Move water rights from Bank Street and upsize Palmer Well | $51,500 | $318,000 | $0 | $0 | $0 |
| Pipe Ties (6" to 12" ~ 50 feet) | Optimization | Growth | Increase water flow efficiency (decrease headloss) | $17,500 | $0 | $0 | $0 | $0 |
| Pipe Ties (6" to 12" ~ 60 feet) | Optimization | Growth | Increase water flow efficiency (decrease headloss) | $21,000 | $0 | $0 | $0 | $0 |
| Reserve / Broadway Tie In | Optimization | Growth | Connect 14" in Reserve to 24" in Broadway | $43,260 | $0 | $0 | $0 | $0 |
| New Transmission Mains | Growth and Development | Growth | New mains to serve a growing area | $0 | $0 | $1,000,000 | $750,000 | $0 |
| Main Upsizing | Growth and Development | Growth | Increase water main size proposed by developer to serve additional future development. | $103,000 | $109,180 | $115,540 | $122,080 | $128,800 |
| Upper Lincoln Hills Storage Tank (220k) | Storage | 50% Growth | Replace tank at the end of its useful life. Tank is undersized to meet fire flow. Partially funded by enterprise fund. | $0 | $206,000 | $0 | $0 | $0 |
| Lower Lincoln Hills Storage Tank (170k) | Storage | 50% Growth | Replace tank at the end of its useful life. Tank is undersized to meet fire flow. Partially funded by enterprise fund. | $0 | $206,000 | $0 | $0 | $0 |
| Upper Prospect | Storage | Growth | Additional storage needed in Upper Prospect to support development in the lower Grant Creek and North Reserve areas. | $515,000 | $530,000 | $0 | $0 | $0 |
| North Zone Water Storage & Water Mains | Storage | Growth | Water storage tank to serve North pressure zone | $0 | $0 | $0 | $0 | $336,000 |
| Rattlesnake Wilderness Dams | Water Rights | 50% Growth | Rehab and Decommissioning. Project partially funded by enterprise fund. | $25,000 | $50,000 | $100,000 | $100,000 | $100,000 |
| Lower Rattlesnake Fire Flow PRV | Operations | Growth | Install a PRV between the north zone and the lower rattlesnake zone to feed to the LRZ in case of fire | $77,250 | $0 | $0 | $0 | $0 |
| **Total Growth and Development** | | | | **$878,230** | **$1,419,180** | **$1,565,540** | **$1,672,080** | **$1,346,800** |

# Appendix A

# AWWA Water Audits

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# AWWA WLCC Free Water Audit Software: Reporting Worksheet

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WAS v4.2

Back to Instructions

? Click to access definition

Water Audit Report for: Mountain Water Company
Reporting Year: 2010 (1/2010 - 12/2010)

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

**All volumes to be entered as: MILLION GALLONS (US) PER YEAR**

## WATER SUPPLIED

<< Enter grading in column 'E'

| | | | | |
|---|---|---|---|---|
| Volume from own sources: | 9 | 8,299.861 | Million gallons (US)/yr (MG/Yr) | |
| Master meter error adjustment (enter positive value): | 9 | 0.000 | under-registered | MG/Yr |
| Water imported: | | 0.000 | MG/Yr | |
| Water exported: | | 0.000 | MG/Yr | |
| **WATER SUPPLIED:** | | 8,299.861 | MG/Yr | |

## AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

| | | | | Pcnt: | Value: |
|---|---|---|---|---|---|
| Billed metered: | 9 | 3,130.633 | MG/Yr | | |
| Billed unmetered: | 7 | 1,675.000 | MG/Yr | | |
| Unbilled metered: | 8 | 0.984 | MG/Yr | | |
| Unbilled unmetered: | | 103.748 | MG/Yr | 1.25% | |

Default option selected for Unbilled unmetered - a grading of 5 is applied but not displayed

Use buttons to select percentage of water supplied **OR** value

**AUTHORIZED CONSUMPTION:** 4,910.365 MG/Yr

## WATER LOSSES (Water Supplied - Authorized Consumption)

3,389.496 MG/Yr

### Apparent Losses

| | | | | Pcnt: | Value: |
|---|---|---|---|---|---|
| Unauthorized consumption: | | 20.750 | MG/Yr | 0.25% | |

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

| | | | | | |
|---|---|---|---|---|---|
| Customer metering inaccuracies: | 6 | 96.854 | MG/Yr | 3.00% | |
| Systematic data handling errors: | | 0.000 | MG/Yr | | |

Systematic data handling errors are likely, please enter a non-zero value; otherwise grade = 5

Choose this option to enter a percentage of billed metered consumption. This is NOT a default value

Apparent Losses: 117.604

### Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: 3,271.893 MG/Yr

**WATER LOSSES:** 3,389.496 MG/Yr

## NON-REVENUE WATER

**NON-REVENUE WATER:** 3,494.229 MG/Yr

= Total Water Loss + Unbilled Metered + Unbilled Unmetered

## SYSTEM DATA

| | | | | |
|---|---|---|---|---|
| Length of mains: | 9 | 317.0 | miles | |
| Number of active AND inactive service connections: | 6 | 25,377 | | |
| Connection density: | | 80 | conn./mile main | |
| Average length of customer service line: | 4 | 60.0 | ft | (pipe length between curbstop and customer meter or property boundary) |
| Average operating pressure: | 9 | 77.0 | psi | |

## COST DATA

| | | | | |
|---|---|---|---|---|
| Total annual cost of operating water system: | 10 | $18,117,418 | $/Year | |
| Customer retail unit cost (applied to Apparent Losses): | 8 | $1.41 | $/100 cubic feet (ccf) | |
| Variable production cost (applied to Real Losses): | 10 | $154.08 | $/Million gallons | |

## PERFORMANCE INDICATORS

### Financial Indicators

| | |
|---|---|
| Non-revenue water as percent by volume of Water Supplied: | 42.1% |
| Non-revenue water as percent by cost of operating system: | 4.1% |
| Annual cost of Apparent Losses: | $221,578 |
| Annual cost of Real Losses: | $504,132 |

### Operational Efficiency Indicators

| | | |
|---|---|---|
| Apparent Losses per service connection per day: | 12.70 | gallons/connection/day |
| Real Losses per service connection per day*: | 353.24 | gallons/connection/day |
| Real Losses per length of main per day*: | N/A | |
| Real Losses per service connection per day per psi pressure: | 4.59 | gallons/connection/day/psi |
| ? Unavoidable Annual Real Losses (UARL): | 215.97 | million gallons/year |
| From Above, Real Losses = Current Annual Real Losses (CARL): | 3,271.89 | million gallons/year |
| ? Infrastructure Leakage Index (ILI) [CARL/UARL]: | 15.15 | |

* only the most applicable of these two indicators will be calculated

### WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 80 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

### PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Customer metering inaccuracies
2: Volume from own sources
3: Unauthorized consumption

For more information, click here to see the Grading Matrix worksheet

# AWWA WLCC Free Water Audit Software: Reporting Worksheet

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WAS v4.2

Back to Instructions

? Click to access definition

Water Audit Report for: Mountain Water company
Reporting Year: 2011 1/2012 - 12/2012

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

**All volumes to be entered as: MILLION GALLONS (US) PER YEAR**

## WATER SUPPLIED

<< Enter grading in column 'E'

| | | | |
|---|---|---|---|
| Volume from own sources: | 8,471.368 | Million gallons (US)/yr (MG/Yr) | |
| Master meter error adjustment (enter positive value): | 0.000 | MG/Yr | |
| Water imported: | 0.000 | MG/Yr | |
| Water exported: | 0.000 | MG/Yr | |
| **WATER SUPPLIED:** | 8,471.368 | MG/Yr | |

## AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

| | | | Pcnt: | Value: |
|---|---|---|---|---|
| Billed metered: | 3,295.413 | MG/Yr | | |
| Billed unmetered: | 1,655.000 | MG/Yr | | |
| Unbilled metered: | 1.349 | MG/Yr | | |
| Unbilled unmetered: | 105.892 | MG/Yr | 1.25% | |

Default option selected for Unbilled unmetered - a grading of 5 is applied but not displayed

Use buttons to select percentage of water supplied **OR** value

| | | |
|---|---|---|
| **AUTHORIZED CONSUMPTION:** | 5,057.655 | MG/Yr |

## WATER LOSSES (Water Supplied - Authorized Consumption)

3,413.713 MG/Yr

### Apparent Losses

| | | | Pcnt: | Value: |
|---|---|---|---|---|
| Unauthorized consumption: | 21.178 | MG/Yr | 0.25% | |

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

| | | | | |
|---|---|---|---|---|
| Customer metering inaccuracies: | 101.962 | MG/Yr | 3.00% | |
| Systematic data handling errors: | 0.000 | MG/Yr | | |

Systematic data handling errors are likely, please enter a non-zero value; otherwise grade = 5

| | | |
|---|---|---|
| Apparent Losses: | 123.140 | |

Choose this option to enter a percentage of billed metered consumption. This is NOT a default value

### Real Losses (Current Annual Real Losses or CARL)

| | | |
|---|---|---|
| Real Losses = Water Losses - Apparent Losses: | 3,290.573 | MG/Yr |
| **WATER LOSSES:** | 3,413.713 | MG/Yr |

## NON-REVENUE WATER

| | | |
|---|---|---|
| **NON-REVENUE WATER:** | 3,520.954 | MG/Yr |

= Total Water Loss + Unbilled Metered + Unbilled Unmetered

## SYSTEM DATA

| | | | |
|---|---|---|---|
| Length of mains: | 318.0 | miles | |
| Number of active AND inactive service connections: | 25,558 | | |
| Connection density: | 80 | conn./mile main | |
| Average length of customer service line: | 50.0 | ft | (pipe length between curbstop and customer meter or property boundary) |
| Average operating pressure: | 77.0 | psi | |

## COST DATA

| | | | |
|---|---|---|---|
| Total annual cost of operating water system: | | $/Year | |
| Customer retail unit cost (applied to Apparent Losses): | $1.93 | | <--Enter units |
| Variable production cost (applied to Real Losses): | | $/Million gallons | |

## PERFORMANCE INDICATORS

### Financial Indicators

| | |
|---|---|
| Non-revenue water as percent by volume of Water Supplied: | 41.6% |
| Non-revenue water as percent by cost of operating system: | |
| Annual cost of Apparent Losses: | |
| Annual cost of Real Losses: | |

### Operational Efficiency Indicators

| | | |
|---|---|---|
| Apparent Losses per service connection per day: | 13.20 | gallons/connection/day |
| Real Losses per service connection per day*: | 352.74 | gallons/connection/day |
| Real Losses per length of main per day*: | N/A | |
| Real Losses per service connection per day per psi pressure: | 4.58 | gallons/connection/day/psi |
| Unavoidable Annual Real Losses (UARL): | 207.11 | million gallons/year |
| From Above, Real Losses = Current Annual Real Losses (CARL): | 3,290.57 | million gallons/year |
| Infrastructure Leakage Index (ILI) [CARL/UARL]: | 15.89 | |

* only the most applicable of these two indicators will be calculated

### WATER AUDIT DATA VALIDITY SCORE:

**Add a grading value for 12 parameter(s) to enable an audit score to be calculated**

### PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Billed metered
3: Billed unmetered

For more information, click here to see the Grading Matrix worksheet

# AWWA WLCC Free Water Audit Software: Reporting Worksheet

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WAS v4.2

Back to Instructions

? Click to access definition

Water Audit Report for: Mountain Water company
Reporting Year: 2012 1/2012 - 12/2012

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

**All volumes to be entered as: MILLION GALLONS (US) PER YEAR**

## WATER SUPPLIED

<< Enter grading in column 'E'

| | | | |
|---|---|---|---|
| Volume from own sources: | 8,658.010 | Million gallons (US)/yr (MG/Yr) | |
| Master meter error adjustment (enter positive value): | 0.000 | | MG/Yr |
| Water imported: | 0.000 | MG/Yr | |
| Water exported: | 0.000 | MG/Yr | |
| **WATER SUPPLIED:** | 8,658.010 | MG/Yr | |

## AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

| | | | Pcnt: | Value: |
|---|---|---|---|---|
| Billed metered: | 3,532.366 | MG/Yr | | |
| Billed unmetered: | 1,707.000 | MG/Yr | | |
| Unbilled metered: | 1.297 | MG/Yr | | |
| Unbilled unmetered: | 108.225 | MG/Yr | 1.25% | |

Default option selected for Unbilled unmetered - a grading of 5 is applied but not displayed

Use buttons to select percentage of water supplied **OR** value

| | | |
|---|---|---|
| **AUTHORIZED CONSUMPTION:** | 5,348.889 | MG/Yr |

## WATER LOSSES (Water Supplied - Authorized Consumption)

3,309.122 MG/Yr

### Apparent Losses

| | | | Pcnt: | Value: |
|---|---|---|---|---|
| Unauthorized consumption: | 21.645 | MG/Yr | 0.25% | |

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

| | | | | |
|---|---|---|---|---|
| Customer metering inaccuracies: | 109.289 | MG/Yr | 3.00% | |
| Systematic data handling errors: | 0.000 | MG/Yr | | |

Systematic data handling errors are likely, please enter a non-zero value; otherwise grade = 5

| | | |
|---|---|---|
| Apparent Losses: | 130.934 | |

Choose this option to enter a percentage of billed metered consumption. This is NOT a default value

### Real Losses (Current Annual Real Losses or CARL)

| | | |
|---|---|---|
| Real Losses = Water Losses - Apparent Losses: | 3,178.188 | MG/Yr |
| **WATER LOSSES:** | 3,309.122 | MG/Yr |

## NON-REVENUE WATER

| | | |
|---|---|---|
| **NON-REVENUE WATER:** | 3,418.644 | MG/Yr |

= Total Water Loss + Unbilled Metered + Unbilled Unmetered

## SYSTEM DATA

| | | | |
|---|---|---|---|
| Length of mains: | 318.0 | miles | |
| Number of active AND inactive service connections: | 25,695 | | |
| Connection density: | 81 | conn./mile main | |
| Average length of customer service line: | 50.0 | ft | (pipe length between curbstop and customer meter or property boundary) |
| Average operating pressure: | 77.0 | psi | |

## COST DATA

| | | | |
|---|---|---|---|
| Total annual cost of operating water system: | | $/Year | |
| Customer retail unit cost (applied to Apparent Losses): | $1.93 | | <--Enter units |
| Variable production cost (applied to Real Losses): | | $/Million gallons | |

## PERFORMANCE INDICATORS

### Financial Indicators

| | |
|---|---|
| Non-revenue water as percent by volume of Water Supplied: | 39.5% |
| Non-revenue water as percent by cost of operating system: | |
| Annual cost of Apparent Losses: | |
| Annual cost of Real Losses: | |

### Operational Efficiency Indicators

| | | |
|---|---|---|
| Apparent Losses per service connection per day: | 13.96 | gallons/connection/day |
| Real Losses per service connection per day*: | 338.87 | gallons/connection/day |
| Real Losses per length of main per day*: | N/A | |
| Real Losses per service connection per day per psi pressure: | 4.40 | gallons/connection/day/psi |
| Unavoidable Annual Real Losses (UARL): | 207.96 | million gallons/year |
| From Above, Real Losses = Current Annual Real Losses (CARL): | 3,178.19 | million gallons/year |
| Infrastructure Leakage Index (ILI) [CARL/UARL]: | 15.28 | |

* only the most applicable of these two indicators will be calculated

**WATER AUDIT DATA VALIDITY SCORE:**

**Add a grading value for 12 parameter(s) to enable an audit score to be calculated**

**PRIORITY AREAS FOR ATTENTION:**

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Billed metered
3: Billed unmetered

For more information, click here to see the Grading Matrix worksheet

# AWWA Free Water Audit Software:
## Reporting Worksheet

WAS v5.0
American Water Works Association.
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? Click to access definition
+ Click to add a comment

**Water Audit Report for:** Mountain Water Company
**Reporting Year:** 2013 1/2013 - 12/2013

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

**All volumes to be entered as: MILLION GALLONS (US) PER YEAR**

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<---------- Enter grading in column 'E' and 'J' ---------->

Master Meter and Supply Error Adjustments

### WATER SUPPLIED

| | | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|---|
| Volume from own sources: | 8 | 8,747.339 | MG/Yr | | | | MG/Yr |
| Water imported: | n/a | | MG/Yr | | | | MG/Yr |
| Water exported: | n/a | | MG/Yr | | | | MG/Yr |

Enter negative % or value for under-registration
Enter positive % or value for over-registration

**WATER SUPPLIED:** 8,747.339 MG/Yr

### AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

| | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|
| Billed metered: | 8 | 3,550.243 | MG/Yr | | | |
| Billed unmetered: | 6 | 879.375 | MG/Yr | | | |
| Unbilled metered: | 5 | 0.488 | MG/Yr | | | |
| Unbilled unmetered: | | 109.342 | MG/Yr | 1.25% | | MG/Yr |

Use buttons to select percentage of water supplied OR value

Default option selected for Unbilled unmetered - a grading of 5 is applied but not displayed

**AUTHORIZED CONSUMPTION:** 4,539.447 MG/Yr

**WATER LOSSES (Water Supplied - Authorized Consumption)** 4,207.892 MG/Yr

#### Apparent Losses

| | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|
| Unauthorized consumption: | | 21.868 | MG/Yr | 0.25% | | MG/Yr |

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

| | | | | | | |
|---|---|---|---|---|---|---|
| Customer metering inaccuracies: | 9 | 72.464 | MG/Yr | 2.00% | | MG/Yr |
| Systematic data handling errors: | | 8.876 | MG/Yr | 0.25% | | MG/Yr |

Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed

**Apparent Losses:** 103.208 MG/Yr

#### Real Losses (Current Annual Real Losses or CARL)

**Real Losses = Water Losses - Apparent Losses:** 4,104.684 MG/Yr

**WATER LOSSES:** 4,207.892 MG/Yr

### NON-REVENUE WATER

**NON-REVENUE WATER:** 4,317.721 MG/Yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

### SYSTEM DATA

| | | | |
|---|---|---|---|
| Length of mains: | 10 | 324.0 | miles |
| Number of active AND inactive service connections: | 9 | 25,956 | |
| Service connection density: | | 80 | conn./mile main |
| Are customer meters typically located at the curbstop or property line? | | No | |
| Average length of customer service line: | 4 | 50.0 | ft |
| Average operating pressure: | 9 | 80.0 | psi |

(length of service line, beyond the property boundary, that is the responsibility of the utility)

### COST DATA

| | | | | |
|---|---|---|---|---|
| Total annual cost of operating water system: | 10 | $19,974,897 | $/Year | |
| Customer retail unit cost (applied to Apparent Losses): | 10 | $2.00 | $/100 cubic feet (ccf) | |
| Variable production cost (applied to Real Losses): | 7 | | $/Million gallons | ☐ Use Customer Retail Unit Cost to value real losses |

### WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 76 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

### PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Unbilled metered
3: Billed unmetered

# Appendix B

# Example Water Utility Bill

# (City of Bozeman)

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# BOZEMAN MT

121 NORTH ROUSE AVENUE
PO BOX 1230
BOZEMAN MT 59771-1230

Water Sewer Garbage/Recycling

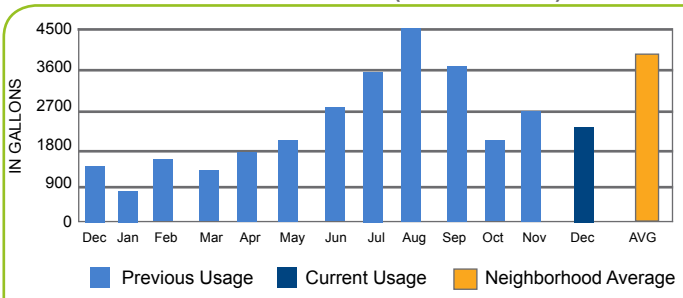
**Utility/Billing Questions Please Call (406) 582-2333**

Pay or View your bill online at www.bozeman.net

## MONTHLY USAGE (1 HCF= 748 GALLONS)

| METER ID NUMBER | READ DATES | DAYS | PREVIOUS METER READ | CURRENT METER READ | USAGE | UNIT |
|---|---|---|---|---|---|---|
| 99999999 | 10/03/14-10/29/14 | 26 | 29583 | 29607.5 | 2.45 | HCF |
| 99999998 | 10/03/14-10/29/14 | 26 | 29583 | 29607.5 | 2.45 | HCF |
| 99999997 | 10/03/14-10/29/14 | 26 | 29583 | 29607.5 | 2.45 | HCF |
| 99999996 | 10/03/14-10/29/14 | 26 | 29583 | 29607.5 | 2.45 | HCF |

## YOUR HISTORICAL USAGE (IN GALLONS)




### How does my water usage compare

## IMPORTANT MESSAGE

Message Line 1, 50-60 characters (upper/lower) Arial 9pt.....
Message Line 2, 50-60 characters (upper/lower) Arial 9pt.....
Message Line 3, 50-60 characters (upper/lower) Arial 9pt.....
Message Line 4, 50-60 characters (upper/lower) Arial 9pt.....
Message Line 5, 50-60 characters (upper/lower) Arial 9pt.....
Message Line 6, 50-60 characters (upper/lower) Arial 9pt.....
Message Line 7, 50-60 characters (upper/lower) Arial 9pt.....
Message Line 8, 50-60 characters (upper/lower) Arial 9pt.....
Message Line 9, 50-60 characters (upper/lower) Arial 9pt.....
Message Line 10, 50-60 characters (upper/lower) Arial 9pt.....

# YOUR MONTHLY STATEMENT

| Account Number | Due Date | Amount Due Now |
|---|---|---|
| 99999-999999 | 02/13/2015 | $435.19 |

**ACCOUNT NAME:** JOHN Q SAMPLE
**SERVICE ADDRESS:** 83 W FIELDVIEW CIR
**RATE CLASS:** RESIDENTIAL
**CYCLE/ROUTE:** 01-23 **BILLING DATE:** 01/13/2015

## ACCOUNT SUMMARY

| | |
|---|---|
| PREVIOUS BALANCE | $395.54 |
| PAYMENT - THANK YOU | -$0.00 |
| ADJUSTMENTS | $0.00 |
| TOTAL CURRENT CHARGES | $39.85 |
| **TOTAL AMOUNT DUE NOW** | **$435.19** |

## CURRENT CHARGE SUMMARY

| DESCRIPTION | USAGE | CHARGE |
|---|---|---|
| **WATER SERVICE** | | |
| WATER SERVICE CHARGE | | $12.70 |
| MINIMUM FIRST 2 HCF | 2.00 | $4.77 |
| USAGE 2-8 HCF | 0.45 | $1.07 |
| EXTRA LINE 4 | 0.00 | $0.00 |
| EXTRA LINE 5 | 0.00 | $0.00 |
| EXTRA LINE 6 | 0.00 | $0.00 |
| EXTRA LINE 7 | 0.00 | $0.00 |
| **TOTAL WATER** | | **$18.54** |
| **SEWER SERVICE** | | |
| SEWER SERVICE CHARGE | | $15.22 |
| USAGE PER HCF | 2.45 | $7.11 |
| EXTRA LINE 10 | 0.00 | $0.00 |
| EXTRA LINE 11 | 0.00 | $0.00 |
| **TOTAL SEWER** | | **$22.33** |
| **GARBAGE/RECYCLING SERVICE** | | |
| 100 GAL RECYCLE TOTE | 10/31/14-10/29/14 | -$0.32 |
| 100 GALLON TOTE | 10/31/14-10/29/14 | -$0.78 |
| EXTRA LINE14 | 0.00 | $0.00 |
| EXTRA LINE 15 | 0.00 | $0.00 |
| **TOTAL GARBAGE/RECYCLING** | | **$1.10** |
| **STORMWATER SERVICE** | | |
| STORMWATER CHARGE | | -$0.12 |
| EXTRA LINE 17 | 0.00 | $0.00 |
| EXTRA LINE 18 | 0.00 | $0.00 |
| **TOTAL STORMWATER** | | **-$0.12** |
| **TOTAL CURRENT CHARGES** | | **$39.85** |

© 2015, All rights reserved. Sample provided by DataProse.

Keep top portion for your records and return the bottom stub with your payment. **Make check payable to: City of Bozeman**
Sign up for Automatic Bill Pay – See Reverse or to pay by credit card or go to www.bozeman.net

BOZEMAN MT
121 NORTH ROUSE AVENUE
PO BOX 1230
BOZEMAN MT 59771-1230

DATAprose DOCUMENT APPROVAL
cjm Internal Review DR Internal Review
Client Initials Date
☐ Approved as is
☐ Approved with changes
☐ Send a new proof

| Account Number | Due Date | Amount Due Now |
|---|---|---|
| 99999-999999 | 02/13/2015 | $435.19 |

A 1.5% Late Fee (or $1.00 minimum) will be assessed on delinquent balances. $15.00 Returned Payment Fee. **Water will be subject to being turned off if payment is not made by due date.**

**AMOUNT ENCLOSED $**

**SINGLE-PIECE 1 SGL 90348AA24-A-1
4 1 SP 0.480

JOHN Q SAMPLE
83 W FIELDVIEW CIR
BOZEMAN MT 59718-1234

CITY OF BOZEMAN
PO BOX 1230
BOZEMAN MT 59771-1230

☐ Check here to receive E-statement (details on back).
Please indicate address corrections above

09999999999900043519

**CITY HALL IS CLOSED TO OBSERVE THE FOLLOWING HOLIDAYS:**

**New Year's Day***
Martin Luther King Jr. Day
Presidents Day
**Memorial Day***
**4th of July***
**Labor Day***
General Election Day (alternating years)
Veterans Day
**Thanksgiving Day***
Friday after Thanksgiving
**Christmas Day***

***Garbage collection will be one day late for the remainder of the week following these holidays.**

**DELINQUENT ACCOUNT POLICY:**

- Water will be subject to turn off if payment is not made by due date.
- A 1.5% late fee (or $1.00 minimum) will be assessed on delinquent balances.
- A $25.00 fee will be assessed to all customers who receive a Hang Tag due to a delinquent utility bill.
- Reconnect Fees are $25.00 during business hours (M-F 8:00 am - 5:00 pm) and $75.00 after hours. For after-hour reconnection call (406) 582-2000.

**Visit our website at www.bozeman.net for additional information.**

**PAYMENT OPTIONS:**

**Auto Pay:** Mail in the completed Authorization Form with your payment.

**Online: www.bozeman.net** Go to the blue "**Pay Online"** Icon (left side of screen). First time users must create a Password (see instructions to right).

**Drop box:** Located at the Rouse Avenue entrance to City Hall.

**Mail to:** PO Box 1230
Bozeman, MT 59771-1230

**Pay in Person:** 121 N Rouse Ave.
M-F 8:00 am - 5:00 pm

DATAprose
DOCUMENT APPROVAL
cjn Internal Review
DR Internal Review
Client Initials Date
☐ Approved as is
☐ Approved with changes
☐ Send a new proof

**TO CREATE AN ONLINE ACCOUNT:**

1. Log onto **www.bozeman.net**
2. Select the "**Pay Online**" icon (left side of screen)
3. Choose "**Create Account**"
4. As they appear on your bill, first enter your account number using the hyphen. Next, enter your cycle/route which appears on the top right section below the account number. Click "**submit**".
5. Enter a password, your email address, security question and security answer. Click "**submit**".
6. You will receive an email that includes a link to enable your account. To ensure your account has been updated **WAIT 5 MINUTES** before clicking on the link. Re-enter your account number and password, then click "**submit"** to complete the process.

**TO ENROLL IN AUTO-PAY ONLINE:**

1. Log onto **www.bozeman.net**
2. Select the "Pay Online" icon (left side of screen)
3. Enter your account number and password (A password must first have been created. See directions above).
4. Select "Auto Pay" (left side of screen)
5. A message will display that your account is currently not enrolled. Click "Enroll" from the menu.
6. Select "Other ACH" to sign up using a checking or savings account. Or, select "other CC" to use a Visa, Mastercard or Discover credit/debit card.
7. Enter the required payment information:
   a. Payments from a checking or savings account will not process until the 15th of the month following enrollment.
   b. Payments on a credit/debit card can be made. immediately or on the next bill due date (15th of the month).
8. Confirm auto-pay information. Select "Continue".
9. Acceptance of the terms and conditions will complete the process (credit card users will see a message that the account was successfully enrolled). Select "Ok".

**TO STOP AUTO-PAY:**

1. If there is a pending payment due, call (406) 582-2333.
2. If there isn't a pending payment due, log-in to your online account and click on "Auto Pay". Then select "Disable", continuing through the steps to the "Your account is Currently Not Enrolled" message.

**TO CHANGE AUTO-PAY INFORMATION:**

1. At **www.bozeman.net** click on "Online Payment" and enter your account number and password.
2. Next, click on "Auto Pay"
3. Select "Modify Enrollment"
4. Select the "modify current card enrollment" bubble
5. On the next screen you may update any address changes. To update card information such as the expiration date or card number, select "Clear Card Information" and enter it under "Card Details" on the next screen.

**CITY OF BOZEMAN AUTO-PAY AUTHORIZATION:** **Date:** _____

I authorize the City of Bozeman and the financial institution listed on this form to initiate electronic withdrawal on the 15th of each month from my account listed below. I understand this authority will remain in effect until I notify the City of Bozeman I wish to cancel (at least three days prior to withdrawal date).

Utility Account #: _____-_____

Customer Name: _____

Service Address: _____

Telephone #: _____

Name & Address of Financial Institution: Account #_____

_____ ❒ Check Account ❒ Savings Account

_____

**A voided check must be attached to this form to be processed**. If received by the 18th of the month, first withdrawal will be the 15th of the following month.

***Signature of Account Holder:*** _____

**E-NOTIFICATION:**

Please provide your email address if you would like to receive your Utility Statement via email.

_____
Email address

*You will receive an email confirmation when we set up your account for E-Notification. You will receive a printed bill for one additional month.

If you would like to continue to receive printed bills regularly in addition to your E-Notification, please indicate below.

❒ Both E-Notification and printed statements please.

# Appendix C

# Technical Memorandum: Demand Forecasting and Hydraulic Modeling Approach

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# Technical Memorandum

Date: Thursday, March 29, 2018

Project: Water Facilities Master Plan

To: City of Missoula

From: Scott Humphrey, PE, GISP

Subject: Demand Forecasting and Hydraulic Modeling Approach

# Background

HDR is in the process of preparing a Water Facilities Master Plan (WFMP) for the City of Missoula (City). A key component to the WFMP is the development of a water system hydraulic model that analyzes the water system facilities necessary to adequately serve existing customers and accommodate future growth. Two key components to the water system hydraulic model are; 1.) The development of existing and future water demands for input into the water system model and 2.) The development of a set of water system criteria for establishing level of service and analyzing the water system for system deficiencies. This technical memorandum presents our approach to developing existing and future demands and presents a set of recommended water system design criteria to use during the hydraulic analysis task of the WFMP.

# Water Demand Projections

The City currently has both metered and non-metered (i.e. flat rate) customers. The challenge with flat rate customers is determining an appropriate water use factor to use in estimating water consumption. HDR was provided with Traffic Analysis Zone (TAZ) polygon data in Geographic Information System (GIS) format to help develop both existing and future water demand projections. A review of the TAZ data indicates that it has sufficient data and detail to adequately estimate existing demands and extrapolate future water demands, based upon use factors developed for existing users. Our approach to both existing and future water demands is described in further detail in the following sections.

## Existing Water Demands

The existing TAZ data contains a total of 2015 residential and non-residential (i.e. retail and non-retail) population. The City developed an estimate of 2017 residential population based upon 2015 residential dwelling units plus new residential dwelling units to calculate a new 2017 total. There is a total residential population of 83,528 people estimated for 2017 within the WFMP Study Area. Non-residential population, however, was not extrapolated to 2017. However, since the 2017 data contains the most accurate estimate of the existing population, we are recommending that the 2017 total be

used to estimate existing system demands. The non-residential population will be increased at the same percentage as the residential population to account for the incremental change in non-residential population from 2015 to 2017.

Existing (2017) residential and non-residential population will be assigned to the developed land within the TAZ for each TAZ polygon. There will be a combination of metered and non-metered accounts by revenue code within each TAZ. An analysis/calibration of each TAZ system wide will be developed based upon an iterative process to determine reasonable residential per capita water use, non-residential per capita water use, and water loss within each TAZ. Per capita water use factors will be developed separately for metered and non-metered accounts. We will calibrate the water use factors to existing production data and the existing system hydraulic model to develop a residential and non-residential per capita water use factor. In addition, we have flat rate account information that includes room count, bathroom count, toilet count, and square footage that we can use as additional calibration data.

Once the draft consumption factors are developed, we will submit them to the City for review and acceptance prior to proceeding with the future demand projections.

## Future Water Demand Projections

For future water demands, we will use the 20 year population figures provided in the TAZ data. A 20 year planning horizon would correspond to 2037, which would roughly correspond with the planning horizon used in the City's 2035 Growth Policy. There is a total residential population of 111,853 within the WFMP Study Area. Similar to the 2017 population, a non-residential population was provided for the 25 year projection (i.e. 2042), but not for the 20 year projection, so the 2037 non-residential population (i.e. retail and non-retail) will be decreased at the same percentage as the residential population to account for the incremental change in non-residential population from 2042 to 2037.

Future projections will be based upon specific growth plan data, where available, and then will be based upon TAZ growth assigned to vacant or developable land within each TAZ polygon.

At this time, these are the known development plans on the City's Planning website:

**Neighborhood and Area Plans**

- Butler Creek Area Comprehensive Plan Amendment - County (October 1996)
- Fort Missoula Plan - City (January 1994)
- Grant Creek Area Plan (1980)
- Greater Missoula Downtown Master Plan (8MB Doc, August 2009)
- Historic Southside Neighborhood Plan (May1991)
- Joint Northside/Westside (NS/WS) Neighborhood Plan (Links) (July 2000) 6.6MB Doc
- Joint NS/WS 2006 Limited Scope Update - (April 2008)
- Miller Creek Plan (August 1997) Links & Map
- Rattlesnake Valley Comprehensive Plan Amendment (October 1995)

- Reserve Street Area Plan 1995 - (July 1995)
- Reserve Street Area Plan 1980 - 36MB Doc, City/County (October 1980)
- South Hills Comprehensive Plan (November 1986)
- Southside Riverfront Area Comprehensive Plan Amendment (March 2000)
- Wye-Mullan Plan City/County (November 2005)

**Neighborhood Infrastructure Plans**

- River Road/Emma Dickinson Infrastructure Plan (2003)
- Franklin to the Fort Doc (2006)

Neighborhood area plans are shown in Figure 1.

One component of the future water demand projections will be the conversion of non-metered accounts to metered accounts. We will assume that this conversion will occur within specific planned areas first and then will occur at the same rate of growth as each individual TAZ (i.e. TAZ areas with a higher growth rate will convert at a higher rate). As customers convert from non-metered to metered accounts, they will use the metered use factor, which we anticipate will be lower than the non-metered use factor.

Non-residential population was not projected for individual time increments (i.e. 5 year, 10, year, 15 year) and we will assume a straight line interpolation of the ratio of non-residential to residential population for each time increment. For example, if the 2017 ratio of non-residential to residential is 10% and the 20 year ratio is 15%, we will assume a straight line interpolation of 10% to 15% occurs over the 20 year planning period.

It should be noted that there is an additional attribute in the TAZ titled "GRP_POP16". This is "Group Quarters" population data and is intended to account for nursing homes and the University of Montana. The University contains the majority of this population and the City is not aware of any plans to build more campus housing. Therefore, it is assumed that these numbers will remain constant over the 20 year planning horizon.

A preliminary analysis of population growth is provided in Figure 2 to show TAZ areas with the highest projected growth based upon residential population. It should be noted that some TAZ areas lose population according to the 2037 population projection.

# Water System Design Criteria

The second part of this Technical Memorandum presents a recommended set of water system design criteria to evaluate the existing and future water system for deficiencies and recommend system improvements.

## Distribution System Criteria

Distribution system criteria addresses system pressure and pipeline requirements. These criteria are established to ensure that the proposed distribution system will provide adequate, but not excessive,

water pressure and the conveyance system can accommodate peak demands without excessive wear or energy usage. It should be noted that the criteria recommended below are planning criteria that are calculated such that they will protect the distribution system under repeated normal operation. These criteria are not recommended to limit, for example, pipeline velocities during intermittent activity such as flushing.

Water system design criteria recommended for this WFMP are generally taken from the Montana Department of Environmental Quality (DEQ) Standards for Water Works, August 9, 2014 Edition, which are based on the 10 State Standards for Water Works and augmented with our experience on similar water utility system master planning projects.

The water service pressure requirements recommended for this WFMP analysis are as follows:

- Maximum desired pressure: 135 psi
- Maximum allowable pressure: 150 psi
- Minimum allowable pressure at peak flow: 40 psi
- Minimum allowable pressure with maximum day demands plus fire flow: 20 psi

In order to help provide standardization throughout the City, provide adequate fire flows and avoid excessive velocity and head loss within the distribution system, the following pipeline design criteria are also recommended:

- Minimum pipe size for new construction w/ fire hydrant 8 inch
- Maximum allowable velocity at peak flow: 7 feet per second
- Maximum allowable velocity at peak flow plus fire flow: 15 feet per second
- Maximum desirable head loss at peak flow: 5 feet per 1000 feet
- Maximum allowable head loss at peak flow: 10 feet per 1000 feet

## Pump Station Criteria

Pump stations will be sized to handle maximum day demand flows to meet the required pressure at all junction nodes. Reservoir storage provides for flow differences between maximum day demand and maximum day plus fire-flow or peak hour, whichever is greater. Pump stations should be able to meet the required pumping rates with the largest capacity pump on standby (inactive).

## Pressure Reducing Station Criteria

Pressure Reducing Stations (PRS) will be sized to meet maximum day demand flows in cases where the downstream pressure zone has a reservoir for flow support during maximum day plus fire flow and peak hour demand conditions. If there are no reservoirs in the downstream pressure zone, the PRS will be sized to handle maximum day plus fire flow or peak hour demands, whichever is greater. The PRS design shall include low flow and high flow pressure reducing valves operating in parallel to allow the PRS to operate over a wide range of flows from minimum night-time demand to the required maximum demand.

## Storage Criteria

City potable water reservoirs should provide storage in order to meet two (2) main objectives:

- Moderate fluctuations during normal operations between supply and demand in the distribution system (Operational Storage).
- Provide storage for fire protection in each pressure zone (Fire Flow Storage).

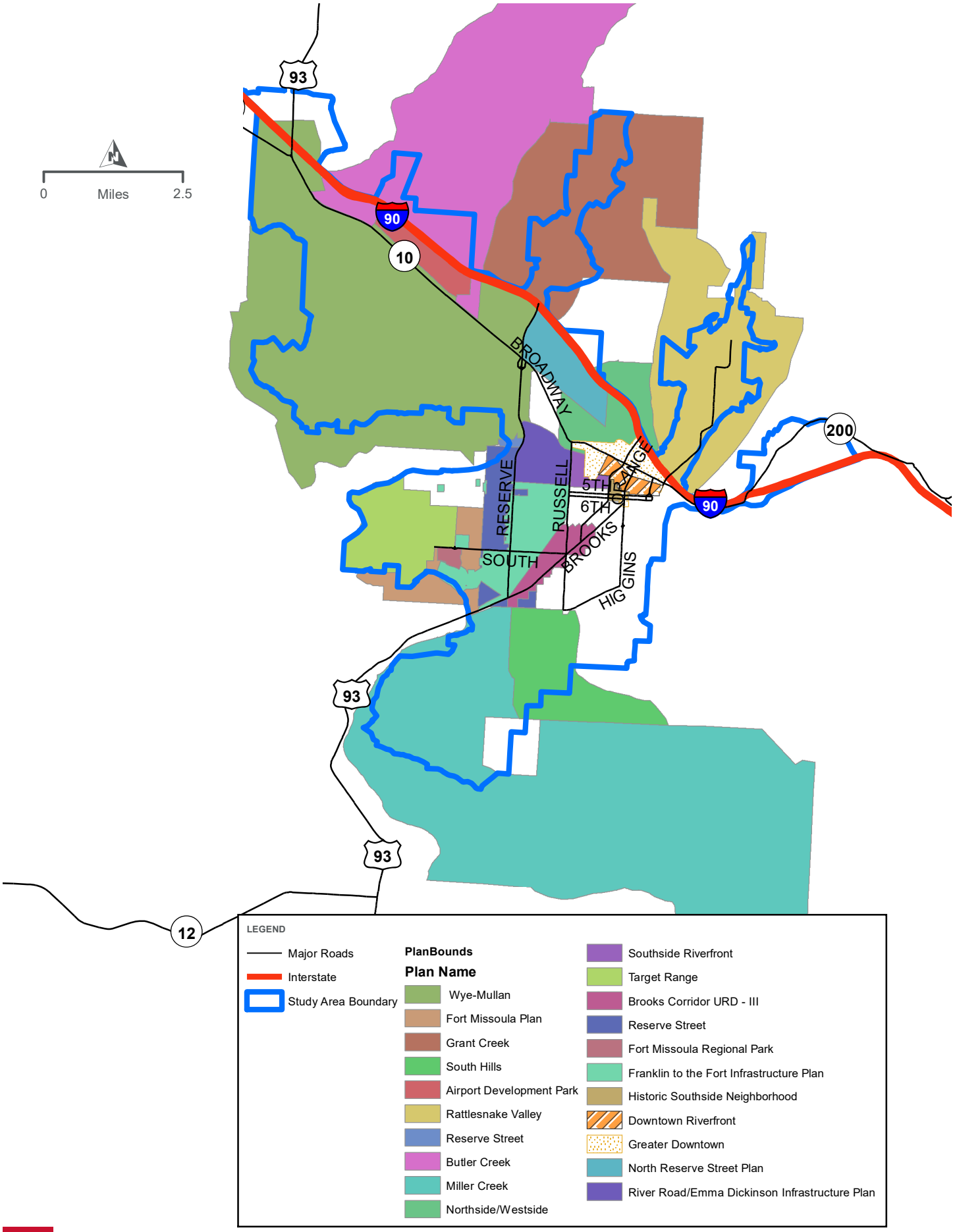
The following recommendation is from the DEQ Water Works Standards:

> Storage facilities must be sufficient, as determined from engineering studies, to supplement source capacity to satisfy all system demands occurring on the maximum day, plus fire flow demands where fire protection is provided.

It is recommended that the DEQ standard for reservoir sizing be used in this WFMP.

From Section 7.01 of the DEQ standard the following storage criteria is recommended:

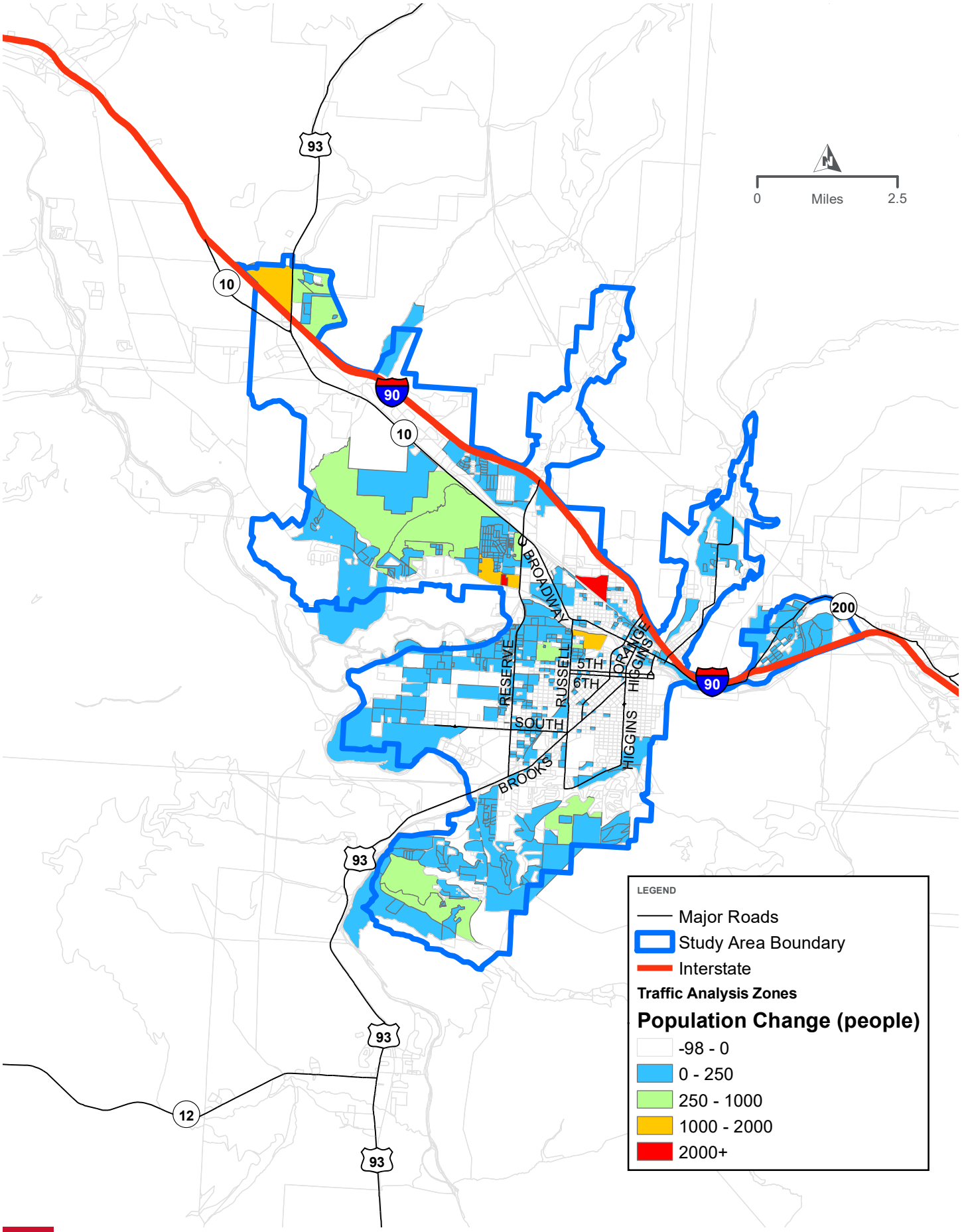
- The minimum allowable storage must be equal to the average day demand plus fire flow demand, as defined below, where fire protection is provided.
- Any volume less than that required under a. above must be accompanied by a Storage Sizing Engineering Analysis, as defined in the glossary. Large non-residential demands must be accompanied by a Storage Sizing Engineering Analysis and may require additional storage to meet system demands.
- Where fire protection is provided, fire flow demand must satisfy the governing fire protection agency recommendation, or without such a recommendation, the fire code adopted by the State of Montana.
- Each pressure zone of systems with multiple pressure zones must be analyzed separately and provided with sufficient storage to satisfy the above requirements.
- Excessive storage capacity should be avoided to prevent water quality deterioration and potential freezing problems.




# DEMAND FORECASTING AND WATER SYSTEM DESIGN CRITERIA APPROACH

## NEIGHBORHOOD PLANS

FIGURE 1




## DEMAND FORECASTING AND WATER SYSTEM DESIGN CRITERIA APPROACH

### PROJECTED 20 YEAR POPULATION GROWTH

FIGURE 2

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# Appendix D

# MDEQ Monitoring Schedule

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# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

## TOTAL COLIFORM BACTERIOLOGICAL SCHEDULES

| Water System Facility Name | Sample Point Label | Analyte Group Name | Sample Count Required | Sample Frequency | Seasonal Start MM/DD | Seasonal End MM/DD | Date Last Collected | Monitoring Period Sampling Satisfied? |
|---|---|---|---|---|---|---|---|---|
| DISTRIBUTION SYSTEM | DS001 SP001 | COLIFORM (TCR) | 60 | Monthly | 1/1 | 12/31 | 12/10/2018 | No |

## SYSTEM SUMMARY REPORTING REQUIREMENTS

| Water System Facility Name | Sample Location Label | Analyte Name | Sample Frequency | Reporting Frequency | DEQ FANL Code |
|---|---|---|---|---|---|
| DISTRIBUTION SYSTEM | DS001 SP001 | CHLORINE | Monthly | Quarterly | MRDL |
| TP FOR WELL 2 S 14TH ST W | TP002 EP502 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 4 S 6TH ST W | TP004 EP504 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 9 DIXON AVENUE | TP009 EP509 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 10 HILDA AVE | TP010 EP510 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 11 AGNES AVE | TP011 EP511 | CHLORINE | Daily | Monthly | SERD |
| TREATMENT PLANT WELL 13 | TP013 EP513 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 17 MOMONT WELL | TP017 EP517 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 18 GHARRETT AVE WELL | TP018 EP518 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 19 N RUSSEL | TP019 EP519 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 20 CATLIN ST WELL | TP020 EP520 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 21 E CENTRAL AVENUE | TP021 EP521 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 22 INTERMOUNTAIN WELL | TP022 EP522 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WLS 023 AND 024 PATTEE CRK WELLS | TP023 EP523 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 25 STEPHENS AVENUE | TP025 EP525 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 26 BENTON AVENUE | TP026 EP526 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 27 26TH ST WELL | TP027 EP527 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 29 ORCHARD AVENUE WELL | TP029 EP529 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 30 BANK ST WELL | TP030 EP530 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 31 KIWANIS ST WELL | TP031 EP531 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 32 ARTHUR AVENUE | TP032 EP532 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 33 GERALD AVENUE | TP033 EP533 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 34 MAURICE | TP034 EP534 | CHLORINE | Daily | Monthly | SERD |

# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

| | | | | | |
|---|---|---|---|---|---|
| TP FOR WELL 35 SOUTHGATE MALL | TP035 EP535 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 1 23RD ST CLARK FORK EAST | TP039 EP539 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 2 23RD ST CLARK FORK WEST | TP040 EP540 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 1 EAST MISSOULA | TP041 EP541 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 2 EAST MISSOULA | TP042 EP542 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 1 MWW PALMER ST | TP046 EP546 | CHLORINE | Daily | Monthly | SERD |
| TP FOR WELL 2 MWW PALMER ST | TP047 EP547 | CHLORINE | Daily | Monthly | SERD |

***Chlorine residual MUST be taken and reported for each TCR sample site collected each month.**

## CHEMICAL SCHEDULES

## DISTRIBUTION SYSTEM SCHEDULES

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitoring Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| SP FOR DS | DS001 SP001 | ASBESTOS | 1 | Every 9 Years | 10/26/2011 | Yes | 01/01/2020-12/31/2028 * |
| 2ND WK AUG- 4505 MARK COURT | DS001 DBP1 | DBP ST 2 | 1 | Yearly | 08/08/2018 | Yes | 08/01/2019-08/30/2019 |
| 2ND WK AUG- 5290 MOM0NT ROAD | DS001 DBP2 | DBP ST 2 | 1 | Yearly | 08/08/2018 | Yes | 08/01/2019-08/30/2019 |
| 2ND WK AUG- 5020 ELK RIDGE ROAD | DS001 DBP3 | DBP ST 2 | 1 | Yearly | 08/08/2018 | Yes | 08/01/2019-08/30/2019 |
| 2ND WK AUG- 505 HIGH PARK | DS001 DBP4 | DBP ST 2 | 1 | Yearly | 08/08/2018 | Yes | 08/01/2019-08/30/2019 |
| SP FOR DS | DS001 SP001 | LEAD COPPER ONLY | 30 | Yearly | 06/27/2018 | Yes | 06/01/2018-09/30/2018 |

***Asbestos - required to monitor during the first three-year compliance period of each nine-year compliance cycle.**

## COMMON HEADER FOR TPS WLS 003 AND 037

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR WLS 003 037 | CH001 EP503 | ARSENIC | 1 | Every 3 Years | 10/03/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR WLS 003 037 | CH001 EP503 | NITRATE NITRITE | 1 | Yearly | 06/19/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR WLS 003 037 | CH001 EP503 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 10/03/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR WLS 003 037 | CH001 EP503 | RAD GROSS ALPHA | 1 | Every 9 Years | 04/30/2014 | No | 01/01/2017-12/31/2025 |
| EP FOR WLS 003 037 | CH001 EP503 | RADIUMS COMBINED | 1 | Every 9 Years | 04/30/2014 | No | 01/01/2017-12/31/2025 |

# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

## COMMON HEADER FOR TPS WLS 003 AND 037

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR WLS 003 037 | CH001 EP503 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 10/24/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR WLS 003 037 | CH001 EP503 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 10/24/2017 | Yes | 01/01/2020-12/31/2022 |

## COMMON HEADER FOR TPS WLS 043 044 045

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR LIND VSTA WLS | CH002 EP543 | ARSENIC | 1 | Every 3 Years | 11/16/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR LIND VSTA WLS | CH002 EP543 | NITRATE NITRITE | 1 | Yearly | 09/19/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR LIND VSTA WLS | CH002 EP543 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 11/16/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR LIND VSTA WLS | CH002 EP543 | RAD GROSS ALPHA | 1 | Every 9 Years | 03/02/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR LIND VSTA WLS | CH002 EP543 | RADIUMS COMBINED | 1 | Every 9 Years | 03/02/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR LIND VSTA WLS | CH002 EP543 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 09/28/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR LIND VSTA WLS | CH002 EP543 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 10/18/2016 | No | 01/01/2017-12/31/2019 |

## COMMON HEADER WELLS 049,050,051

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| COMMON HEADER WELLS 049,050,051 | CH004 EP549 | ARSENIC | 1 | Every 3 Years | 03/08/2017 | Yes | 01/01/2020-12/31/2022 |
| COMMON HEADER WELLS 049,050,051 | CH004 EP549 | NITRATE NITRITE | 1 | Yearly | 07/31/2018 | Yes | 01/01/2019-12/31/2019 |
| COMMON HEADER WELLS 049,050,051 | CH004 EP549 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 03/08/2017 | Yes | 01/01/2020-12/31/2022 |
| COMMON HEADER WELLS 049,050,051 | CH004 EP549 | RAD GROSS ALPHA | 1 | Every 9 Years | 01/09/2018 | Yes | 01/01/2026-12/31/2034 |
| COMMON HEADER WELLS 049,050,051 | CH004 EP549 | RADIUMS COMBINED | 1 | Every 9 Years | 01/09/2018 | Yes | 01/01/2026-12/31/2034 |
| COMMON HEADER WELLS 049,050,051 | CH004 EP549 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 01/09/2018 | Yes | 01/01/2020-12/31/2022 |

# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

## COMMON HEADER WELLS 049,050,051

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| COMMON HEADER WELLS 049,050,051 | CH004 EP549 | VOLATILE ORGANIC COMPOUNDS | 1 | Yearly | 07/31/2018 | Yes | 01/01/2019-12/31/2019 |

## TREATMENT PLANT FOR WELL 2 S 14TH ST W

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR WELL 2 S 14TH | TP002 EP502 | ARSENIC | 1 | Every 3 Years | 10/10/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR WELL 2 S 14TH | TP002 EP502 | NITRATE NITRITE | 1 | Yearly | 09/19/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR WELL 2 S 14TH | TP002 EP502 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 10/10/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR WELL 2 S 14TH | TP002 EP502 | RAD GROSS ALPHA | 1 | Every 9 Years | 10/18/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR WELL 2 S 14TH | TP002 EP502 | RADIUMS COMBINED | 1 | Every 9 Years | 10/18/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR WELL 2 S 14TH | TP002 EP502 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 09/21/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR WELL 2 S 14TH | TP002 EP502 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 09/21/2016 | No | 01/01/2017-12/31/2019 |

## TREATMENT PLANT FOR CANYON RIVER WELL

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP TP WELL 048 | TP048 EP548 | ARSENIC | 1 | Every 3 Years | 09/26/2017 | Yes | 01/01/2020-12/31/2022 |
| EP TP WELL 048 | TP048 EP548 | NITRATE NITRITE | 1 | Yearly | 06/05/2018 | Yes | 01/01/2019-12/31/2019 |
| EP TP WELL 048 | TP048 EP548 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 09/26/2017 | Yes | 01/01/2020-12/31/2022 |
| EP TP WELL 048 | TP048 EP548 | RADIUMS COMBINED | 1 | Every 9 Years | 11/24/2014 | No | 01/01/2017-12/31/2025 |
| EP TP WELL 048 | TP048 EP548 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 06/05/2018 | Yes | 01/01/2020-12/31/2022 |
| EP TP WELL 048 | TP048 EP548 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 09/13/2017 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 1 23RD ST CLARK FORK EAST

# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

## TREATMENT PLANT FOR WELL 1 23RD ST CLARK FORK EAST

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 1 23RD S | TP039 EP539 | ARSENIC | 1 | Every 3 Years | 10/11/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 1 23RD S | TP039 EP539 | NITRATE NITRITE | 1 | Yearly | 09/19/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 1 23RD S | TP039 EP539 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 10/11/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 1 23RD S | TP039 EP539 | RAD GROSS ALPHA | 1 | Every 9 Years | 02/29/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 1 23RD S | TP039 EP539 | RADIUMS COMBINED | 1 | Every 6 Years | 02/29/2016 | No | 01/01/2017-12/31/2022 |
| EP FOR TPWL 1 23RD S | TP039 EP539 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 11/01/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 1 23RD S | TP039 EP539 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 11/01/2017 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 1 EAST MISSOULA

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 1EAST MS | TP041 EP541 | ARSENIC | 1 | Every 3 Years | 06/05/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 1EAST MS | TP041 EP541 | NITRATE NITRITE | 1 | Yearly | 06/05/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 1EAST MS | TP041 EP541 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 06/05/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 1EAST MS | TP041 EP541 | RAD GROSS ALPHA | 1 | Every 9 Years | 07/17/2018 | Yes | 01/01/2026-12/31/2034 |
| EP FOR TPWL 1EAST MS | TP041 EP541 | RADIUMS COMBINED | 1 | Every 9 Years | 07/17/2018 | Yes | 01/01/2026-12/31/2034 |
| EP FOR TPWL 1EAST MS | TP041 EP541 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 06/05/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 1EAST MS | TP041 EP541 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 06/05/2018 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 1 MWW PALMER ST

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR WELL 1 MWW | TP046 EP546 | ARSENIC | 1 | Every 3 Years | 10/03/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR WELL 1 MWW | TP046 EP546 | NITRATE NITRITE | 1 | Yearly | 09/18/2018 | Yes | 01/01/2019-12/31/2019 |

# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

## TREATMENT PLANT FOR WELL 1 MWW PALMER ST

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR WELL 1 MWW | TP046 EP546 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 10/03/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR WELL 1 MWW | TP046 EP546 | RAD GROSS ALPHA | 1 | Every 9 Years | 04/30/2014 | No | 01/01/2017-12/31/2025 |
| EP FOR WELL 1 MWW | TP046 EP546 | RADIUMS COMBINED | 1 | Every 9 Years | 04/30/2014 | No | 01/01/2017-12/31/2025 |
| EP FOR WELL 1 MWW | TP046 EP546 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 11/21/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR WELL 1 MWW | TP046 EP546 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 11/21/2017 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 10 HILDA AVE

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 10 HILDA | TP010 EP510 | ARSENIC | 1 | Every 3 Years | 10/10/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TPWL 10 HILDA | TP010 EP510 | NITRATE NITRITE | 1 | Yearly | 09/11/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 10 HILDA | TP010 EP510 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 10/10/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TPWL 10 HILDA | TP010 EP510 | RAD GROSS ALPHA | 1 | Every 9 Years | 10/19/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 10 HILDA | TP010 EP510 | RADIUMS COMBINED | 1 | Every 9 Years | 10/19/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 10 HILDA | TP010 EP510 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 09/21/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TPWL 10 HILDA | TP010 EP510 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 09/21/2016 | No | 01/01/2017-12/31/2019 |

## TREATMENT PLANT FOR WELL 11 AGNES AVE

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 11 AGNES | TP011 EP511 | ARSENIC | 1 | Every 3 Years | 10/11/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 11 AGNES | TP011 EP511 | NITRATE NITRITE | 1 | Yearly | 09/11/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 11 AGNES | TP011 EP511 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 10/11/2017 | Yes | 01/01/2020-12/31/2022 |

# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

## TREATMENT PLANT FOR WELL 11 AGNES AVE

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 11 AGNES | TP011 EP511 | RAD GROSS ALPHA | 1 | Every 9 Years | 04/30/2014 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 11 AGNES | TP011 EP511 | RADIUMS COMBINED | 1 | Every 9 Years | 04/30/2014 | Yes | 01/01/2020-12/31/2028 |
| EP FOR TPWL 11 AGNES | TP011 EP511 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 09/14/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TPWL 11 AGNES | TP011 EP511 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 09/14/2016 | No | 01/01/2017-12/31/2019 |

## TREATMENT PLANT FOR WELL 17 MOMONT WELL

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 17 MOMNT | TP017 EP517 | ARSENIC | 1 | Every 3 Years | 09/26/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 17 MOMNT | TP017 EP517 | NITRATE NITRITE | 1 | Yearly | 09/18/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 17 MOMNT | TP017 EP517 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 09/26/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 17 MOMNT | TP017 EP517 | RAD GROSS ALPHA | 1 | Every 6 Years | 02/29/2016 | No | 01/01/2017-12/31/2022 |
| EP FOR TPWL 17 MOMNT | TP017 EP517 | RADIUMS COMBINED | 1 | Every 6 Years | 02/29/2016 | No | 01/01/2017-12/31/2022 |
| EP FOR TPWL 17 MOMNT | TP017 EP517 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 11/21/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 17 MOMNT | TP017 EP517 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 11/21/2017 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 18 GHARRETT AVE WELL

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 18 GHART | TP018 EP518 | ARSENIC | 1 | Every 3 Years | 10/03/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 18 GHART | TP018 EP518 | NITRATE NITRITE | 1 | Yearly | 06/19/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 18 GHART | TP018 EP518 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 10/03/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 18 GHART | TP018 EP518 | RAD GROSS ALPHA | 1 | Every 9 Years | 10/18/2016 | No | 01/01/2017-12/31/2025 |

# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

## TREATMENT PLANT FOR WELL 18 GHARRETT AVE WELL

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 18 GHART | TP018 EP518 | RADIUMS COMBINED | 1 | Every 9 Years | 10/18/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 18 GHART | TP018 EP518 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 10/24/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 18 GHART | TP018 EP518 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 10/24/2017 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 19 N RUSSEL

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 19 N RUS | TP019 EP519 | ARSENIC | 1 | Every 3 Years | 11/16/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TPWL 19 N RUS | TP019 EP519 | NITRATE NITRITE | 1 | Yearly | 09/18/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 19 N RUS | TP019 EP519 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 11/16/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TPWL 19 N RUS | TP019 EP519 | RAD GROSS ALPHA | 1 | Every 9 Years | 08/10/2010 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 19 N RUS | TP019 EP519 | RADIUMS COMBINED | 1 | Every 9 Years | 03/05/2013 | Yes | 01/01/2020-12/31/2028 |
| EP FOR TPWL 19 N RUS | TP019 EP519 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 04/03/2018 | No | 01/01/2017-12/31/2019 |
| EP FOR TPWL 19 N RUS | TP019 EP519 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 09/21/2016 | No | 01/01/2017-12/31/2019 |

## TREATMENT PLANT FOR WELL 2 23RD ST CLARK FORK WEST

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 2 23RD S | TP040 EP540 | ARSENIC | 1 | Every 3 Years | 11/09/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TPWL 2 23RD S | TP040 EP540 | NITRATE NITRITE | 1 | Yearly | 09/19/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 2 23RD S | TP040 EP540 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 11/09/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TPWL 2 23RD S | TP040 EP540 | RAD GROSS ALPHA | 1 | Every 6 Years | 02/29/2016 | No | 01/01/2017-12/31/2022 |
| EP FOR TPWL 2 23RD S | TP040 EP540 | RADIUMS COMBINED | 1 | Every 9 Years | 02/29/2016 | No | 01/01/2017-12/31/2025 |

# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

## TREATMENT PLANT FOR WELL 2 23RD ST CLARK FORK WEST

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 2 23RD S | TP040 EP540 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 11/01/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 2 23RD S | TP040 EP540 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 11/01/2017 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 2 EAST MISSOULA

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 2 EAST M | TP042 EP542 | ARSENIC | 1 | Every 3 Years | 06/19/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 2 EAST M | TP042 EP542 | NITRATE NITRITE | 1 | Yearly | 06/19/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 2 EAST M | TP042 EP542 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 06/19/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 2 EAST M | TP042 EP542 | RAD GROSS ALPHA | 1 | Every 6 Years | 07/17/2018 | Yes | 01/01/2023-12/31/2028 |
| EP FOR TPWL 2 EAST M | TP042 EP542 | RADIUMS COMBINED | 1 | Every 9 Years | 07/17/2018 | Yes | 01/01/2026-12/31/2034 |
| EP FOR TPWL 2 EAST M | TP042 EP542 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 06/19/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 2 EAST M | TP042 EP542 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 06/19/2018 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 2 MWW PALMER ST

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR WELL 2 MWW | TP047 EP547 | ARSENIC | 1 | Every 3 Years | 10/03/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR WELL 2 MWW | TP047 EP547 | NITRATE NITRITE | 1 | Yearly | 09/18/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR WELL 2 MWW | TP047 EP547 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 10/03/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR WELL 2 MWW | TP047 EP547 | RAD GROSS ALPHA | 1 | Every 6 Years | 03/02/2016 | No | 01/01/2017-12/31/2022 |
| EP FOR WELL 2 MWW | TP047 EP547 | RADIUMS COMBINED | 1 | Every 9 Years | 03/02/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR WELL 2 MWW | TP047 EP547 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 11/21/2017 | Yes | 01/01/2020-12/31/2022 |

# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

## TREATMENT PLANT FOR WELL 2 MWW PALMER ST

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR WELL 2 MWW | TP047 EP547 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 11/21/2017 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 20 CATLIN ST WELL

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 20 CATLN | TP020 EP520 | ARSENIC | 1 | Every 3 Years | 07/17/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 20 CATLN | TP020 EP520 | NITRATE NITRITE | 1 | Yearly | 07/17/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 20 CATLN | TP020 EP520 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 07/17/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 20 CATLN | TP020 EP520 | RAD GROSS ALPHA | 1 | Every 9 Years | 02/17/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 20 CATLN | TP020 EP520 | RADIUMS COMBINED | 1 | Every 6 Years | 02/17/2016 | No | 01/01/2017-12/31/2022 |
| EP FOR TPWL 20 CATLN | TP020 EP520 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 07/17/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 20 CATLN | TP020 EP520 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 07/17/2018 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 21 E CENTRAL AVENUE

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 21 E CEN | TP021 EP521 | ARSENIC | 1 | Every 3 Years | 10/11/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 21 E CEN | TP021 EP521 | NITRATE NITRITE | 1 | Yearly | 09/11/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 21 E CEN | TP021 EP521 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 10/11/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 21 E CEN | TP021 EP521 | RAD GROSS ALPHA | 1 | Every 9 Years | 02/17/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 21 E CEN | TP021 EP521 | RADIUMS COMBINED | 1 | Every 9 Years | 02/17/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 21 E CEN | TP021 EP521 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 11/01/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 21 E CEN | TP021 EP521 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 11/01/2017 | Yes | 01/01/2020-12/31/2022 |

# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

## TREATMENT PLANT FOR WELL 22 INTERMOUNTAIN WELL

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 22 INTER | TP022 EP522 | ARSENIC | 1 | Every 3 Years | 10/11/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 22 INTER | TP022 EP522 | NITRATE NITRITE | 1 | Yearly | 09/11/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 22 INTER | TP022 EP522 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 10/11/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 22 INTER | TP022 EP522 | RAD GROSS ALPHA | 1 | Every 9 Years | 03/26/2014 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 22 INTER | TP022 EP522 | RADIUMS COMBINED | 1 | Every 9 Years | 03/26/2014 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 22 INTER | TP022 EP522 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 10/24/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 22 INTER | TP022 EP522 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 10/24/2017 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 25 STEPHENS AVENUE

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 25 STEPH | TP025 EP525 | ARSENIC | 1 | Every 3 Years | 11/16/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TPWL 25 STEPH | TP025 EP525 | NITRATE NITRITE | 1 | Yearly | 09/12/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 25 STEPH | TP025 EP525 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 11/16/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TPWL 25 STEPH | TP025 EP525 | RAD GROSS ALPHA | 1 | Every 9 Years | 03/02/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 25 STEPH | TP025 EP525 | RADIUMS COMBINED | 1 | Every 9 Years | 03/02/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 25 STEPH | TP025 EP525 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 09/14/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TPWL 25 STEPH | TP025 EP525 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 09/14/2016 | No | 01/01/2017-12/31/2019 |

## TREATMENT PLANT FOR WELL 26 BENTON AVENUE

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 26 BENTN | TP026 EP526 | ARSENIC | 1 | Every 3 Years | 07/18/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 26 BENTN | TP026 EP526 | NITRATE NITRITE | 1 | Yearly | 07/18/2018 | Yes | 01/01/2019-12/31/2019 |

# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

## TREATMENT PLANT FOR WELL 26 BENTON AVENUE

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 26 BENTN | TP026 EP526 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 07/18/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 26 BENTN | TP026 EP526 | RAD GROSS ALPHA | 1 | Every 9 Years | 07/18/2018 | Yes | 01/01/2026-12/31/2034 |
| EP FOR TPWL 26 BENTN | TP026 EP526 | RADIUMS COMBINED | 1 | Every 9 Years | 07/18/2018 | Yes | 01/01/2023-12/31/2031 |
| EP FOR TPWL 26 BENTN | TP026 EP526 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 07/18/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 26 BENTN | TP026 EP526 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 07/18/2018 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 27 26TH ST WELL

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 27 26TH | TP027 EP527 | ARSENIC | 1 | Every 3 Years | 07/17/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 27 26TH | TP027 EP527 | NITRATE NITRITE | 1 | Yearly | 07/17/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 27 26TH | TP027 EP527 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 07/17/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 27 26TH | TP027 EP527 | RAD GROSS ALPHA | 1 | Every 9 Years | 07/17/2018 | Yes | 01/01/2026-12/31/2034 |
| EP FOR TPWL 27 26TH | TP027 EP527 | RADIUMS COMBINED | 1 | Every 6 Years | 07/17/2018 | Yes | 01/01/2023-12/31/2028 |
| EP FOR TPWL 27 26TH | TP027 EP527 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 07/17/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 27 26TH | TP027 EP527 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 07/17/2018 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 29 ORCHARD AVENUE WELL

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 29 ORCHA | TP029 EP529 | ARSENIC | 1 | Every 3 Years | 11/09/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TPWL 29 ORCHA | TP029 EP529 | NITRATE NITRITE | 1 | Yearly | 09/18/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 29 ORCHA | TP029 EP529 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 11/09/2016 | No | 01/01/2017-12/31/2019 |

# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

## TREATMENT PLANT FOR WELL 29 ORCHARD AVENUE WELL

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 29 ORCHA | TP029 EP529 | RAD GROSS ALPHA | 1 | Every 9 Years | 10/26/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 29 ORCHA | TP029 EP529 | RADIUMS COMBINED | 1 | Every 6 Years | 10/26/2016 | No | 01/01/2017-12/31/2022 |
| EP FOR TPWL 29 ORCHA | TP029 EP529 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 10/24/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 29 ORCHA | TP029 EP529 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 10/24/2017 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 30 BANK ST WELL

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 30 BANK | TP030 EP530 | ARSENIC | 1 | Every 3 Years | 08/14/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 30 BANK | TP030 EP530 | NITRATE NITRITE | 1 | Yearly | 08/14/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 30 BANK | TP030 EP530 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 08/14/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 30 BANK | TP030 EP530 | RAD GROSS ALPHA | 1 | Every 9 Years | 10/26/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 30 BANK | TP030 EP530 | RADIUMS COMBINED | 1 | Every 6 Years | 10/26/2016 | No | 01/01/2017-12/31/2022 |
| EP FOR TPWL 30 BANK | TP030 EP530 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 08/14/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 30 BANK | TP030 EP530 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 09/05/2018 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 31 KIWANIS ST WELL

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 31 KIWAN | TP031 EP531 | ARSENIC | 1 | Every 3 Years | 09/05/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 31 KIWAN | TP031 EP531 | NITRATE NITRITE | 1 | Yearly | 09/05/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 31 KIWAN | TP031 EP531 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 09/05/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 31 KIWAN | TP031 EP531 | RAD GROSS ALPHA | 1 | Every 9 Years | 09/05/2018 | Yes | 01/01/2026-12/31/2034 |

# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

## TREATMENT PLANT FOR WELL 31 KIWANIS ST WELL

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 31 KIWAN | TP031 EP531 | RADIUMS COMBINED | 1 | Every 9 Years | 09/05/2018 | Yes | 01/01/2026-12/31/2034 |
| EP FOR TPWL 31 KIWAN | TP031 EP531 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 09/05/2018 | No | 01/01/2017-12/31/2019 |
| EP FOR TPWL 31 KIWAN | TP031 EP531 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 09/05/2018 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 32 ARTHUR AVENUE

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 32 ARTHR | TP032 EP532 | ARSENIC | 1 | Every 3 Years | 11/09/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TPWL 32 ARTHR | TP032 EP532 | NITRATE NITRITE | 1 | Yearly | 09/12/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 32 ARTHR | TP032 EP532 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 11/09/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TPWL 32 ARTHR | TP032 EP532 | RAD GROSS ALPHA | 1 | Every 9 Years | 02/24/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 32 ARTHR | TP032 EP532 | RADIUMS COMBINED | 1 | Every 9 Years | 02/24/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 32 ARTHR | TP032 EP532 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 09/28/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TPWL 32 ARTHR | TP032 EP532 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 10/18/2016 | No | 01/01/2017-12/31/2019 |

## TREATMENT PLANT FOR WELL 33 GERALD AVENUE

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 33 GERAL | TP033 EP533 | ARSENIC | 1 | Every 3 Years | 08/14/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 33 GERAL | TP033 EP533 | NITRATE NITRITE | 1 | Yearly | 08/14/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 33 GERAL | TP033 EP533 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 08/14/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 33 GERAL | TP033 EP533 | RAD GROSS ALPHA | 1 | Every 9 Years | 10/26/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 33 GERAL | TP033 EP533 | RADIUMS COMBINED | 1 | Every 9 Years | 10/26/2016 | No | 01/01/2017-12/31/2025 |

# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

## TREATMENT PLANT FOR WELL 33 GERALD AVENUE

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 33 GERAL | TP033 EP533 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 08/14/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 33 GERAL | TP033 EP533 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 09/05/2018 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 34 MAURICE

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 34 MAURI | TP034 EP534 | ARSENIC | 1 | Every 3 Years | 09/26/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 34 MAURI | TP034 EP534 | NITRATE NITRITE | 1 | Yearly | 09/12/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 34 MAURI | TP034 EP534 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 09/26/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 34 MAURI | TP034 EP534 | RAD GROSS ALPHA | 1 | Every 9 Years | 02/24/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 34 MAURI | TP034 EP534 | RADIUMS COMBINED | 1 | Every 9 Years | 02/24/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TPWL 34 MAURI | TP034 EP534 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 11/21/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 34 MAURI | TP034 EP534 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 11/21/2017 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 35 SOUTHGATE MALL

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 35 SOUTH | TP035 EP535 | ARSENIC | 1 | Every 3 Years | 05/15/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 35 SOUTH | TP035 EP535 | NITRATE NITRITE | 1 | Yearly | 05/15/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TPWL 35 SOUTH | TP035 EP535 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 05/15/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TPWL 35 SOUTH | TP035 EP535 | RAD GROSS ALPHA | 1 | Every 6 Years | 06/27/2018 | Yes | 01/01/2023-12/31/2028 |
| EP FOR TPWL 35 SOUTH | TP035 EP535 | RADIUMS COMBINED | 1 | Every 9 Years | 06/27/2018 | Yes | 01/01/2026-12/31/2034 |
| EP FOR TPWL 35 SOUTH | TP035 EP535 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 05/15/2018 | Yes | 01/01/2020-12/31/2022 |

DEQ Montana Department of Environmental Quality

# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

## TREATMENT PLANT FOR WELL 35 SOUTHGATE MALL

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TPWL 35 SOUTH | TP035 EP535 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 05/15/2018 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WELL 4 S 6TH ST W

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR WELL 4 S 6TH | TP004 EP504 | ARSENIC | 1 | Every 3 Years | 10/10/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR WELL 4 S 6TH | TP004 EP504 | NITRATE NITRITE | 1 | Yearly | 09/19/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR WELL 4 S 6TH | TP004 EP504 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 10/10/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR WELL 4 S 6TH | TP004 EP504 | RAD GROSS ALPHA | 1 | Every 9 Years | 10/19/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR WELL 4 S 6TH | TP004 EP504 | RADIUMS COMBINED | 1 | Every 9 Years | 10/19/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR WELL 4 S 6TH | TP004 EP504 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 09/21/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR WELL 4 S 6TH | TP004 EP504 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 09/21/2016 | No | 01/01/2017-12/31/2019 |

## TREATMENT PLANT FOR WELL 8 SCHILLING ST

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TP WL 8 SCHIL | TP008 EP508 | ARSENIC | 1 | Every 3 Years | 05/23/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TP WL 8 SCHIL | TP008 EP508 | NITRATE NITRITE | 1 | Yearly | 05/23/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TP WL 8 SCHIL | TP008 EP508 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 05/23/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TP WL 8 SCHIL | TP008 EP508 | RAD GROSS ALPHA | 1 | Every 9 Years | 06/27/2018 | Yes | 01/01/2026-12/31/2034 |
| EP FOR TP WL 8 SCHIL | TP008 EP508 | RADIUMS COMBINED | 1 | Every 9 Years | 06/27/2018 | Yes | 01/01/2026-12/31/2034 |
| EP FOR TP WL 8 SCHIL | TP008 EP508 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 05/23/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TP WL 8 SCHIL | TP008 EP508 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 05/23/2018 | Yes | 01/01/2020-12/31/2022 |

# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

## TREATMENT PLANT FOR WELL 9 DIXON AVENUE

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TP WL 9 DIXON | TP009 EP509 | ARSENIC | 1 | Every 3 Years | 05/15/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TP WL 9 DIXON | TP009 EP509 | NITRATE NITRITE | 1 | Yearly | 05/15/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR TP WL 9 DIXON | TP009 EP509 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 05/15/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TP WL 9 DIXON | TP009 EP509 | RAD GROSS ALPHA | 1 | Every 9 Years | 06/27/2018 | Yes | 01/01/2026-12/31/2034 |
| EP FOR TP WL 9 DIXON | TP009 EP509 | RADIUMS COMBINED | 1 | Every 9 Years | 06/27/2018 | Yes | 01/01/2026-12/31/2034 |
| EP FOR TP WL 9 DIXON | TP009 EP509 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 05/15/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR TP WL 9 DIXON | TP009 EP509 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 05/15/2018 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT FOR WLS 023 AND 024 PATTEE CRK WELLS

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR WLS 023 024 | TP023 EP523 | ARSENIC | 1 | Every 3 Years | 07/18/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR WLS 023 024 | TP023 EP523 | NITRATE NITRITE | 1 | Yearly | 07/18/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR WLS 023 024 | TP023 EP523 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 07/18/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR WLS 023 024 | TP023 EP523 | RAD GROSS ALPHA | 1 | Every 9 Years | 07/18/2018 | Yes | 01/01/2026-12/31/2034 |
| EP FOR WLS 023 024 | TP023 EP523 | RADIUMS COMBINED | 1 | Every 9 Years | 09/05/2018 | Yes | 01/01/2023-12/31/2031 |
| EP FOR WLS 023 024 | TP023 EP523 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 07/18/2018 | Yes | 01/01/2020-12/31/2022 |
| EP FOR WLS 023 024 | TP023 EP523 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 07/18/2018 | Yes | 01/01/2020-12/31/2022 |

## TREATMENT PLANT WELL 13

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TP013 | TP013 EP513 | ARSENIC | 1 | Every 3 Years | 11/09/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TP013 | TP013 EP513 | NITRATE NITRITE | 1 | Yearly | 09/12/2018 | Yes | 01/01/2019-12/31/2019 |

# Public Water Supply Monitoring Schedule

Report Generated on: 12/14/2018

Standard Monitoring Framework: 2ND YR OF 3YR 2017-19; 8TH YR OF 9YR 2011-19

| | | | | | |
|---|---|---|---|---|---|
| **Public Water Supply ID No.** | **MT0000294** | **Water System Name** | **MISSOULA WATER** | | |
| **Principle County Served** | **MISSOULA** | **Primary Water Source** | **GROUND WATER** | **Class**** | **COMMUNITY** |
| **Number of Connections** | **23972** | **Population** | **56335** | | |

## TREATMENT PLANT WELL 13

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR TP013 | TP013 EP513 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 11/09/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TP013 | TP013 EP513 | RAD GROSS ALPHA | 1 | Every 9 Years | 02/17/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TP013 | TP013 EP513 | RADIUMS COMBINED | 1 | Every 9 Years | 02/17/2016 | No | 01/01/2017-12/31/2025 |
| EP FOR TP013 | TP013 EP513 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 09/28/2016 | No | 01/01/2017-12/31/2019 |
| EP FOR TP013 | TP013 EP513 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 10/18/2016 | No | 01/01/2017-12/31/2019 |

## WELL 24 1955 PATTEE CK 50 HP GWIC 69412

| Sample Point Name | Sample Label | Analyte Group Name | Sample Count Require | Sample Frequency | Date Last Taken | Current Monitorin Period Satisfied? | Next Collection Period |
|---|---|---|---|---|---|---|---|
| EP FOR WELL 24 | WL024 EP524 | ARSENIC | 1 | Every 3 Years | 10/11/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR WELL 24 | WL024 EP524 | NITRATE NITRITE | 1 | Yearly | 09/11/2018 | Yes | 01/01/2019-12/31/2019 |
| EP FOR WELL 24 | WL024 EP524 | PHASE2-5 INORGANICS | 1 | Every 3 Years | 10/11/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR WELL 24 | WL024 EP524 | RAD GROSS ALPHA | 1 | Every 6 Years | 04/30/2014 | No | 01/01/2017-12/31/2022 |
| EP FOR WELL 24 | WL024 EP524 | RADIUMS COMBINED | 1 | Every 9 Years | 04/30/2014 | No | 01/01/2017-12/31/2025 |
| EP FOR WELL 24 | WL024 EP524 | SYNTHETIC ORGANIC COMPOUNDS REGULATED | 1 | Every 3 Years | 11/01/2017 | Yes | 01/01/2020-12/31/2022 |
| EP FOR WELL 24 | WL024 EP524 | VOLATILE ORGANIC COMPOUNDS | 1 | Every 3 Years | 11/01/2017 | Yes | 01/01/2020-12/31/2022 |

**Distribution System** - The delivery system of water available for a water system. This includes all of the pipes and devices that provide water to the fixtures. For example: Water mains, service lines, hydrants and business or residential plumbing.
**Entry Point** - The point at which water is discharged into the distribution system from a well, storage tank, pressure tank, clear well, or water treatment plant. Usually this is not part of the distribution system. However, if there is no available sample tap prior to the first service from the source or treatment plant, the first service may be used as an entry point.
**Raw Water** - Directly from the source prior to treatment
**Quarter Key** - 1QT - January-March, 2QT April-June, 3QT July-September, 4QT October-December

***Inorganic/SOC/VOC Waiver Renewal**: Must monitor in the First 3 year period of the new monitoring cycle. Proof of public notice is required.
****The Consumer Confidence Report** (CCR) is only required for Community Systems. The CCR is due to DEQ by June 30. The CCR Certification Form is due to DEQ by September 30.

# Appendix E

# Hydraulic Modeling Supporting Documentation

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# Appendix E - Existing Hydraulic Model Quality Control / Quality Assurance

HDR received an existing InfoWater ® hydraulic model from the City to use as the basis for water system analysis. HDR performed a quality control/quality assurance (QA/QC) check on the existing model to detect inaccuracies and errors. HDR's QA/QC protocol is used to further define boundary conditions (i.e. tank levels, pump station discharge pressures, PRV settings), determine network connectivity issues, and ensure proper pressure zone isolation. The QA/QC process uncovered some errors that were resolved:

- Head and flow were reversed for pumps B26a, 26b, and 26c
- Phantom pipe P749 was removed from model. The map and the database became disjointed and a synchronization was necessary.
- Pipe M1103 was closed to isolate the Upper Linda Vista Zone and the PRV Gharrett Zone
- 4 duplicate pipes were found in the active network:
  - Pipe 255 and pipe 234 were duplicated. Pipe 255 was removed.
  - Pipe P1885 and pipe P1887 were duplicated. Pipe P1887 was removed.
- There were 11 network issues that affected the hydraulic model:
  - 1. M1082 in the model, which was combined with M2122in the GIS needs to be split at J21254 and J17470 (this needs to be reflected in the GIS as well).
  - 2. M3512 was removed from the model, which resolved connectivity issue with M3511.
  - 3. P1231 was removed (duplicate pipe) and node J27728 was removed.
  - 4. M603 was removed (duplicate pipe) and node J22276 was removed.
  - 5. P953 was removed (duplicate pipe) and node J27694 was removed.
  - 6. P883 was removed (duplicate pipe) and node J27668 was removed.
  - 7. P1449 was modified to fix connectivity issue with J26618.
  - 8. M3512 was removed from the model, which resolved connectivity issue with P771 (Related to Issue No. 2).
  - 9. M2403 was removed (duplicate pipe) and node J17752 was removed, which resolved connectivity issues with P839.
  - 10. M2403 was removed (duplicate pipe) and node J17752 was removed to fix connectivity issues with P877.
  - 11. P1135 was removed (duplicate pipe) and node J27690 was removed to fix connectivity issues with P945.
- There are 24 additional network inconsistencies that were identified that are not hydraulically significant, but could be reconciled in the GIS.

## *Static Calibration Results*

| Pressure Zone | < 5 psi | 5 - 10 psi | >10 psi | Percent Calibrated |
|---|---|---|---|---|
| EAST MISSOULA (PZ9) | 38 | 1 | 1 | 97.5% |
| FOX FARM/TIMBERLANE (PZ33) | 16 | | | 100.0% |
| GHARRETT (PZ16) | 2 | 2 | | 100.0% |
| HIGH PARK (PZ10) | 22 | 2 | | 100.0% |
| HILLVIEW (PZ12) | 18 | 3 | | 100.0% |
| LOWER ELK RIDGE (PZ14) | 8 | 2 | | 100.0% |
| LOWER FAIRVIEWS (PZ19) | 14 | 5 | | 100.0% |
| LOWER LINCOLN HILLS (PZ17) | 15 | | | 100.0% |
| LOWER LINDA VISTA (PZ6) | 14 | | | 100.0% |
| MANSION HEIGHTS (PZ15) | 1 | 3 | 1 | 80.0% |
| NORTH (PZ1) | 433 | 6 | 2 | 99.5% |
| PRV FOOTHILLS/23RD (PZ22) | 4 | | | 100.0% |
| PRV FT MISSOULA (PZ47) | 9 | 2 | | 100.0% |
| PRV GHARRETT (PZ26) | 1 | | | 100.0% |
| PRV HELENA DRIVE (PZ36) | 4 | | | 100.0% |
| PRV HIGHLAND PARK/CRESTLINE (PZ4 | 6 | 1 | | 100.0% |
| PRV LINCOLN HILLS (PZ35) | 3 | 3 | 1 | 85.7% |
| PRV LONGVIEW/GRANDVIEW (PZ24) | 9 | 9 | | 100.0% |
| PRV MARK COURT (PZ43) | 6 | | | 100.0% |
| PRV MILLER CRK @ JEFF RD (PZ44) | 11 | | | 100.0% |
| PRV MOUNTAIN VIEW (PZ32) | 3 | 1 | | 100.0% |
| PRV OLD QUARRY (PZ21) | 5 | | | 100.0% |
| PRV PAUL LN/JACK DR (PZ42) | 17 | 1 | | 100.0% |
| PRV PROSPECT @ ARGENTA (PZ38) | 3 | | | 100.0% |
| PRV PROSPECT @ KLONDIKE (PZ39) | 3 | | | 100.0% |
| PRV RICHARD STREET (PZ31) | 8 | | | 100.0% |
| PRV WESTVIEW (PZ29) | 2 | | 1 | 66.7% |
| PRV WHITAKER @ PARKVIEW (PZ28) | 2 | | | 100.0% |
| PRV WHITAKER @ PINTLAR MTN (PZ45 | 5 | 7 | 2 | 85.7% |
| PRV WHITAKER/MANSION HTS (PZ46) | 1 | 2 | 4 | 42.9% |
| RATTLESNAKE (PZ2) | 26 | 5 | 3 | 91.2% |
| SKYVIEW (PZ4) | 39 | 4 | 1 | 97.7% |
| SOUTH (PZ3) | 302 | 198 | 2 | 99.6% |
| ST THOMAS/ST FRANCIS (PZ25) | 7 | | | 100.0% |
| UPPER FAIRVIEWS (PZ13) | 16 | 4 | | 100.0% |
| UPPER HILLVIEW (PZ20) | 2 | 2 | | 100.0% |
| UPPER LINCOLN HILLS (PZ11) | 3 | 1 | | 100.0% |
| UPPER LINDA VISTA (PZ7) | 26 | 1 | | 100.0% |
| UPPER PROSPECT (PZ8) | 5 | 5 | 1 | 90.9% |
| Grand Total | 1109 | 270 | 19 | 98.6% |

# Static Calibration

| Pressure Zone | < 5 psi | 5 - 10 psi | >10 psi | Percent Calibrated |
|---|---|---|---|---|
| EAST MISSOULA (PZ9) | 38 | 1 | 1 | 97.5% |
| FOX FARM/TIMBERLANE (PZ33) | 16 | | | 100.0% |
| GHARRETT (PZ16) | 2 | 2 | | 100.0% |
| HIGH PARK (PZ10) | 22 | 2 | | 100.0% |
| HILLVIEW (PZ12) | 18 | 3 | | 100.0% |
| LOWER ELK RIDGE (PZ14) | 8 | 2 | | 100.0% |
| LOWER FAIRVIEWS (PZ19) | 14 | 5 | | 100.0% |
| LOWER LINCOLN HILLS (PZ17) | 15 | | | 100.0% |
| LOWER LINDA VISTA (PZ6) | 14 | | | 100.0% |
| MANSION HEIGHTS (PZ15) | 1 | 3 | 1 | 80.0% |
| NORTH (PZ1) | 433 | 6 | 2 | 99.5% |
| PRV FOOTHILLS/23RD (PZ22) | 4 | | | 100.0% |
| PRV FT MISSOULA (PZ47) | 9 | 2 | | 100.0% |
| PRV GHARRETT (PZ26) | 1 | | | 100.0% |
| PRV HELENA DRIVE (PZ36) | 4 | | | 100.0% |
| PRV HIGHLAND PARK/CRESTLINE (PZ4 | 6 | 1 | | 100.0% |
| PRV LINCOLN HILLS (PZ35) | 3 | 3 | 1 | 85.7% |
| PRV LONGVIEW/GRANDVIEW (PZ24) | 9 | 9 | | 100.0% |
| PRV MARK COURT (PZ43) | 6 | | | 100.0% |
| PRV MILLER CRK @ JEFF RD (PZ44) | 11 | | | 100.0% |
| PRV MOUNTAIN VIEW (PZ32) | 3 | 1 | | 100.0% |
| PRV OLD QUARRY (PZ21) | 5 | | | 100.0% |
| PRV PAUL LN/JACK DR (PZ42) | 17 | 1 | | 100.0% |
| PRV PROSPECT @ ARGENTA (PZ38) | 3 | | | 100.0% |
| PRV PROSPECT @ KLONDIKE (PZ39) | 3 | | | 100.0% |
| PRV RICHARD STREET (PZ31) | 8 | | | 100.0% |
| PRV WESTVIEW (PZ29) | 2 | | 1 | 66.7% |
| PRV WHITAKER @ PARKVIEW (PZ28) | 2 | | | 100.0% |
| PRV WHITAKER @ PINTLAR MTN (PZ45 | 5 | 7 | 2 | 85.7% |
| PRV WHITAKER/MANSION HTS (PZ46) | 1 | 2 | 4 | 42.9% |
| RATTLESNAKE (PZ2) | 26 | 5 | 3 | 91.2% |
| SKYVIEW (PZ4) | 39 | 4 | 1 | 97.7% |
| SOUTH (PZ3) | 302 | 198 | 2 | 99.6% |
| ST THOMAS/ST FRANCIS (PZ25) | 7 | | | 100.0% |
| UPPER FAIRVIEWS (PZ13) | 16 | 4 | | 100.0% |
| UPPER HILLVIEW (PZ20) | 2 | 2 | | 100.0% |
| UPPER LINCOLN HILLS (PZ11) | 3 | 1 | | 100.0% |
| UPPER LINDA VISTA (PZ7) | 26 | 1 | | 100.0% |
| UPPER PROSPECT (PZ8) | 5 | 5 | 1 | 90.9% |
| Grand Total | 1109 | 270 | 19 | 98.6% |
| EAST MISSOULA (PZ9) | 38 | 1 | 1 | 97.5% |
| FOX FARM/TIMBERLANE (PZ33) | 16 | | | 100.0% |
| GHARRETT (PZ16) | 2 | 2 | | 100.0% |
| HIGH PARK (PZ10) | 22 | 2 | | 100.0% |
| HILLVIEW (PZ12) | 18 | 3 | | 100.0% |
| LOWER ELK RIDGE (PZ14) | 8 | 2 | | 100.0% |

Static Calibration

| | | | | |
|---|---|---|---|---|
| LOWER FAIRVIEWS (PZ19) | 14 | 5 | | 100.0% |
| LOWER LINCOLN HILLS (PZ17) | 15 | | | 100.0% |
| LOWER LINDA VISTA (PZ6) | 14 | | | 100.0% |

# Fire Flow Calibration

| Pressure Zone | ID | Field Pressure Drop (psi) | Model Pressure Drop (psi) | Delta (Model - Field) |
|---|---|---|---|---|
| North (PZ1) | H753 | 8 | 4 | -4 |
| North (PZ1) | J15748 | 14 | 12 | -2 |
| North (PZ1) | H480 | 11 | 12 | 1 |
| North (PZ1) | H114 | 16 | 16 | 0 |
| North (PZ1) | H1072 | 8 | 4 | -4 |
| EAST MISSOULA (PZ9) | H1324 | 18 | 14 | -4 |
| EAST MISSOULA (PZ9) | H507 | 12 | 8 | -4 |
| EAST MISSOULA (PZ9) | H692 | 10 | 10 | 0 |
| RATTLESNAKE (PZ2) | H549 | 19 | 17 | -2 |
| RATTLESNAKE (PZ2) | H708 | 8 | 4 | -4 |
| RATTLESNAKE (PZ2) | H660 | 8 | 3 | -5 |
| SOUTH (PZ3) | H1349 | 15 | 13 | -2 |
| SOUTH (PZ3) | H1470 | 13 | 10 | -3 |
| SOUTH (PZ3) | H295 | 6 | 9 | 3 |
| SOUTH (PZ3) | H729 | 14 | 13 | -1 |
| SOUTH (PZ3) | H228 | 5 | 7 | 2 |
| PRV MISSOULA (PZ47) | H869 | 25 | 9 | -16 |
| PRV MISSOULA (PZ47) | H875 | 14 | 9 | -5 |
| SKYVIEW (PZ4) | H9471 | 11 | 12 | 1 |
| SKYVIEW (PZ4) | H856 | 26 | 21 | -5 |
| SKYVIEW (PZ4) | H958 | 46 | 44 | -2 |
| LOWER LINDA VISTA (PZ6) | H1006 | 11 | 14 | 3 |
| LOWER LINDA VISTA (PZ6) | H1276 | 35 | 33 | -2 |
| UPPER LINDA VISTA (PZ7) | H1478 | 9 | 9 | 0 |
| PRV OLD QUARRY (PZ21) | H1116 | 14 | 18 | 4 |
| PRV PROSPECT @ ARGENTA (PZ38) | H1103 | 14 | 17 | 3 |
| UPPER PROSPECT (PZ8) | H1109 | 5 | 2 | -3 |
| PRV PROSPECT @ KLONDIKE (PZ39) | H1106 | 11 | 10 | -1 |
| HIGH PARK (PZ10) | H315 | 3 | 2 | -1 |
| HIGH PARK (PZ10) | H746 | 16 | 15 | -1 |
| LOWER ELK RIDGE (PZ14) | H570 | 13 | 20 | 7 |
| LOWER LINCOLN HILLS (PZ17) | H675 | 19 | 19 | 0 |
| PRV LINCOLN HILLS (PZ35) | H560 | 47 | 51 | 4 |
| UPPER LINCOLN HILLS (PZ11) | H580 | 23 | 26 | 3 |
| HILLVIEW (PZ12) | H922 | 10 | 14 | 4 |
| LOWER FAIRVIEWS (PZ19) | H426 | 5 | 8 | 3 |
| UPPER FAIRVIEWS (PZ13) | H431 | 7 | 5 | -2 |
| MANSION HEIGHTS (PZ15) | H315 | 7 | 5 | -2 |
| PRV WHITAKER @ PINTLAR MTN (PZ45) | H1036 | 15 | 16 | 1 |
| PRV WHITAKER/MANSION HTS (PZ46) | H1236 | 16 | 14 | -2 |
| PRV WESTVIEW (PZ29) | H454 | 12 | 15 | 3 |
| PRV WHITAKER @ PARKVIEW (PZ28) | H378 | 36 | 45 | 9 |
| GHARRETT (PZ16) | H400 | 11 | 17 | 6 |
| UPPER HILLVIEW (PZ20) | H902 | 36 | 36 | 0 |
| PRV FOOTHILLS/23RD (PZ22) | H401 | 13 | 10 | -3 |
| PRV LONGVIEW/GRANDVIEW (PZ24) | H918 | 29 | 29 | 0 |

# Fire Flow Calibration

| | | | | |
|---|---|---|---|---|
| PRV LONGVIEW/GRANDVIEW (PZ24) | H924 | 15 | 18 | 3 |
| ST THOMAS/ST FRANCIS (PZ25) | H956 | 14 | 23 | 9 |
| PRV GHARRETT (PZ26) | H393 | 10 | 10 | 0 |
| PRV STEVENS (PZ30) | No Flow Tests | | | |
| PRV RICHARD STREET (PZ31) | H44 | 20 | 19 | -1 |
| PRV MOUNTAIN VIEW (PZ32) | H567 | 30 | 30 | 0 |
| FOX FARM/TIMBERLANE (PZ33) | H539 | 17 | 16 | -1 |
| FOX FARM/TIMBERLANE (PZ33) | H620 | 30 | 34 | 4 |
| PRV HELENA DRIVE (PZ36) | JH1089 | 24 | 25 | 1 |
| PRV PAUL LN/JACK DR (PZ42) | H966 | 14 | 11 | -3 |
| PRV PAUL LN/JACK DR (PZ42) | H1262 | 20 | 15 | -5 |
| PRV MARK COURT (PZ43) | H1013 | 18 | 17 | -1 |
| PRV MARK COURT (PZ43) | H854 | 26 | 21 | -5 |
| PRV MILLER CRK @ JEFF RD (PZ44) | H1409 | 14 | 14 | 0 |
| PRV HIGHLAND PARK/CRESTLINE (PZ48) | H451 | 27 | 29 | 2 |

## Table E-1. Required Fire Flows by Fire Marshal

| wSystemID[a.] | Project Name | Property Type | Required Fire Flow (gpm)[b.c.] |
|---|---|---|---|
| FF2 | S 3rd/S 7th/Tower/Grove | Residential | 1500 |
| FF3 | Lorraine South County | Residential | 500 |
| FF4 | Dickinson 1A | Condos | 1000 |
| FF5 | Msla Federal Credit Union - Russell St | Commercial | 2250 |
| FF6 | Msla Federal Credit Union - Russell St | Commercial | 1000 |
| FF7 | Clizbe PNC | Condos | 1000 |
| FF8 | Hellgate Elementary | Commercial | 2000 |
| FF9 | FH at Mount / Reserve | Commercial | 1000 |
| FF10 | FH for Lower Estates - Fox Hollow | Residential | 1000 |
| FF11 | The Hub - Expressway | Commercial | 2500 |
| FF12 | The Hub - Expressway | Commercial | 1500 |
| FF13 | E Msla Addition - Iowa Ave | Residential | 975 |
| FF14 | Schoolhouse PNC | Townhouses | 1500 |
| FF15 | Reno Casino | Trailer Park | 1500 |
| FF16 | Howard Raser / Hobbs Lane | Commercial | 2100 |
| FF17 | Hylton Main Extension | Commercial | 1430 |
| FF19 | River Place Subdivision | Residential | 1000 |
| FF20 | Eaton / Agnes townhomes | Townhouses | 1500 |
| FF21 | The Haven - 39th Street | Residential | 1000 |
| FF22 | Larkinwood | Residential | 1000 |
| FF23 | FH on 27th Ave | Residential | 1000 |
| FF24 | Cheyenne Ln | Residential | 1000 |
| FF25 | Water's Edge | Townhouses | 1000 |
| FF26 | Grove St Manor | Residential | 1000 |
| FF27 | Twite / Maloney | Residential | 1000 |
| FF28 | Twite / Maloney | Residential | 1000 |

| | | | |
|---|---|---|---|
| FF29 | Meadowwood Condos | Condos | 1000 |
| FF30 | Costco | Commercial | 3500 |
| FF31 | Liberty Lane Equinox | AptComplex | 1000 |
| FF32 | Wilson Heights - 39th Street | AptComplex | 1500 |
| FF33 | Mullan Ranch Apts | AptComplex | 1500 |
| FF35 | Windsor Park Phase VII, Phase 2 | Residential | 1000 |
| FF36 | HOYT/MOSTAD | | 1500 |
| FF37 | Linda Vista 13th Supplement | Residential | 1500 |
| FF38 | Linnea Lane | Townhouses | 1500 |
| FF39 | Trail St | Townhouses | 1500 |
| FF40 | Canyon River, Phase 3-5 | Residential | 1000 |
| FF41 | Russell St | Apartment Cpx | 1500 |
| FF44 | The Cottages | Townhouses | 1500 |
| FF45 | Flynn Ranch Subdivision Phase 2 | Residential | 1500 |
| FF46 | Garden Dist Homes | Apartment Cpx | 2000 |
| FF47 | Silver Park | Residential | 1500 |
| FF48 | South Crossing | Commercial | 1500 |
| FF49 | Missoula Recovery Center | | 1500 |
| FF50 | Gilbert Ave | Residential | 1000 |
| FF449 | 44 Ranch | Residential | 1500 |
| FF18 | Flynn Ranch Subdivision | Residential | 1000 |
| FF450 | The Terraces | Residential | 1000 |
| FF451 | My Place Hotel | Hotel | 1500 |
| FF851 | Rattlesnake Townhomes | Residential | 1000 |
| FF852 | Bretz | Commercial | 1500 |
| FF853 | Consumer Direct | Commercial | 1500 |
| FF1 | S 3rd/S 7th/Tower/Grove | Residential | 1000 |
| FF855 | Water Wheel | Residential | 1000 |
| FF1251 | FORT MISSOULA REGIONAL PARK | | 1000 |

| | | | |
|---|---|---|---|
| FF1252 | 44 Ranch | Residential | 1000 |
| FF1253 | Crestview Heights | Townhouses | 1000 |
| FF1254 | Windsor Park | Residential | 1000 |
| FF1255 | Silvertip Apartments | Apartment Cpx | 1500 |
| FF1256 | The Aspens Townhomes | Townhouses | 1000 |
| FF1257 | Scott Street Village | Townhouses | 1500 |
| FF1652 | MISSOULA COLLEGE | | 1500 |
| FF1653 | Springfield Townhome | Townhouses | 2000 |
| FF1654 | Halling Farms Apts | Apartment Cpx | 1500 |
| FF2055 | Canyon River, Phase 6-7 | Residential | 1000 |
| FF2056 | GARDEN CITY PLUMBING | Commercial | 3000 |
| FF2454 | Sirens Townhomes | Residential | 1000 |
| FF2854 | RANKIN SCHOOL | Commercial | 1500 |
| FF3254 | Holler Townhomes | Residential | 1000 |
| FF3654 | East Village Homes | Residential | 1000 |
| FF3655 | Teddy Turn | Residential | 1000 |
| FF3656 | Cowboy Flats | Residential | 1000 |
| FF3657 | Invermere PH2A | Residential | 1000 |

Notes:

a.) wSystemID is a GIS identifier and corresponds to locations shown on Figure 6-2.
b.) All fire flow durations are assumed to be 2 hour minimum, unless otherwise specified.
c.) The City tracks the required fire flow typically provided in a letter from the fire marshal.

Table E-2. Recommended C Factors per Pressure Zone

| Material | PZ-1 | PZ-2 | PZ-3 | PZ-4 | PZ-6 | PZ-7 | PZ-8 | PZ-9 | PZ-10 | PZ-11 | PZ-12 | PZ-13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DI | 128 | 128 | 92 | 120 | 120 | 120 | 128 | 128 | 92 | N/A | 120 | 128 |
| CI | 101 | 101 | 80 | N/A | N/A | N/A | N/A | 101 | N/A | N/A | N/A | N/A |
| CPK | 95 | N/A | 116 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| CPST | 83 | N/A | 104 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| HDPE | 140 | 140 | 140 | N/A | N/A | N/A | N/A | 140 | N/A | N/A | N/A | N/A |
| PVC | 147 | 147 | 135 | 147 | 135 | 135 | 147 | 147 | 135 | 147 | 147 | 135 |
| ST | 113 | 113 | 119 | 120 | N/A | N/A | N/A | 113 | 119 | N/A | 113 | 119 |
| GVST | 120 | 120 | 98 | 106 | 106 | 106 | 120 | 120 | N/A | 106 | N/A | N/A |
| STC | N/A | 113 | 110 | 113 | N/A | N/A | N/A | 113 | 110 | 113 | N/A | 113 |
| SLC | N/A | 113 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AC | N/A | N/A | 125 | 120 | N/A | N/A | N/A | N/A | 125 | N/A | 120 | 120 |
| K | N/A | N/A | 89 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| PE | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 130 | N/A | N/A |

Table E-2. Recommended C Factors per Pressure Zone

| Material | PZ-14 | PZ-15 | PZ-16 | PZ-17 | PZ-18 | PZ-19 | PZ-20 | PZ-21 | PZ-22 | PZ-23 | PZ-24 | PZ-25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DI | 128 | 128 | 92 | 128 | 128 | 92 | 120 | 128 | 92 | 120 | 120 | 120 |
| CI | N/A | N/A | 80 | N/A | N/A | 101 | N/A | N/A | N/A | N/A | N/A | N/A |
| CPK | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| CPST | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| HDPE | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| PVC | N/A | 135 | 135 | 147 | 147 | 135 | 147 | 147 | 135 | 107 | 107 | 147 |
| ST | 113 | 119 | 119 | 113 | 113 | 119 | 113 | 113 | 119 | N/A | N/A | N/A |
| GVST | 120 | N/A | N/A | 120 | 120 | N/A | N/A | 120 | 98 | N/A | 106 | 106 |
| STC | 113 | N/A | 110 | 113 | 113 | 110 | N/A | N/A | 110 | 113 | N/A | N/A |
| SLC | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AC | N/A | N/A | N/A | N/A | N/A | 125 | 120 | N/A | N/A | N/A | 120 | N/A |
| K | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| PE | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Table E-2. Recommended C Factors per Pressure Zone

| Material | PZ-26 | PZ-27 | PZ-28 | PZ-29 | PZ-30 | PZ-31 | PZ-32 | PZ-33 | PZ-35 | PZ-36 | PZ-38 | PZ-39 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DI | 120 | 120 | 92 | N/A | N/A | 128 | N/A | 128 | 128 | 120 | 128 | 128 |
| CI | N/A | N/A | N/A | N/A | N/A | 101 | 101 | N/A | N/A | N/A | N/A | N/A |
| CPK | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| CPST | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| HDPE | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| PVC | 147 | N/A | 147 | 135 | N/A | 147 | N/A | 147 | 147 | 147 | 147 | 147 |
| ST | N/A | 120 | 119 | N/A | N/A | 113 | 113 | 113 | N/A | 120 | 113 | N/A |
| GVST | 106 | N/A | 120 | 120 | N/A | 120 | N/A | 120 | 120 | N/A | 120 | 120 |
| STC | 113 | 113 | 113 | 110 | 113 | N/A | 113 | 113 | 125 | N/A | N/A | N/A |
| SLC | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AC | N/A | N/A | N/A | 125 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| K | N/A | N/A | N/A | N/A | N/A | 89 | N/A | N/A | N/A | N/A | N/A | N/A |
| PE | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Table E-2. Recommended C Factors per Pressure Zone

| Material | PZ-42 | PZ-43 | PZ-44 | PZ-45 | PZ-46 | PZ-47 | PZ-48 |
|---|---|---|---|---|---|---|---|
| DI | 120 | N/A | 120 | 128 | 128 | 92 | 92 |
| CI | N/A | N/A | N/A | N/A | N/A | 80 | N/A |
| CPK | N/A | N/A | N/A | N/A | N/A | 116 | N/A |
| CPST | N/A | N/A | N/A | N/A | N/A | 104 | N/A |
| HDPE | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| PVC | 147 | 135 | N/A | 135 | 135 | 135 | 147 |
| ST | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| GVST | N/A | 106 | N/A | 120 | 120 | 98 | 106 |
| STC | N/A | N/A | N/A | N/A | N/A | N/A | 110 |
| SLC | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AC | N/A | N/A | N/A | N/A | N/A | 125 | 125 |
| K | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| PE | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

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# Appendix F

# Supply and Demand Analysis

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| Pump/Well # | Type | Pressure Zone | Avg. Flow (GPM) | Total Flow (GPM) | Firm Capacity (GPM) |
|---|---|---|---|---|---|
| 19 | Well | North | 1190 | | |
| 30 | Well | North | 3267 | | |
| 31 | Well | North | 3258 | | |
| 32 | Well | North | 3540 | | |
| 17 | Well | North | 985 | | |
| 41 | Well | North | 1102 | | |
| 42 | Well | North | 1133 | **14476** | 10936 |
| 4 | Well | East Missoula | 464 | | |
| 12 | Well | East Missoula | 470 | | |
| 43 | Well | East Missoula | 593 | | |
| B20A | Booster | East Missoula | 534 | | |
| B20B | Booster | East Missoula | 521 | **2583** | 1989 |
| 13 | Well | Rattlesnake/PRV Richard St | 700 | | |
| B13A | Booster | Rattlesnake/PRV Richard St | 1659 | | |
| B13B | Booster | Rattlesnake/PRV Richard St | 1864 | | |
| B13C | Booster | Rattlesnake/PRV Richard St | 937 | **5160** | 3296 |
| B24A | Booster | PRV Old Quarry | 210 | | |
| B24B | Booster | PRV Old Quarry | 350 | | |
| B24C | Booster | PRV Old Quarry | 350 | **910** | 560 |
| B14A | Booster | Lower Lincoln Hills/PRV Mountainview | 979 | | |
| B14B | Booster | Lower Lincoln Hills/PRV Mountainview | 994 | **1973** | 979 |
| B2A | Booster | Lower Elk Ridge/PRV Fox Farm/Timberlane | 628 | | |
| B2B | Booster | Lower Elk Ridge/PRV Fox Farm/Timberlane | 540 | | |
| B2C | Booster | Lower Elk Ridge/PRV Fox Farm/Timberlane | 382 | **1550** | 922 |
| B7A | Booster | Upper Lincoln Hills/PRV Lincoln Hills Dr System | 475 | | |
| B7B | Booster | Upper Lincoln Hills/PRV Lincoln Hills Dr System | 491 | | |
| B7C | Booster | Upper Lincoln Hills/PRV Lincoln Hills Dr System | 208 | **1174** | 683 |
| B6A | Booster | Upper Elk Ridge | 100 | | |
| B6B | Booster | Upper Elk Ridge | 41 | **141** | 41 |
| B23A | Booster | Upper Prospect/PRV Argenta/PRV Klondkie | 358 | | |
| B23B | Booster | Upper Prospect/PRV Argenta/PRV Klondkie | 402 | | |
| B23C | Booster | Upper Prospect/PRV Argenta/PRV Klondkie | 326 | **1086** | 684 |
| ***North System*** | | | Total | **29052** | 20090.05715 |

| | | | | | |
|---|---|---|---|---|---|
| 1 | Well | South/PRV FT Missoula | 757 | | |
| 2 | Well | South/PRV FT Missoula | 1172 | | |
| 3A | Well | South/PRV FT Missoula | 968 | | |
| 3B | Well | South/PRV FT Missoula | 1985 | | |
| 8 | Well | South/PRV FT Missoula | 1090 | | |
| 9 | Well | South/PRV FT Missoula | 1091 | | |
| 10 | Well | South/PRV FT Missoula | 1236 | | |
| 33 | Well | South/PRV FT Missoula | 3419 | | |
| 34 | Well | South/PRV FT Missoula | 5726 | | |
| 35 | Well | South/PRV FT Missoula | 1674 | | |
| 11 | Well | South/PRV FT Missoula | 872 | | |
| 16 | Well | South/PRV FT Missoula | | | |
| 18 | Well | South/PRV FT Missoula | 937 | | |
| 20 | Well | South/PRV FT Missoula | 1082 | | |
| 21 | Well | South/PRV FT Missoula | 1194 | | |

| | | | | |
|---|---|---|---|---|
| 22 | Well | South/PRV FT Missoula | 1197 | |
| 26 | Well | South/PRV FT Missoula | 1084 | |
| 27 | Well | South/PRV FT Missoula | 514 | **25997** |
| 23 | Well | Lower Farviews/PRV Stephens | 194 | |
| 24 | Well | Lower Farviews/PRV Stephens | 306 | |
| 25 | Well | Lower Farviews/PRV Stephens | 618 | |
| B16 | Booster | Lower Farviews/PRV Stephens | 564 | **1682** |
| B15A | Booster | High Park System | 519 | |
| B15B | Booster | High Park System | 1719 | |
| B15C | Booster | High Park System | 1797 | |
| B4A | Booster | High Park System | 280 | |
| B4B | Booster | High Park System | 445 | **4760** |
| B5A | Booster | Upper Farview/PRV High Park Tank/PRV Highland Park/Crestline System/PRV Westview | 370 | |
| B5B | Booster | Upper Farview/PRV High Park Tank/PRV Highland Park/Crestline System/PRV Westview | 1194 | |
| B5C | Booster | Upper Farview/PRV High Park Tank/PRV Highland Park/Crestline System/PRV Westview | 1189 | |
| B8 | Booster | Upper Farview/PRV High Park Tank/PRV Highland Park/Crestline System/PRV Westview | 348 | **3100** |
| B26A | Booster | Mansion Heights/PRV Mansion Heights/PRV Pintlar Mountain | 116 | |
| B26B | Booster | Mansion Heights/PRV Mansion Heights/PRV Pintlar Mountain | 212 | |
| B26C | Booster | Mansion Heights/PRV Mansion Heights/PRV Pintlar Mountain | 256 | **584** |
| B1 | Booster | Gharrett | 444 | |
| 29 | Well | Gharrett | 946 | **1389** |
| 38 | Well | Skyview/PRV Foothills/23rd System/PRV Pinewood/PRV St Thomas/St Francis System/PRV Paul Lane/Jack Dr System | 1750 | |
| 39 | Well | Skyview/PRV Foothills/23rd System/PRV Pinewood/PRV St Thomas/St Francis System/PRV Paul Lane/Jack Dr System | 1605 | |
| B9A | Booster | Skyview/PRV Foothills/23rd System/PRV Pinewood/PRV St Thomas/St Francis System/PRV Paul Lane/Jack Dr System | 429 | |
| B9B | Booster | Skyview/PRV Foothills/23rd System/PRV Pinewood/PRV St Thomas/St Francis System/PRV Paul Lane/Jack Dr System | 564 | |
| B27A | Booster | Skyview/PRV Foothills/23rd System/PRV Pinewood/PRV St Thomas/St Francis System/PRV Paul Lane/Jack Dr System | 958 | |
| B27B | Booster | Skyview/PRV Foothills/23rd System/PRV Pinewood/PRV St Thomas/St Francis System/PRV Paul Lane/Jack Dr System | 950 | **6255** |
| B17A | Booster | Hillview/PRV Miller Creek/PRV Longview/Grandview/PRV 57th/PRV Gharrett | 696 | |
| B17B | Booster | Hillview/PRV Miller Creek/PRV Longview/Grandview/PRV 57th/PRV Gharrett | 771 | |
| B17C | Booster | Hillview/PRV Miller Creek/PRV Longview/Grandview/PRV 57th/PRV Gharrett | 1363 | |
| B17D | Booster | Hillview/PRV Miller Creek/PRV Longview/Grandview/PRV 57th/PRV Gharrett | 790 | |
| B25A | Booster | Hillview/PRV Miller Creek/PRV Longview/Grandview/PRV 57th/PRV Gharrett | 419 | |
| B25B | Booster | Hillview/PRV Miller Creek/PRV Longview/Grandview/PRV 57th/PRV Gharrett | 437 | **4475** |
| B18A | Booster | Upper Hillview | 100 | |
| B18B | Booster | Upper Hillview | 250 | |
| B18C | Booster | Upper Hillview | 250 | |
| B18D | Booster | Upper Hillview | 30 | **630** |
| 40A | Well | Lower Linda Vista/PRV Helena Dr | 204 | |
| 40B | Well | Lower Linda Vista/PRV Helena Dr | 212 | |
| 40C | Well | Lower Linda Vista/PRV Helena Dr | 202 | **618** |
| 45A | Well | Sophie (<Null>) | 1000 | |
| 45B | Well | Sophie (<Null>) | 1000 | |
| 45C | Well | Sophie (<Null>) | 770 | **2770** |
| B21A | Booster | Upper Linda Vista/PRV Mark Court/Shaver | 133 | |
| B21B | Booster | Upper Linda Vista/PRV Mark Court/Shaver | 110 | |
| B28A | Booster | Upper Linda Vista/PRV Mark Court/Shaver | 622 | |
| B28B | Booster | Upper Linda Vista/PRV Mark Court/Shaver | 622 | |
| B28C | Booster | Upper Linda Vista/PRV Mark Court/Shaver | 622 | **2109** |
| ***South/South Hills System*** | | | Total | **54368** |

# Appendix G

# Condition Assessment Inspection Reports

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## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B01 – Gharrett Street | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 3:50 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1992 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Located in back of a residential lawn |
| Buildings and Structures | 4 | Wood fence is not as secure as other fences at other facilities |
| Security | 3 | Wood fence is not as secure as other fences at other facilities |
| Power Distribution | 3 | Age. Portable standby power quick disconnects. |
| Electrical | 4 | New electrical |
| Instrumentation / Analyzers | 4 | Newer SCADA. Flow meter in vault so could not inspect |
| Pump | 0 | Pitless adapter so could not inspect. Info from city 9/2018 – pump rebuilt. |
| Motor | 0 | Pitless adapter so could not inspect, motor was rebuilt in 2016 |
| Piping | 0 | Piping is underground so could not inspect |
| Valves | 0 | Valves in vault so could not inspect |
| HVAC | N/A | Not applicable |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 3.7 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 22 years old |
| 2 | Access issues- electrical improvements may potentially require fence modifications to meet electrical code |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – | Photo 2 – |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B02 – Lower Elk ridge | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 2:40 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1966 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 2 | Site is close to 100 year floodplain of Rattlesnake Creek |
| Buildings and Structures | 3 | Building 48 years old and in fair shape |
| Security | 5 | Fence. Intrusion alarm and motion detectors and cameras. |
| Power Distribution | 4 | Portable new standby power hooked up to system |
| Electrical | 4 | Good shape and access |
| Instrumentation / Analyzers | 4 | Newer SCADA. Newer C12 residual meter |
| Pump | 3 | Pumps and motors appear to have been exchanged, but there is some corrosion. Info from city 9/2018 - #3 50 hp pump rebuilt. |
| Motor | 3 | See above |
| Piping | 3 | Corrosion on piping. Some spool pieces need coating. |
| Valves | 4 | Valves appear to have been exchanged recently |
| HVAC | 4 | No issues |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 3.5 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 48 years old |
| 2 | Site is close to 100 year flood plain. Need to verify. |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Site | Photo 2 – Site and flood plain |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B04 – High Park | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 12:00 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1979 |

## Condition Rankings

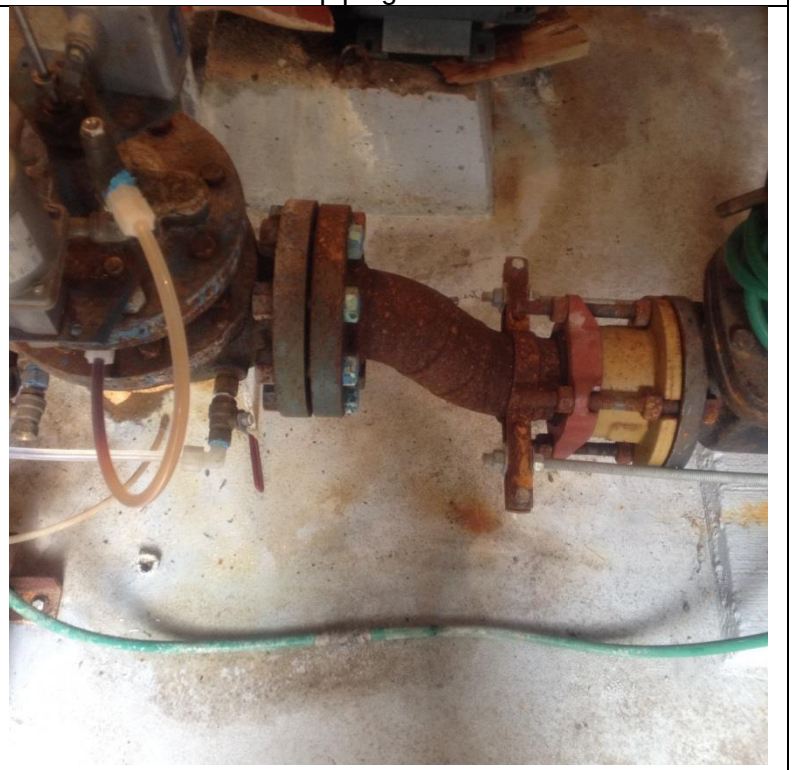
| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 2 | Access, drainage issues and close to creek. |
| Buildings and Structures | 3 | Older concrete structure. Some cracking in walls. |
| Security | 3 | No fence. Intrusion alarm and motion detectors. |
| Power Distribution | 3 | Age. Portable standby power quick disconnects. |
| Electrical | 3 | Access issues to electrical panels. Newer conduit, but older MCC, control cabinets, switchgear |
| Instrumentation / Analyzers | 3.5 | Newer SCADA. Older flow metering. Newer chlorine analyzer. |
| Pump | 2.5 | Three pumps. Pump A , B, C rehabs in 2001, 1984 and 2001 respectively. Pump foundations do not meet industry standards. |
| Motor | 3 | Three motors. Motor A (30 hp), B (30 hp), C (15 hp) rehabs in 2003, 2001, and 2010 respectively. |
| Piping | 2 | Corrosion on piping. Pipe supports do not meet industry standards. |
| Valves | 2 | No equipment history. Operations are satisfactory. Corrosion on valves. |
| HVAC | 2 | Age |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 2.6 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 35 years old |
| 2 | Site very close to creek and susceptible to flooding. |
| 3 | Access issues- electrical improvements may potentially require building modifications to meet electrical code |
| 4 | Site access is difficult. |
| 5 | |
| | |

## Photos

| Photo 1 – Well Building and site slopes | Photo 2 – Corrosion on piping and valves |
|---|---|
| |  |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B05 – Upper Farviews | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 11:00 am |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | Unknown |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Potential flooding of pitless adapters |
| Buildings and Structures | 4 | Precast concrete structure. Interior floors and walls recently painted. |
| Security | 4 | New fence. Intrusion alarm and motion detectors. |
| Power Distribution | 4 | New power distribution |
| Electrical | 4 | Newer electrical |
| Instrumentation / Analyzers | 4 | Newer SCADA. New flow metering. New chlorine analyzer. |
| Pump | 0 | Two pitless adapters so could not inspect |
| Motor | 0 | Two pitless adapters so could not inspect |
| Piping | 3 | Minor corrosion on piping |
| Valves | 3 | Newer valves. No equipment history. Operations are satisfactory. |
| HVAC | 4 | Newer HVAC system |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 3.7 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Need to remove risk of pitless adapters flooding. |
| 2 | Developer provided  facility. |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Pitless adapter | Photo 2 – |
|---|---|
| | |

# Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B06 – Upper Elk ridge | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 3:40 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1990 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Site is in good shape. New fence encloses Booster Station and Tank 8, Upper Elk Ridge. Access from road not good, need steps. |
| Buildings and Structures | 4 | Building 24 years old and in good shape |
| Security | 5 | Intrusion alarm and motion detectors. New fence. |
| Power Distribution | 4 | GenSet connection available |
| Electrical | 4 | Good shape and access |
| Instrumentation / Analyzers | 3.5 | Newer SCADA. Older residual meter. |
| Pump | 4 | Pumps and motors appear to have been exchanged recently |
| Motor | 4 | See above |
| Piping | 4 | Pipe appears to have been changed recently |
| Valves | 4 | Valves appear to have been exchanged recently |
| HVAC | 3 | Older heater |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 3.9 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 24 years old |
| 2 | Site is shared with Upper Elk Ridge Tank No. 8 |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Site with Tank No. 8 | Photo 2 – |
|---|---|
| | |
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B07 – Upper Lincoln Hills | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 4:00 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1991 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Small sight, uncertain about room for expansion. |
| Buildings and Structures | 4 | Building 23 years old and in good shape |
| Security | 5 | Intrusion alarm and motion detectors. New fence. |
| Power Distribution | 2 | Standby generator on –site. Connections are temporary. Need to make permanent. |
| Electrical | 3 | Good access. Hot 100v step down transformer (170 deg F) |
| Instrumentation / Analyzers | 3 | Newer SCADA. Older flow meter |
| Pump | 3 | One pump missing from site. In for repair. |
| Motor | 3 | No records or rehabilitation |
| Piping | 2 | Severe to moderate corrosion |
| Valves | 4 | Valves appear to have been exchanged recently |
| HVAC | 3 | Older heater . Room appears to have condensate issues |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 3.2 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 23 years old |
| 2 | One pump out of service for repairs |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Severe corrosion | Photo 2 – Temporary standby power installation |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B08 – Upper Farviews | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 9:30 am |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | Unknown |

## Condition Rankings

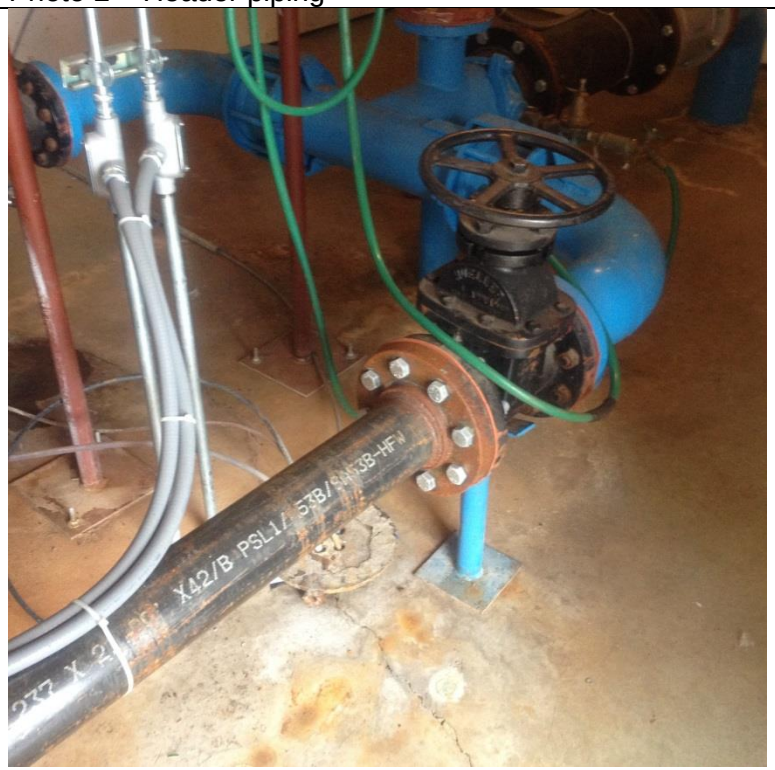
| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 2 | Wood structure not recently painted. Aged asphalt roof. Cracking on foundation. Cracking of interior floor. Waffle board interior not recently painted. |
| Security | 3 | No fence. Intrusion alarm and motion detectors. |
| Power Distribution | 3 | Age. No standby power disconnects. |
| Electrical | 3 | Access issues to electrical panels. Newer conduit, but older MCC, control cabinets, switchgear |
| Instrumentation / Analyzers | 4 | Newer SCADA. New flow metering. Newer chlorine analyzer. |
| Pump | 2 | Two pumps. Pump A, and B rehabs in 1985 and 1988 respectively. Pump foundations do not meet industry standards. |
| Motor | 3 | Two motors. Motor A (25 hp) and B (50 hp) rehabs in 1985 and 2001 respectively. |
| Piping | 3 | Corrosion on piping. Some spool pieces need coating. |
| Valves | 3 | No equipment history. Operations are satisfactory. Corrosion on older valves. |
| HVAC | 2 | Age |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 2.9 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Building in need of rehabilitation. |
| 2 | Access issues- electrical improvements may potentially require building modifications to meet electrical code. |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Well Building | Photo 2 – Header piping |
|---|---|
| |  |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B09 – Skyview @ Gharrett | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 3:15 pm |
| **RUNNING (YES/NO)** | Yes | **INSTALL DATE** | Unknown |

## Condition Rankings

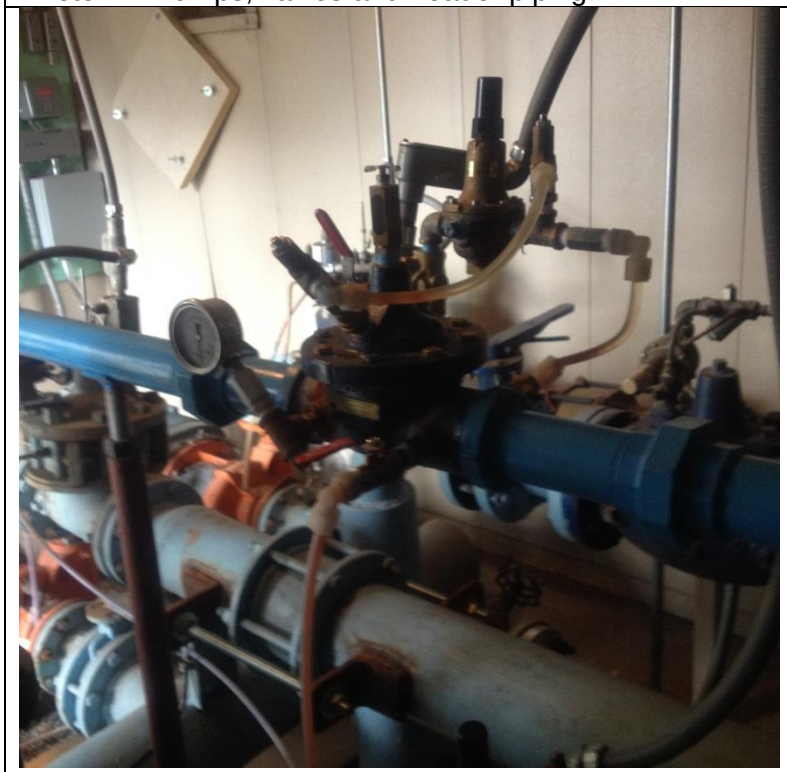
| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 3 | Metal building not recently painted. Interior walls, floor and roof good shape. |
| Security | 4 | New fence. Intrusion alarm and motion detectors. |
| Power Distribution | 3 | Age. No standby power disconnects. |
| Electrical | 3 | Access issues to electrical panels. Newer conduit, but older MCC, control cabinets, switchgear |
| Instrumentation / Analyzers | 4 | Newer SCADA. New flow metering. Newer chlorine analyzer. |
| Pump | 2 | Two pumps. Pump A, and B rehabs in 2001 and 1995 respectively. |
| Motor | 3 | Two motors. Motor A (50 hp) and B (40 hp) rehabs in 2001 and 2010 respectively. |
| Piping | 3 | Corrosion on piping. Some spool pieces need coating. |
| Valves | 2 | No equipment history. Operations are satisfactory. Corrosion on older valves. |
| HVAC | 2 | Age |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 3.0 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Access issues- electrical improvements may potentially require building modifications to meet electrical code. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Pumps, valves and header piping | Photo 2 – Header piping |
|---|---|
|  | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B13 – Rattlesnake | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/30/14 and 10-1 | **TIME ARRIVED ON SITE** | 2:15 pm and 11:26 a |
| **RUNNING (YES/NO)** | No and Yes on the 1st | **INSTALL DATE** | 1973 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Site is in good shape with good access |
| Buildings and Structures | 2 | Building 40 years old and in poor shape. Booster station needs new building. Roof shows signs of significant leaks. |
| Security | 5 | Intrusion alarm. New fence. Surveillance camera |
| Power Distribution | 2 | GenSet onsite and hooked up to system. Older switchgear and main feed. |
| Electrical | 2 | Access issues to electrical panels. Newer conduit, but older MCC, control cabinets, switchgear. Some panels replaced. |
| Instrumentation / Analyzers | 4 | Newer SCADA |
| Pump | 2 | Pumps and motors appear to have never been exchanged, replace |
| Motor | 2 | See above |
| Piping | 2 | Replace |
| Valves | 2 | Replace |
| HVAC | 2 | Replace with new building/HVAC |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 2.6 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 41 years old and in need of replacement. |
| 2 | Building has severe access and safety issues.  Egress from below grade pump room is severely hampered. |
| 3 | Pump 1 foundation shows severe deterioration.  Frame shimmed and not bolted down. |
| 4 | Site is shared with North Reservoir No. 1 |
| 5 | |
| | |

## Photos

| Photo 1 – Electrical panels | Photo 2 –  Motors, pumps, piping and valves |
|---|---|
| | |
| | |

# Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B14 – Lower Lincoln Hills | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 4:30 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1991 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Site is small. With electrical code issues, might need a new electrical building and more area. Well blow-off returns to well |
| Buildings and Structures | 3 | Building 23 years old and in fair shape. |
| Security | 4 | Intrusion alarm. Partial new fence. |
| Power Distribution | 4 | GenSet hook ups available. |
| Electrical | 3 | Access issues to electrical panels. Older MCC, control cabinets, switchgear. |
| Instrumentation / Analyzers | 4 | Newer SCADA. Older residual analyzer |
| Pump | 3 | Pumps and motors appear to have never been rehabilitated. Energy efficiency study indicates pumps are relatively efficient |
| Motor | 3 | See above |
| Piping | 3 | Piping in good shape, however due to the buildings footprint, pipes are installed close together with minimal access for maintenance. Piping requires some coating. |
| Valves | 3 | Does not appear much has been replaced, nearing end of life expectancy |
| HVAC | 2 | Energy efficiency study indicates building is poorly insulated and has a high heat demond. |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 3.2 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Booster facility is 23 years old. |
| 2 | Site is small and it appears inadequate if new electrical building is needed. |
| 3 | W13 Mountainview shares site. |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Site | Photo 2 – Electrical panels, motors, pumps, piping and valves |
|---|---|
| | |
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B15 – Highpark @ S Reservoir | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 11:30 am |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | Unknown |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 5 | Precast concrete building. Floors and roof good shape. |
| Security | 5 | Fence. Intrusion alarm and motion detectors and cameras. |
| Power Distribution | 4 | Standby generator on-site. Connections are temporary. Need to make permanent. |
| Electrical | 4 | Newer electrical |
| Instrumentation / Analyzers | 4 | Newer SCADA. Newer flow and pressure devices. Chlorine analyzer. |
| Pump | 3.5 | Two pumps with rehab in 2002. Third pump was moved in from vault outside. |
| Motor | 3.5 | Two 150 hp motors and one 50 hp motor. Rehab in 2011. |
| Piping | 3 | Some piping needs to be coated |
| Valves | 4 | No equipment history. Operations are satisfactory. New valves. |
| HVAC | 5 | New HVAC system. |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 4.1 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Developer provided facility. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Header piping with pump and motor | Photo 2 – New HVAC system |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B16 – Lower Farviews | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 9:15 am |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | Unknown |

## Condition Rankings

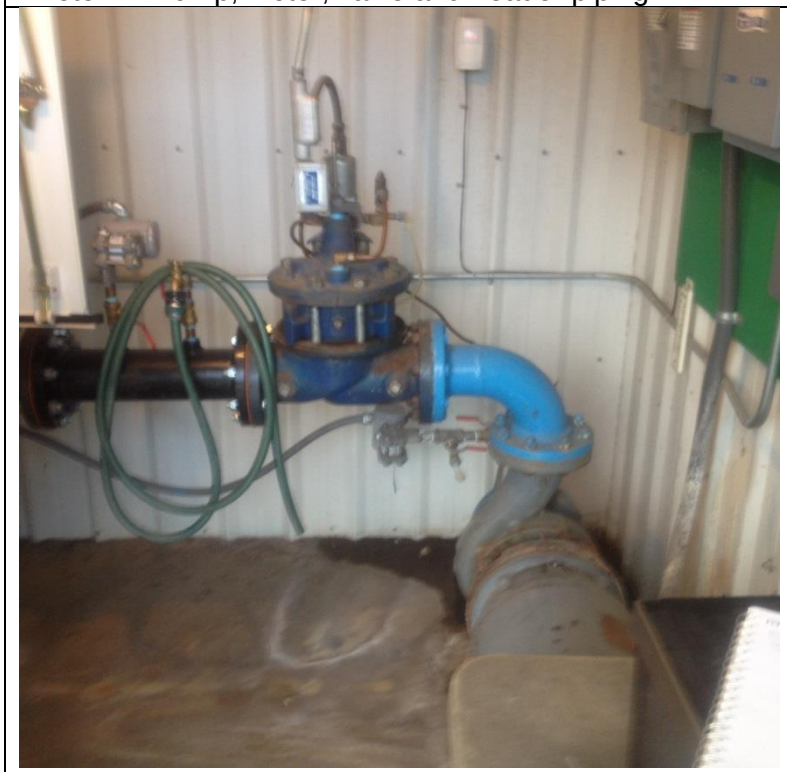
| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 3 | Metal building not recently painted. Interior walls, floor and roof good shape. |
| Security | 3 | No fence. Intrusion alarm and motion detectors. |
| Power Distribution | 3 | Age. No standby power disconnects. |
| Electrical | 3 | Access issues to electrical panels. Newer conduit, but older MCC, control cabinets, switchgear |
| Instrumentation / Analyzers | 4 | Newer SCADA. New flow and pressure metering. |
| Pump | 2 | One pump. Rehab in 1991. |
| Motor | 2 | One 40 hp motor. Rehab in 1991. |
| Piping | 3 | Corrosion on piping. Some spool pieces need coating. |
| Valves | 2 | No equipment history. Operations are satisfactory. Corrosion on older valves. |
| HVAC | 2 | Age |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 2.8 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Access issues- electrical improvements may potentially require building modifications to meet electrical code. |
| 2 | Pump and motor needs replacement. |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Pump, motor, valve and header piping | Photo 2 – Pump motor |
|---|---|
|  | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B17 – Hillview @ Skyview | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 3:40 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1992 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 4 | Precast concrete building with minor cracking and spalling on walls. Interior walls and floor good shape. One ton hoist crane. |
| Security | 5 | Fence. Intrusion alarm and motion detectors. Cameras |
| Power Distribution | 3 | Standby generator on-site with spill containment. Connections are temporary. Need to make permanent. |
| Electrical | 4 | Newer electrical |
| Instrumentation / Analyzers | 4 | Newer SCADA. New flow and pressure metering. Chlorine analyzer. Info from city 9/2018 – pump rebuilt. |
| Pump | 3.5 | Four pumps. A. rehab in 2002. B. rehab in 2003. C. rehab in 1996. D. rehab unknown. |
| Motor | 3.5 | Four motors. A. 75 hp rehab in 2002 B. 75 hp rehab in 2003 C. 150 hp rehab in 1996 D. 100 hp |
| Piping | 3 | Minor corrosion on piping. |
| Valves | 3 | No equipment history. Operations are satisfactory. Newer valves. |
| HVAC | 4 | No issues |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 3.7 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Developer supplied facility. |
| 2 | One pump and motor needs rehab or replacement. |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Pump, motor, valve and header piping | Photo 2 – Header piping |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B18 – Upper Hillview | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 4:00 pm |
| **RUNNING (YES/NO)** | Yes | **INSTALL DATE** | 1992 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 4 | Newer pump building around older skid mounted pumping unit. |
| Security | 3 | Fence. Intrusion alarm and motion detectors. |
| Power Distribution | 3 | Standby generator on-site. Connections are temporary. Need to make permanent. |
| Electrical | 3 | Access issues to electrical panels. |
| Instrumentation / Analyzers | 4 | Newer SCADA. |
| Pump | 3 | Four pumps mounted on a packaged pump skid. |
| Motor | 2 | Four motors. (2) 20 hp, (1) 10 hp, (1) 3 hp jockey pump. 20 hp pump running hot. |
| Piping | 2 | Corrosion on piping. |
| Valves | 2 | Age. No equipment history. Operations are satisfactory. |
| HVAC | 4 | No issues |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 3.1 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Even though age of pumps would indicate still within useful life, continual running of the pump to keep the system pressurized may require motor replacement. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – | Photo 2 – |
|---|---|
| | |

# Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B20 – East Missoula | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 10:08 am |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Site is small, not fenced |
| Buildings and Structures | 3.5 | Building is in good shape. Some settling and top of stand up walls chipped out. Needs painting finished on exterior |
| Security | 3 | Intrusion alarm. No fence. |
| Power Distribution | 4 | GenSet connections available |
| Electrical | 4 | Good shape |
| Instrumentation / Analyzers | 4 | Newer SCADA. |
| Pump | 4 | Pumps and motors in good shape |
| Motor | 4 | See above |
| Piping | 4 | Piping in good shape with good access for maintenance |
| Valves | 4 | Good shape |
| HVAC | 4 | Good |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 3.8 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is fairly new, no date given. |
| 2 | Site is small and not fenced |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Site | Photo 2 – Motors, pumps, piping and valves |
|---|---|
| | |
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W26 – Haugen Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | Not Inspected – Not in Use | **TIME ARRIVED ON SITE** | |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 0 | |
| Buildings and Structures | 0 | |
| Security | 0 | |
| Power Distribution | 0 | |
| Electrical | 0 | |
| Instrumentation / Analyzers | 0 | |
| Pump | 0 | |
| Motor | 0 | |
| Piping | 0 | |
| Valves | 0 | |
| HVAC | 0 | |
| Chemical Equipment | 0 | |
| Overall Facility Rating | 0.0 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 - | Photo 2 - |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B21 – Upper Linda Vista | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 2:00 pm |
| **RUNNING (YES/NO)** | Yes | **INSTALL DATE** | 1993 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 3 | Wood sided building. Some deterioration toward bottom of structure. Roof, interior walls and floor in good shape. |
| Security | 3 | No fence. Intrusion alarm and motion detectors. |
| Power Distribution | 3 | Age. No standby power disconnects. |
| Electrical | 3 | Access issues to electrical panels. Newer conduit, but older MCC, control cabinets, switchgear |
| Instrumentation / Analyzers | 4 | Newer SCADA. Fairly new flow and pressure devices. Chlorine analyzer. |
| Pump | 3 | Two pumps. Both had rehab in 2012. Pumps not bolted down. |
| Motor | 3 | Two 15hp motor. Both had rehab in 2012. |
| Piping | 2 | Corrosion on piping. Black plastic covering sections of header piping. |
| Valves | 3 | No equipment history. Operations are satisfactory. Corrosion on older valves. Some newer valves. |
| HVAC | 2 | Age |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 3.0 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Access issues- electrical improvements may potentially require building modifications to meet electrical code. |
| 2 | Black plastic on header pipe sections raises concern of corrosion. |
| 3 | Exterior lights to show pumps running were not on. |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Header piping covered up by black plastic | Photo 2 – Older and new valves |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B23 Upper Prospect | **TYPE OF FACILITY** | Booster |
| **DATE INSPECTED** | 9/29/14 and 10/2/14 | **TIME ARRIVED ON SITE** | 11:48 and 12:08 |
| **RUNNING (YES/NO)** | Yes on second visit | **INSTALL DATE** | 1981 |

## Condition Rankings

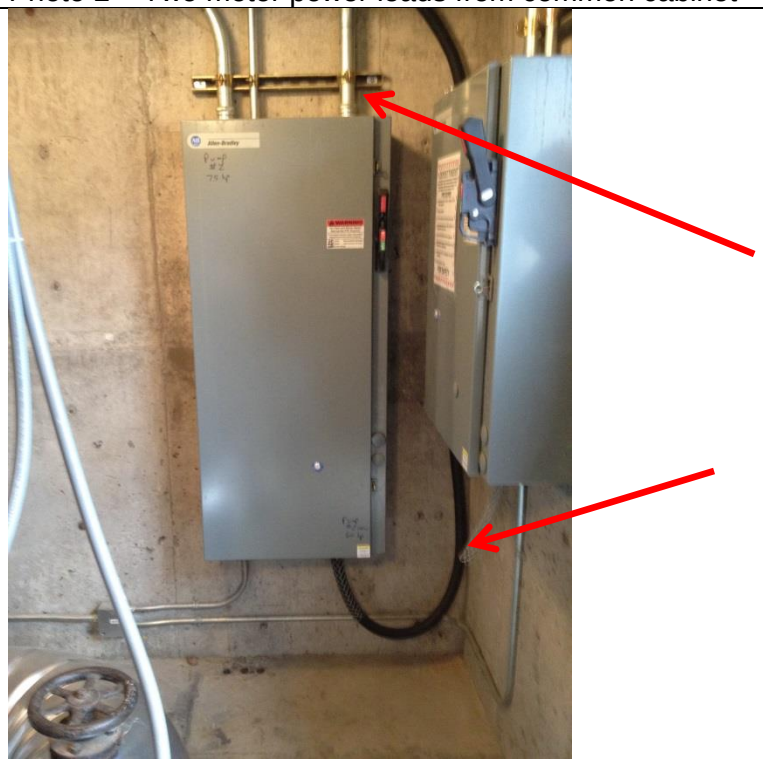
| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 2 | Upper bank sloughing onto site. Access to booster station via gravel path and landscape timber steps poor. Blow by pipe discharges out to field during shutdown. |
| Buildings and Structures | 3 | Older structure, but upgraded for condition. |
| Security | 4 | Intrusion alarm and motion detectors. Downgraded due to condition and height of security fence at slope slough. |
| Power Distribution | 3 | Portable standby power quick disconnects. New switchgear required. |
| Electrical | 3 | Access issues to electrical panels. Two pump motors are sharing the same cabinet. |
| Instrumentation / Analyzers | 3.5 | Newer SCADA. Older flow metering. Newer Cl2 residual |
| Pump | 3.5 | Newer pumps except middle pump is aged. Pump foundations do not meet industry standards. |
| Motor | 3 | Newer motors (see above) Lag pump motor rehab of motor in 2001. Deduct for power lead connection to common MCC. |
| Piping | 3 | Insulated metal jacket. Dissimilar metals on ductile iron pipe. Three foot section moderate signs of corrosion. |
| Valves | 5 | New regulating valves. New isolation valves |
| HVAC | 3 | Clearance issue at supply ducting. Heater and fans industrial. HVAC system not performing adequately. |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 3.3 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 33 years old |
| 2 | Slope and landscaping sloughing and intruding onto site. |
| 3 | Access issues- electrical improvements may potentially require building modifications to meet electrical code |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Slope intrusion. Security fence only 4’ high | Photo 2 – Two motor power leads from common cabinet |
|---|---|
| 4’ effective height on backside of fence |  |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B24 – Grant Creek | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 12:06 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 2001 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Site in good shape and with good access. Site is shared with Northwest Energy gas building and piping |
| Buildings and Structures | 4 | Building 13 years old and in good shape |
| Security | 5 | Intrusion alarm and motion detectors |
| Power Distribution | 4 | Portable standby power quick connections. |
| Electrical | 4 | Good shape and access. |
| Instrumentation / Analyzers | 4 | Newer SCADA. Newer C12 residual meter |
| Pump | 3 | Pumps have 13 years on them, degraded due to corrosion on bowls |
| Motor | 4 | Motors have 13 years on them. |
| Piping | 3 | Pipe requires some coating, but generally good. No link seals at floor penetration. Thrust blocking is questionable. |
| Valves | 3 | 13 year old valves with corrosion on all of them. |
| HVAC | 4 | No issues |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 3.8 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 13 years old |
| 2 | Site has Northwest Energy building and gas piping |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Site with Northwest Energy building | Photo 2 – Missing link seals at floor penetration |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B25 – Hillview @ Miller Creek | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 2:40 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1999 |

## Condition Rankings

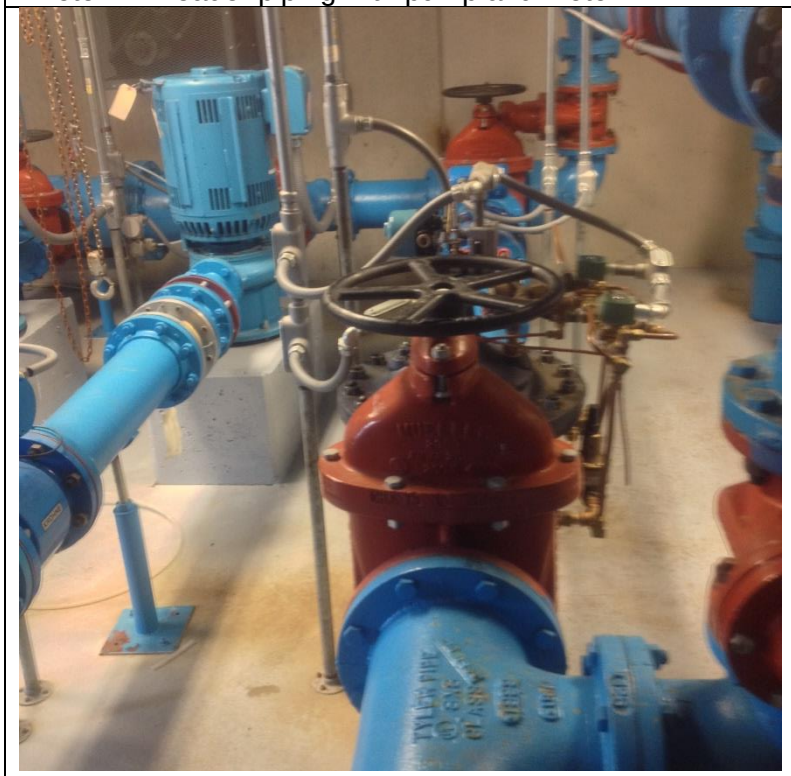
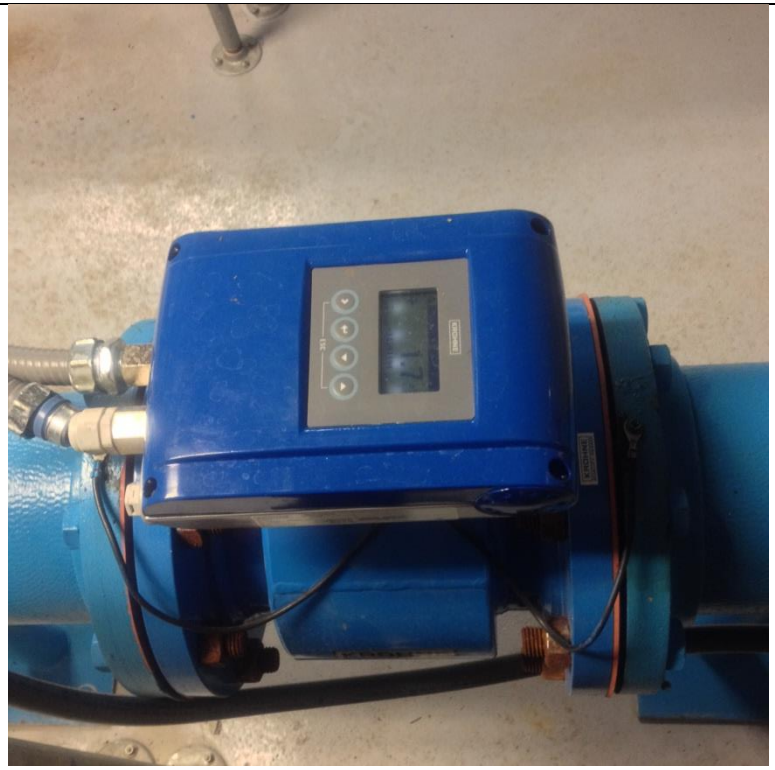
| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 3 | Precast concrete building with some minor spalling in places. Some cracking in floor. One ton hoist crane |
| Security | 3 | No fence. Intrusion alarm and motion detectors. |
| Power Distribution | 3 | No standby power disconnects. |
| Electrical | 4 | Newer electrical |
| Instrumentation / Analyzers | 4 | Newer SCADA. New flow and pressure devices. Chlorine analyzer. |
| Pump | 4 | Two pumps. |
| Motor | 4 | Two 50 hp motors. |
| Piping | 3 | Very minor corrosion on piping. |
| Valves | 4 | No equipment history. Operations are satisfactory. New valves. |
| HVAC | 3 | Newer HVAC system. Currently plugged off with Styrofoam. |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 3.6 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Developer provided facility. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Header piping with pump and motor | Photo 2 – New flow meter |
|---|---|
|  |  |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B26 – Mansion Heights | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 10:20 am |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 2002 |

## Condition Rankings

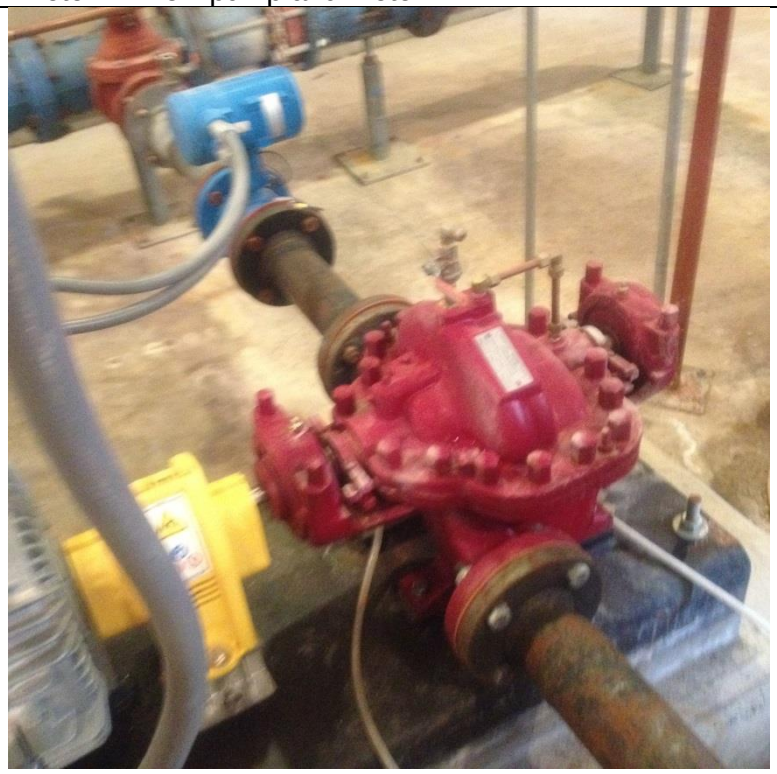
| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Has exterior controlled sprinkler system. |
| Buildings and Structures | 3 | Concrete precast structure. Some spalling and cracking. Interior floor and walls good shape. |
| Security | 3 | No fence. Intrusion alarm and motion detectors. |
| Power Distribution | 3 | Standby generator on-site. Install spill containment. Connections are temporary. Need to make permanent. |
| Electrical | 4 | Newer electrical |
| Instrumentation / Analyzers | 4 | Newer SCADA. Fairly new flow and pressure devices. Chlorine analyzer. |
| Pump | 3 | Three pumps. Pump A had rehab in 2011 and Pump B and C had rehab in 2010. |
| Motor | 3 | Pump A (10 hp) good shape. Pumps B & C (40 hp) fair shape. |
| Piping | 2 | Corrosion on piping. |
| Valves | 3 | No equipment history. Operations are satisfactory. Corrosion on older valves. Some newer valves. |
| HVAC | 2 | Age. Closed off vents and heater needs replacement. |
| Chemical Equipment | N/A | Not applicable |
| Overall Facility Rating | 3.1 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Pumps, motors and header piping | Photo 2 – New pump and motor |
|---|---|
| |  |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B27 – Skyview Booster | **TYPE OF FACILITY** | Booster |
| **DATE INSPECTED** | 9/29/2014 – See Inspection Reports for W38 & W39 | **TIME ARRIVED ON SITE** | 2:15 pm |
| **RUNNING (YES/NO)** | | **INSTALL DATE** | |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | | |
| Buildings and Structures | | |
| Security | | |
| Power Distribution | | |
| Electrical | | |
| Instrumentation / Analyzers | | |
| Pump | | |
| Motor | | |
| Piping | | |
| Valves | | |
| HVAC | | |
| Chemical Equipment | | |
| Overall Facility Rating | | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – | Photo 2 – |
|---|---|
| | |

## Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R01 North Reservoir | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 10:45 AM |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1978 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Site is well fenced. |
| Buildings and Structures | 4 | Mountain Water data says this reservoir is 112 years old. It must have been re-done in the last 20 years as the reservoir appears to be is excellent shape with dome enclosure. |
| Security | 4 | Intrusion alarms, lights and fencing |
| Power Distribution | 4 | |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | Level sensor elements appear to be installed within the past 5 years |
| Pump | N/A | Pumps in booster station or well. Inspected separately. |
| Motor | N/A | N/A |
| Piping | 0 | Piping is underground |
| Valves | 0 | Any valves are underground |
| HVAC | N/A | N/A |
| Chemical Equipment | N/A | N/A |
| Overall Facility Rating | 4 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 112 years old but appears to be in excellent shape |
| 2 | No history of reservoir being re-built. |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

Photo 1 – Reservoir over all site

Photo 2 – Domed reservoir

# Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | Rattlesnake Reservoir | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 10/24/2018 | **TIME ARRIVED ON SITE** | 10:37 am |
| **RUNNING (YES/NO)** | Yes | **INSTALL DATE** | |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Somewhat isolated location. Drainage good. |
| Buildings and Structures | 4 | Corrosion on vents. Screens in tact. Concrete vault spalling and concrete damaged. Minor (5-10 gpm) overflow noticed where overflow enters Rattlesnake Creek. |
| Security | 4 | Fence is generally secure around site and in good condition. Lighting, cameras and motion detectors on site. New future project planned to replace the security system and wiring. |
| Power Distribution | N/A | |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | New transducer installed summer 2018 |
| Pump | N/A | |
| Motor | N/A | |
| Piping | 4 | All piping is underground except for overflow. |
| Valves | N/A | All valves buried. |
| HVAC | N/A | |
| Chemical Equipment | N/A | |
| Overall Facility Rating | 4.0 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Isolated location with good access road.  Perimeter security fence in good condition. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Corrosion on air vent | Photo 2 –Lights and cameras |
|---|---|
| | |

| Photo 3 – Damaged concrete vault | Photo 4 – Water leaking from overflow into Rattlesnake Creek |
| --- | --- |
| | |

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## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R03 South | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 11:30 am |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | 1979 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Drainage good. |
| Buildings and Structures | 4 | Concrete reservoir completely buried. |
| Security | 5 | Security fence in good condition. Intrusion alarm and cameras. |
| Power Distribution | 4 | Genset on-site in spill containment. |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | SLC 500 series PLC with battery back-up, radio communication. Excessive I/C capacity for only 3 I/O inputs. |
| Pump | N/A | Pumps in booster station or well. Inspected separately. |
| Motor | N/A | See above |
| Piping | 4 | All piping is underground except overflow. Two vent pipes. |
| Valves | 0 | Any valves are underground |
| HVAC | N/A | N/A |
| Chemical Equipment | N/A | N/A |
| Overall Facility Rating | 4.1 | Good |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – R3 Grass covered reservoir | Photo 2 – |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R04 Lower Linda Vista | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 2:30 pm |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | 1989 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Drainage good. |
| Buildings and Structures | 4 | Concrete reservoir completely buried. |
| Security | 4 | Security fence in good condition. Intrusion alarm. |
| Power Distribution | 4 | |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | SLC 500 series PLC with battery back-up, radio communication. Excessive I/C capacity for only 3 I/O inputs. |
| Pump | N/A | Pumps at booster station or well. Inspected separately. |
| Motor | N/A | See above |
| Piping | 4 | All piping is underground except overflow. Overflow to side hill with screen. One vent pipe with screen. |
| Valves | 0 | Any valves are underground |
| HVAC | N/A | N/A |
| Chemical Equipment | N/A | N/A |
| Overall Facility Rating | 4.0 | Good |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – R4 Grass covered reservoir | Photo 2 – Overflow with screen |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R05 Upper Linda Vista | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 3:00 pm |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | 1998 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Drainage good. |
| Buildings and Structures | 3 | Concrete reservoir half buried. Freshly painted on parking lot side. Water ponding on roof. Minor cracking where lid meets side of tank. |
| Security | 4 | Security fence in good condition. Intrusion alarm. |
| Power Distribution | 4 | |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | SLC 500 series PLC with battery back-up, radio communication. Excessive I/C capacity for only 3 I/O inputs. |
| Pump | N/A | Pumps at booster station. Inspected separately. |
| Motor | N/A | See above |
| Piping | 4 | All piping is underground except overflow. Overflow to sump with drain to side hill. One vent pipe on top of tank. |
| Valves | 0 | Any valves are underground |
| HVAC | N/A | N/A |
| Chemical Equipment | N/A | N/A |
| Overall Facility Rating | 3.9 | Good |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – R5 Side of concrete reservoir | Photo 2 – Overflow with screen |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R06 – Lower Prospect Reservoir | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | Not Inspected | **TIME ARRIVED ON SITE** | |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 0 | |
| Buildings and Structures | 0 | |
| Security | 0 | |
| Power Distribution | 0 | |
| Electrical | 0 | |
| Instrumentation / Analyzers | 0 | |
| Pump | 0 | |
| Motor | 0 | |
| Piping | 0 | |
| Valves | 0 | |
| HVAC | 0 | |
| Chemical Equipment | 0 | |
| Overall Facility Rating | 0.0 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 - | Photo 2 - |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R10 Skyview | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 3:40 pm |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | 2000 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Drainage good. |
| Buildings and Structures | 3 | Concrete reservoir half buried. Top of tank recently painted. Water ponding on roof. Minor cracking and spalling of concrete on side of tank. |
| Security | 5 | Security fence in good condition. Intrusion alarm and cameras. |
| Power Distribution | 4 | |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | SLC 500 series PLC with battery back-up, radio communication. Excessive I/C capacity for only 3 I/O inputs. |
| Pump | N/A | Pumps at booster station or well. Inspected separately. |
| Motor | N/A | See above |
| Piping | 4 | All piping is underground except overflow. Overflow to sump with air gap. Vent pipe on top of tank. |
| Valves | 0 | Any valves are underground |
| HVAC | N/A | N/A |
| Chemical Equipment | N/A | N/A |
| Overall Facility Rating | 4.0 | Good |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – R10 Skyview Reservoir | Photo 2 – |
|---|---|
| | |

# Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | Upper Prospect | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 10/24/2018 | **TIME ARRIVED ON SITE** | 3:30 pm |
| **RUNNING (YES/NO)** | Yes | **INSTALL DATE** | |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 4 | |
| Security | 3 | No fence around site. Vents are caged. |
| Power Distribution | N/A | |
| Electrical | 4 | Buried electrical to site. |
| Instrumentation / Analyzers | 4 | Project underway to replace antennae and radio. |
| Pump | N/A | |
| Motor | N/A | |
| Piping | N/A | All piping buried |
| Valves | N/A | All valves buried. |
| HVAC | N/A | |
| Chemical Equipment | N/A | |
| Overall Facility Rating | 3.8 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | |

| | |
|---|---|
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Top of tank Caged vent and locked access vault | Photo 2 – Antennae and communication equipment |
|---|---|
| | |

# Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | East Missoula | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 10/24/2018 | **TIME ARRIVED ON SITE** | 10:03 am |
| **RUNNING (YES/NO)** | Yes | **INSTALL DATE** | |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Located on hill north of East Missoula. Drainage good. |
| Buildings and Structures | 4 | Some corrosion at base of circular reservoir. Corroded bolt on air gap/overflow of rectangular tank and some concrete spalling on roof. |
| Security | 4 | Fence is generally secure around site and in good condition with exception of some detached 3-strand barb-wire. |
| Power Distribution | N/A | |
| Electrical | 4 | |
| Instrumentation / Analyzers | 5 | SCADA system upgraded summer 2018 |
| Pump | N/A | |
| Motor | N/A | |
| Piping | 4 | All piping is underground except for overflow. |
| Valves | N/A | All valves buried. |
| HVAC | N/A | |
| Chemical Equipment | N/A | |
| Overall Facility Rating | 4.2 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Access to site is on seep road cut into mountain. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – West side of circular reservoir | Photo 2 –Detached 3-strand barb wire |
|---|---|
| | |

| Photo 3 – Spalling concrete on rectangular reservoir | Photo 4 – Rectangular reservoir overflow with screen |
| --- | --- |
| | |

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## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R13 High Park | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 11:00 am |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | Unknown |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Drainage good. |
| Buildings and Structures | 2 | Concrete reservoir half buried. Top and front side of tank recently painted. Minor cracking and spalling of concrete on side of tank. Some leakage observed. |
| Security | 5 | Security fence in good condition. Intrusion alarm and cameras. |
| Power Distribution | 4 | |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | SLC 500 series PLC with battery back-up, radio communication. Excessive I/C capacity for only 3 I/O inputs. |
| Pump | N/A | Pumps at booster station or well. Inspected separately. |
| Motor | N/A | See above |
| Piping | 4 | All piping is underground except overflow. Overflow to sump with air gap. Two vent pipes on top of tank. |
| Valves | 0 | Any valves are underground |
| HVAC | N/A | N/A |
| Chemical Equipment | N/A | N/A |
| Overall Facility Rating | 3.9 | Good |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – | Photo 2 – |
|---|---|
| | |

# Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R14 Hillview | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 4:00 pm |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | Unknown |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Drainage good |
| Buildings and Structures | 4 | Gunite covered steel wire wrapped reservoir. Good condition. |
| Security | 4 | Security fence in good condition. Intrusion alarm. Caged and locked access ladder. |
| Power Distribution | 4 | |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | SLC 500 series PLC with battery back-up, radio communication. Excessive I/C capacity for only 3 I/O inputs. |
| Pump | N/A | Pumps in booster station or well. Inspected separately. |
| Motor | N/A | See above |
| Piping | 3 | All piping is underground except overflow. Air gap off of overflow. Overflow piping directed towards private property. |
| Valves | 0 | Any valves are underground |
| HVAC | N/A | N/A |
| Chemical Equipment | N/A | N/A |
| Overall Facility Rating | 3.9 | Good |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – | Photo 2 – |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T01 East Missoula | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 4:20PM |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | 1964 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Site with shoring up against steep slope, appears to be adequate. Small swale around tank needed, so water/snow does not pile up at tank wall. |
| Buildings and Structures | 3 | Bolted steel tank. Original paint. Minor surface rust at bottom due to poor drainage around tank. Tank is 50 years old. |
| Security | 4 | Security fence in good condition. Intrusion alarm and cameras. |
| Power Distribution | 4 | |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | SLC 500 series PLC with battery back-up, radio communication. Excessive I/C capacity for only 3 I/O inputs. |
| Pump | N/A | Pumps at booster station or well. Inspected separately. |
| Motor | N/A | See above |
| Piping | 3 | All piping is underground except at drain pipe discharge points. Not inspected. |
| Valves | 0 | Any valves are underground and in valve vaults. |
| HVAC | N/A | N/A |
| Chemical Equipment | N/A | N/A |
| Overall Facility Rating | 3.7 | Good |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Tank needs spot recoating. |
| 2 | Small swale around tank. |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – T01 East Missoula Tank and shoring | Photo 2 – T01 surface rust and drainage issues |
|---|---|
| | |
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T02 Lower Elk Ridge | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 3:40 pm |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | 1988 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Good shape, good drainage. Shared with Booster Station |
| Buildings and Structures | 4 | Bolted steel tank. Paint in good condition. |
| Security | 4 | Security fence in good condition. Intrusion alarm, cameras. |
| Power Distribution | 4 | |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | SLC 500 series PLC with battery back-up, radio communication. Excessive I/C capacity for only 3 I/O inputs. |
| Pump | N/A | Pumps at booster station or well. Inspected separately. |
| Motor | N/A | See above |
| Piping | 3 | All piping is underground except at drain pipe discharge points |
| Valves | 0 | Any valves are underground |
| HVAC | N/A | N/A |
| Chemical Equipment | N/A | N/A |
| Overall Facility Rating | 3.9 | Good |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – T01 | Photo 2 – T01 |
|---|---|
| | |
| | |

# Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T04 - Gharrett Ave | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 3:15 pm |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | 2007 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Drainage good |
| Buildings and Structures | 3 | Bolted steel tank. Recently painted. Bolts and seams recently caulked. No concrete foundation (stone base). New roof railing installed. |
| Security | 4 | Security fence in good condition. Caged and locked access ladder. |
| Power Distribution | 4 | |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | SLC 500 series PLC with battery back-up, radio communication. Excessive I/C capacity for only 3 I/O inputs. |
| Pump | N/A | Pumps in booster station or well. Inspected separately. |
| Motor | N/A | See above |
| Piping | 3 | All piping is underground except overflow. Overflow to air gap sump that discharges to street. |
| Valves | 0 | Any valves are underground |
| HVAC | N/A | N/A |
| Chemical Equipment | N/A | N/A |
| Overall Facility Rating | 3.7 | Fair to Good |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – | Photo 2 – |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T06 Lincoln Hills | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 4:10PM |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | 1967 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Site fenced with grass |
| Buildings and Structures | 3 | Tank should actually be called a reservoir as it is underground. Inside condition is unknown. It is 47 years old. |
| Security | 4 | Security fence in good condition. |
| Power Distribution | 4 | |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | SLC 500 series PLC with battery back-up, radio communication is apparently in the Booster Station. Excessive I/C capacity for only 3 I/O inputs. |
| Pump | N/A | Pumps at booster station or well. Inspected separately. |
| Motor | N/A | See above |
| Piping | 3 | All piping is underground except at drain pipe discharge points |
| Valves | 0 | Any valves are underground or in valve vault |
| HVAC | N/A | N/A |
| Chemical Equipment | N/A | N/A |
| Overall Facility Rating | 3.7 | Fair to Good |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Underground tank |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – T02 underground tank | Photo 2 – |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T09, 13, 14 Lower Farview | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 10:00 am |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | T09 1945 T13 &14 Unknown |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Buried only roofs of tanks showing. Drainage good. |
| Buildings and Structures | 2.5 | T09 Concrete tank aged. Vent is overflow. Not painted. Concrete spalling and cracking. T13 & T14 bolted steel. Needs painting. Has overflow and vent. |
| Security | 4 | Security Fence in good condition. Intrusion alarms. Anti-intrusion devices on hatches. |
| Power Distribution | 4 | Main disconnect in good condition |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | SLC 500 series PLC with battery back-up, radio communication. Excessive I/C capacity for only 3 I/O inputs. |
| Pump | N/A | Pumps at booster station or well. Inspected separately. |
| Motor | N/A | See above |
| Piping | 3 | All piping is underground, except tank overflow which was missing screen. |
| Valves | 0 | Any valves are underground |
| HVAC | N/A | N/A |
| Chemical Equipment | N/A | N/A |
| Overall Facility Rating | 3.6 | Fair to Good |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Tanks are in need of painting. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – T13 & T14 | Photo 2 – T09 |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T15 High Park | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 11:00 am |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | Unknown |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Drainage good |
| Buildings and Structures | 3 | Bolted steel tank. Original paint |
| Security | 4 | Security fence in good condition. Intrusion alarm and cameras |
| Power Distribution | 4 | |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | SLC 500 series PLC with battery back-up, radio communication. Excessive I/C capacity for only 3 I/O inputs. |
| Pump | N/A | Pumps in booster station or well. Inspected separately. |
| Motor | N/A | See above |
| Piping | 3 | All piping is underground except overflow (airgap to sump) |
| Valves | 0 | Any valves are underground |
| HVAC | N/A | N/A |
| Chemical Equipment | N/A | N/A |
| Overall Facility Rating | 3.7 | Fair to Good |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Tank is in need of painting. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – T15 painting condition | Photo 2 – |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T16 Upper Lincoln Hills | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 4:20PM |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | 1977 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 2 | Overflow and tank drain discharges areas in need of rip-rap or rocked settling basin. Steep, natural growth hillside. |
| Buildings and Structures | 3 | Bolted steel tank. Original paint. Poorly repaired bullet hole in back. |
| Security | 4 | Security fence in good condition. Intrusion alarm, cameras and communications. |
| Power Distribution | 4 | |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | SLC 500 series PLC with battery back-up, radio communication. Excessive I/C capacity for only 3 I/O inputs. |
| Pump | N/A | Pumps at booster station or well. Inspected separately. |
| Motor | N/A | See above |
| Piping | 3 | All piping is underground except at drain pipe discharge points |
| Valves | 0 | Any valves are underground |
| HVAC | N/A | N/A |
| Chemical Equipment | N/A | N/A |
| Overall Facility Rating | 3.4 | Fair to Good |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Tank is in need of proper repair of bullet hole and recoating. |
| 2 | Place rip-rap at pipe discharge points. |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – T06 repaired bullet hole | Photo 2 – T06 drainage issues |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T17 – Skyview Tank | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | Not Inspected – Out of Service | **TIME ARRIVED ON SITE** | |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 0 | |
| Buildings and Structures | 0 | |
| Security | 0 | |
| Power Distribution | 0 | |
| Electrical | 0 | |
| Instrumentation / Analyzers | 0 | |
| Pump | 0 | |
| Motor | 0 | |
| Piping | 0 | |
| Valves | 0 | |
| HVAC | 0 | |
| Chemical Equipment | 0 | |
| Overall Facility Rating | 0.0 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 - | Photo 2 - |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T18 Hillview | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 4:00 pm |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | 1985 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Drainage good |
| Buildings and Structures | 3 | Bolted steel tank. Original paint (oxidized), nicks and scratches. No concrete foundation. |
| Security | 4 | Security fence in good condition. Intrusion alarm . Caged and locked access ladder. |
| Power Distribution | 4 | |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | SLC 500 series PLC with battery back-up, radio communication. Excessive I/C capacity for only 3 I/O inputs. |
| Pump | N/A | Pumps at booster station or well. Inspected separately. |
| Motor | N/A | See above |
| Piping | 3 | All piping is underground except overflow. No air gap on overflow. |
| Valves | 0 | Any valves are underground |
| HVAC | N/A | N/A |
| Chemical Equipment | N/A | N/A |
| Overall Facility Rating | 3.7 | Fair to Good |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Tank is in need of painting. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – T18 painting condition | Photo 2 – |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T19 Upper Fairview | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 10:20 am |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | 1993 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Improve drainage to drain away from tank. |
| Buildings and Structures | 3 | Bolted steel tank. Original paint (oxidized), minor nicks and scratches. No concrete foundation. |
| Security | 4 | Security fence in good condition. Intrusion alarm . Caged and locked access ladder. |
| Power Distribution | 4 | |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | SLC 500 series PLC with battery back-up, radio communication. Excessive I/C capacity for only 3 I/O inputs. |
| Pump | N/A | Pumps at booster station or well. Inspected separately. |
| Motor | N/A | See above |
| Piping | 3 | All piping is underground except overflow (airgap to sump) |
| Valves | 0 | Any valves are underground |
| HVAC | N/A | N/A |
| Chemical Equipment | N/A | N/A |
| Overall Facility Rating | 3.6 | Fair to Good |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Tank is in need of painting. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – T19 painting condition | Photo 2 – Caged access ladder |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T20 Mansion Heights | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 10:45 AM |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | 1998 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Need to monitor and assess site drainage |
| Buildings and Structures | 3.5 | Evidence of prior leakage, Steel Tank Inspection report 10/26/2011 indicates leaks were fixed with epoxy at joints. Tank not painted since installation. No Concrete foundation or tank anchors. |
| Security | 4 | Security Fence in good condition, panel alarms on PLC cabinet. Ladder cut off for security reasons. |
| Power Distribution | 4 | Incoming 25 KVA ground transformer on site, main disconnect in good condition |
| Electrical | 4 | |
| Instrumentation / Analyzers | 4 | SLC 5/02 series PLC with battery back-up, radio communication. Excessive I/C capacity for only 3 I/O inputs. |
| Pump | N/A | Pumps at booster station or well. Inspected separately. |
| Motor | N/A | See above |
| Piping | 2 | All piping is underground, except tank overflow which was missing screen. |
| Valves | 0 | Any valves are underground |
| HVAC | N/A | N/A |
| Chemical Equipment | N/A | N/A |
| Overall Facility Rating | 3.6 | Fair to Good |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Tank is in need of painting, hasn't been painted in 16 years since installation. |
| 2 | Recommend improved site drainage around tank. |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 | Photo 2 |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W01 - 6TH Street Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/2014 | **TIME ARRIVED ON SITE** | 10:20 am |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1935 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Hole in ground around the outside of drain manhole. Filled with cobbles. |
| Buildings and Structures | 3 | Exterior walls have new EFIS. Roof recently painted. Interior walls poor shape and need replacement. Well room floor cracked and settling. No link seals at header pipe floor penetrations – 2 1/2' x 4' hole in floor. |
| Security | 4 | New fence. Has intrusion alarm. |
| Power Distribution | 3 | Age. No standby power. |
| Electrical | 3 | Age |
| Instrumentation / Analyzers | 3 | Newer SCADA. Newer flow metering. |
| Pump | 2 | Age. No equipment history of rehab. Seal water drain pipe to outside through wall. Poor efficiency testing results. |
| Motor | 3 | Rehab of motor in 2001. |
| Piping | 3 | Corrosion on piping. |
| Valves | 3 | Age. No equipment history. Operations are satisfactory. |
| HVAC | 2 | Age |
| Chemical Equipment | 2 | No leak detection. No chlorine analyzer. HVAC non-functional. |
| Overall Facility Rating | 2.8 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Interior of Well Building is in need of rehabilitation. |
| 2 | Access issues- electrical improvements may potentially require building modifications to meet electrical code. |
| 3 | Pump and motor are in need of replacement. |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1- Interior of 6th Street Well Building | Photo 2 – 6th Street Well Blowoff Drywell |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 02 - 14TH Street Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/2014 | **TIME ARRIVED ON SITE** | 11:10 am |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1935/1993 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Minor cleanup needed |
| Buildings and Structures | 3 | Exterior walls have new EFIS. Well Building and Chlorine Room interior walls poor shape and need to be replaced. No link seal at header pipe floor penetration – 1 1/2' x 1 1/2' hole in floor. |
| Security | 4 | New fence. Has intrusion alarm. |
| Power Distribution | 4 | Has capability for standby power. |
| Electrical | 4 | Newer electrical. |
| Instrumentation / Analyzers | 3 | Newer SCADA. Newer flow metering. |
| Pump | 2 | Age. No equipment history of rehab. Poor efficiency testing results. |
| Motor | 2 | Age. Rehab of motor in 1995. |
| Piping | 3 | Corrosion on piping. |
| Valves | 3 | No equipment history. Operations are satisfactory. Corrosion on valves. |
| HVAC | 2 | Age. House fan for HVAC fan. |
| Chemical Equipment | 2 | No leak detection. Chemical spill in chlorine room. No chlorine analyzer. |
| Overall Facility Rating | 3.0 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Interior of Well Building is in need of rehabilitation. |
| 2 | Interior of Chlorine Room is in need of rehabilitation. |
| 3 | Pump and motor are in need of replacement. |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1- Interior of 14th Street Well Building | Photo 2 – Interior of 14th Street Well Chlorine Room |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W3 South Ave | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 12:15 pm |
| **RUNNING (YES/NO)** | Yes - 200HP | **INSTALL DATE** | 1993 100HP /1998 200HP |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Cannot determine site boundaries |
| Buildings and Structures | 3 | Siding on building in good shape. Electrical upgrades will require a larger footprint. Cannot access panels without crawling over pipe |
| Security | 3 | Intrusion alarm on door only, No fence |
| Power Distribution | 3 | Age. No standby power. |
| Electrical | 4 | Newer MCC and control cabinets, older incoming feed and switchgear |
| Instrumentation / Analyzers | 4 | Newer SCADA. Newer flow metering. Newer Cl2 residual monitoring |
| Pump | 3 | Age. Cannot determine last rehab date. Energy efficiency study results indicate 100 HP pump in need of rehabilitation. |
| Motor | 3 | 100 HP Motor rehab in 2003. 200 HP motor has distinct oscillation coming from upper bearing. Motor temp about 140 degrees F |
| Piping | 2 | Severe pipe corrosion. Info from city 9/2018 – all internal piping has been replaced. |
| Valves | 4 | No equipment history. Operations are satisfactory. Newer regulating valves. |
| HVAC | 2 | Heaters are old. Indication of damp environment. Door corroded. |
| Chemical Equipment | 4 | No sealant on containment floor. Building in good shape. Fire suppression installed. |
| Overall Facility Rating | 3.2 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Well data records show 3A as 79 years old and 3B as 30 years old. |
| 2 | 100 HP well motor disconnect in the open position. |
| 3 | Access issues- electrical improvements may potentially require building modifications to meet electrical code |
| 4 | No equipment records to indicate pump and motor rehabilitation. |
| 5 | |
| | |

## Photos

| Photo 1 – Sever pipe corrosion | Photo 2 – Walking access to SCADA control cabinet blocked by pipes |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W4 Sommers St | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 09/30/14 | **TIME ARRIVED ON SITE** | 9:17 AM |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1996 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Room for small expansion if necessary |
| Buildings and Structures | 3 | Stucco building in good shape. Interior walls require repair. |
| Security | 5 | Motion detectors. Intrusion alarm. Fencing |
| Power Distribution | 4 | Portable standby power quick disconnects |
| Electrical | 3 | Panels from 1996. Newer conduit. |
| Instrumentation / Analyzers | 3 | Newer SCADA. Older flow metering. |
| Pump | 2 | Energy efficiency study indicates well pump significantly below expected performance. Pump producing 70% of rated flow. |
| Motor | 4 | Original motor installed in 1996 |
| Piping | 3 | Moderate to severe pipe corrosion. Some pipe segments replaced |
| Valves | 3 | Age. No equipment history. Operations are satisfactory. Original regulating valve. |
| HVAC | 2 | Temporary fans. Heaters are old. |
| Chemical Equipment | 4 | Good secondary containment |
| Overall Facility Rating | 3.6 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 18 years old with no evidence of consistent maintenance and/or rehabilitation |
| 2 | No equipment records to indicate pump and motor rehabilitation |
| 3 | Energy efficiency study indicates well pump rehabilitation needed |
| 4 | . |
| 5 | |
| | |

## Photos

| Photo 1 – Replace chemical application pipe spool | Photo 2 – Severe pipe corrosion / Exposed earth |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 08 - Schilling Street Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/2014 | **TIME ARRIVED ON SITE** | 1:15 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | Rehabilitation - 2014 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 5 | |
| Buildings and Structures | 4 | Exterior walls have new EFIS, installed over existing metal siding and frame. Interior walls are new. Floor has some cracking. Older roof. No link seal at header pipe floor penetration - 2' x 2' hole in floor. |
| Security | 5 | New fence. Has intrusion alarm. |
| Power Distribution | 5 | Has capability for standby power. |
| Electrical | 5 | New electrical. |
| Instrumentation / Analyzers | 5 | New SCADA. New flow metering. |
| Pump | 2 | Age. No equipment history of rehab. Poor efficiency testing results. |
| Motor | 2 | Age. |
| Piping | 5 | New header piping |
| Valves | 3 | No equipment history. Operations are satisfactory. |
| HVAC | 5 | New HVAC |
| Chemical Equipment | 5 | New Chemical Room |
| Overall Facility Rating | 4.3 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Rehabilitation of facility is currently in process.  All work needs to be finished. |
| 2 | Pump and motor are in need of replacement. |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1- Exterior of Schilling Street Well Building | Photo 2 – New pump blowoff piping of Schilling Street Well |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 09 – Dixon Avenue Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/2014 | **TIME ARRIVED ON SITE** | 2:15 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1955 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Work needed to improve visual look of site area. |
| Buildings and Structures | 3 | Exterior walls have been painted recently. Chlorine Room building on railroad tie foundation. No link seal at header pipe floor penetration – 2' x 2' hole in floor. Crack in well building concrete floor. |
| Security | 3 | No fence. Has intrusion alarm. |
| Power Distribution | 3 | Upgrade for capability of standby power. |
| Electrical | 4 | Newer electrical. |
| Instrumentation / Analyzers | 3 | Newer SCADA. Newer flow metering. |
| Pump | 2 | Age. No equipment history of rehab. Bolts missing on pump pedestal. Poor efficiency testing results. |
| Motor | 2 | Age. Rehab of motor in 1982. |
| Piping | 1 | Severe corrosion on piping. |
| Valves | 3 | No equipment history. Operations are satisfactory. Corrosion on valves. |
| HVAC | 2 | Age. |
| Chemical Equipment | 2 | No leak detection. 175 gallon chemical tank. It does not appear that secondary containment sump will hold entire contents of tank if spill occurs. No chlorine analyzer. |
| Overall Facility Rating | 2.6 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Walking path next to facility.  Security needs improvement. |
| 2 | Need new foundation for Chlorine Room. |
| 3 | Pump and motor are in need of replacement. |
| 4 | Header piping in need of replacement. |
| 5 | |
| | |

## Photos

| Photo 1- Header piping | Photo 2 – Railroad tie foundation for Chlorine Room |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W10 Hilda | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 10:58 |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1957 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 2 | Site is in public alley way. Garbage cans and wood pile resting against building. |
| Buildings and Structures | 2 | Older “Butler” metal building in poor shape. Severe corrosion. Poor interior insulation |
| Security | 3 | Intrusion alarm on door only, No fence |
| Power Distribution | 3 | Age. No standby power. |
| Electrical | 3 | Older MCC, control cabinets, switchgear. Info from city 9/2018 – outside disconnect replaced. |
| Instrumentation / Analyzers | 3 | Newer SCADA. Older flow metering. No Cl2 residual monitoring |
| Pump | 2 | Age. Well pump frame is shimmed. Energy efficiency study recommends rehabilitation of pump. |
| Motor | 3 | No record of motor rehab |
| Piping | 2 | Severe pipe corrosion |
| Valves | 3 | Age. No equipment history. Operations are satisfactory. |
| HVAC | 2 | Temporary fans. Heaters are old. |
| Chemical Equipment | 2 | No sealant on containment floor. Building in poor shape |
| Overall Facility Rating | 2.5 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 57 years old with no evidence of consistent maintenance and/or rehabilitation |
| 2 | No Cl2 residual sample monitoring. |
| 3 | Access issues- electrical improvements may potentially require building modifications to meet electrical code |
| 4 | No equipment records to indicate pump and motor rehabilitation. |
| 5 | |
| | |

## Photos

| Photo 1 – Sever pipe corrosion | Photo 2 – Private refuse resting against building |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W11 Agnes Ave | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 11:57 am |
| **RUNNING (YES/NO)** | Yes | **INSTALL DATE** | 1957 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Cannot determine site boundaries |
| Buildings and Structures | 3 | Wooded building in fair shape. Electrical upgrades will require a larger footprint. |
| Security | 3 | Intrusion alarm on door only, No fence |
| Power Distribution | 3 | Age. No standby power. |
| Electrical | 3 | Older MCC, control cabinets, switchgear |
| Instrumentation / Analyzers | 3 | Newer SCADA. Older flow metering. No Cl2 residual monitoring |
| Pump | 2 | Age. Cannot determine last rehab date. No energy efficiency study results |
| Motor | 4 | Motor rehab in 1993. Motor runs smooth with no heat buildup or noticeable vibration. |
| Piping | 2 | Severe pipe corrosion |
| Valves | 3 | Age. No equipment history. Operations are satisfactory. |
| HVAC | 2 | Temporary fans. Heaters are old. |
| Chemical Equipment | 3 | New chemical building needed. No sealant on concrete floor. |
| Overall Facility Rating | 2.8 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 57 years old with no evidence of consistent maintenance and/or rehabilitation |
| 2 | No Cl2 residual sample monitoring. |
| 3 | Access issues- electrical improvements may potentially require building modifications to meet electrical code |
| 4 | No equipment records to indicate pump and motor rehabilitation. |
| 5 | |
| | |

## Photos

| Photo 1 – Sever pipe corrosion | Photo 2 – Severe pipe corrosion / Exposed earth |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W12 Judi Drive | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 09/30/14 | **TIME ARRIVED ON SITE** | 4:35 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1964 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Small site. Diesel standby generator 30 feet from private residence |
| Buildings and Structures | 3 | Metal in building in good shape. Interior walls require repair. |
| Security | 3 | Intrusion alarm on door only, Fencing around generator only. |
| Power Distribution | 3 | Has portable GenSet onsite with containment. Temporary power connections. |
| Electrical | 3 | Older MCC, control cabinets, switchgear |
| Instrumentation / Analyzers | 3 | Newer SCADA. Older flow metering and Cl2 residual |
| Pump | 2 | Age. Cannot determine last rehab date. Energy efficiency study indicates well pump significantly below expected performance. |
| Motor | 4 | Motor rehab in 2001. |
| Piping | 3 | Moderate to severe pipe corrosion |
| Valves | 3 | Age. No equipment history. Operations are satisfactory. New regulating valve. |
| HVAC | 2 | Temporary fans. Heaters are old. |
| Chemical Equipment | 3 | New chemical building needed. No sealant on concrete floor. Gap between floor and wall |
| Overall Facility Rating | 2.9 | Fair – Shows moderate signs of deterioration. |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 50 years old with no evidence of consistent maintenance and/or rehabilitation |
| 2 | No equipment records to indicate pump and motor rehabilitation |
| 3 | Energy efficiency study indicates well pump rehabilitation |
| 4 | . |
| 5 | |
| | |

## Photos

| Photo 1 – 50 HP pump and motor | Photo 2 – Severe corrosion / Exposed earth |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W13 Mountainview | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 4:35 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1968 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Blow –off site drains towards dry creek bed. Potential flood plain issues. |
| Buildings and Structures | 3 | Cracks in well room floor. Dents in steel building walls. No access hatch to well pump/motor. No link seals at header pipe floor penetrations. |
| Security | 5 | Video surveillance, intrusion alarms, fencing, and motion detectors |
| Power Distribution | 3 | Age. No standby power. |
| Electrical | 3 | Access issues to electrical panels. Newer conduit, but older MCC, control cabinets, switchgear |
| Instrumentation / Analyzers | 3 | Newer SCADA. Older flow metering. Newer Cl2 residual |
| Pump | 2 | Age. Noticeable non-metallic knock upon first 10 minutes of start up. No equipment history of rehab. Poor efficiency testing results. |
| Motor | 3 | Rehab of motor in 2001. |
| Piping | 0 | Not inspected. Insulation and jacketing around header piping. Condition unknown. |
| Valves | 3 | Age. No equipment history. Operations are satisfactory. |
| HVAC | 2 | Temporary fans. Heaters are old. |
| Chemical Equipment | 2 | New chemical building needed. No sealant on concrete floor. Gap between floor and wall. HVAC non-functional. Fire suppression installed. |
| Overall Facility Rating | 2.9 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 37 years old with no evidence of consistent maintenance and/or rehabilitation |
| 2 | Blow off piping discharge force overflows existing catch basin on hillside |
| 3 | Access issues- electrical improvements may potentially require building modifications to meet electrical code |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 | Photo 2 |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 16 – 24th Street Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/2014 | **TIME ARRIVED ON SITE** | 3:10 pm |
| **RUNNING (YES/NO)** | No – Out of Service | **INSTALL DATE** | 1969 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 2 | Metal building needs rehabilitation inside and out. |
| Security | 2 | Upgrade security. |
| Power Distribution | 2 | Upgrade power distribution. |
| Electrical | 2 | Upgrade electrical. |
| Instrumentation / Analyzers | 0 | Install instrumentation and analyzers. |
| Pump | 0 | Install pump and motor |
| Motor | 0 | See above |
| Piping | 2 | Install header piping. |
| Valves | 2 | Install valves. |
| HVAC | 2 | Install HVAC system. |
| Chemical Equipment | 0 | New chemical building |
| Overall Facility Rating | 2.3 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is currently out of service and has been converted to a filing station.  A complete rehabilitation of the facility is required. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – | Photo 2 – |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W17 Momont | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 10:46 |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1968 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Blow –off site drains towards dry creek bed. Potential flood plain issues. |
| Buildings and Structures | 3 | Older building. Exterior metal in good shape. Interior walls in bad shape. |
| Security | 5 | Intrusion alarms, fencing, and motion detectors |
| Power Distribution | 3 | Has portable GenSet onsite with containment. Temporary power connections. |
| Electrical | 3 | Access issues to electrical panels. Newer conduit, but older MCC, control cabinets, switchgear |
| Instrumentation / Analyzers | 4 | Newer SCADA. Newer Cl2 residual |
| Pump | 5 | Pump in process of replacement. Assumed to be in new condition upon in-service date |
| Motor | 5 | Motor in process of replacement. Assumed to be in new condition upon in-service date |
| Piping | 5 | New pipe on site, but not installed |
| Valves | 3 | Age. No equipment history. Operations are satisfactory. Older regulating valve |
| HVAC | 2 | Energy efficiency study indicates abnormally high baseline electrical load attributed to HVAC and building insulation |
| Chemical Equipment | 2 | New chemical building needed. No sealant on concrete floor. |
| Overall Facility Rating | 3.6 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 46 years old with no evidence of consistent maintenance. Pump, motor and piping in process of replacement. |
| 2 | Blow off piping discharges to dry creek bed |
| 3 | Evidence of potential flood events |
| 4 | Energy efficiency study noted the pump performance was poor, but did not recommend replacement due to historically low run hours. |
| 5 | |
| | |

## Photos

| Photo 1 – Blow-off pipe to dry creek bed | Photo 2 – Makeshift berm to divert run-off |
|---|---|
| | |

# Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 18 - Willowwood Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/2014 | **TIME ARRIVED ON SITE** | 3:20 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1968 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Well blowoff is eroding side of ditch. |
| Buildings and Structures | 3 | Metal building has not been recently painted with some denting. Interior walls good shape. Well Building interior floor cracked. No link seal at header floor penetration – 1 1/2' x 2' hole in floor. |
| Security | 4 | Fence. Has intrusion alarm. |
| Power Distribution | 3 | No standby power. |
| Electrical | 3 | Access issues to electrical panels. Newer conduit, but older MCC, control cabinets, switchgear. |
| Instrumentation / Analyzers | 4 | Newer SCADA. New flow metering. |
| Pump | 2 | Age. No equipment history of rehab. Poor efficiency testing results. |
| Motor | 2 | Age |
| Piping | 0 | Not inspected. Insulation and jacketing around header piping. Condition unknown. Info from city 9/2018 - Well casing from the Dickens well have been refurbished and will be installed at Willowwood. |
| Valves | 3 | No equipment history. Operations are satisfactory. |
| HVAC | 2 | Heaters are old. Automated HVAC not functioning. |
| Chemical Equipment | 2 | No leak detection. No spill containment. No chlorine analyzer. HVAC non-functional. |
| Overall Facility Rating | 2.8 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Upgrade site for standby power. |
| 2 | Access issues- electrical improvements may potentially require building modifications to meet electrical code. |
| 3 | Pump and motor are in need of replacement. |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1- Pump and motor | Photo 2 – Metal jacketing over header piping |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W19 N Russell | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 1:45 PM |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1969 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Cl2 analyzer sample drain exposed to public at backside of building. |
| Buildings and Structures | 2 | Interior of building in poor shape. Severe corrosion on doors pipe supports indicates high moisture levels. |
| Security | 3 | Intrusion alarms only. No fence |
| Power Distribution | 3 | Age. No standby power. |
| Electrical | 3 | Access issues to electrical panels. Newer conduit, but older MCC, control cabinets, switchgear |
| Instrumentation / Analyzers | 4 | Newer SCADA. Newer Cl2 residual |
| Pump | 2 | Age. No equipment history of rehab. |
| Motor | 4 | Motor rehabilitated in 2012. |
| Piping | 1 | No leak seals between floor and piping. Pipe patches at failure points. Severe corrosion. |
| Valves | 3 | Age. No equipment history. Operations are satisfactory. |
| HVAC | 2 | Temporary fans. Heaters are old. |
| Chemical Equipment | 2 | New chemical building needed. No sealant on concrete floor. Gap between floor and wall. HVAC non-functional. |
| Overall Facility Rating | 2.7 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 45 years old with no evidence of consistent maintenance and/or rehabilitation |
| 2 | Motor is rehabilitated, but no evidence of same on well pump |
| 3 | Imminent failure of pipe is likely. |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Pipe patch | Photo 2 – Missing link seals |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 20 – Catlin Street Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/2014 | **TIME ARRIVED ON SITE** | 10:45 am |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1969 |

## Condition Rankings

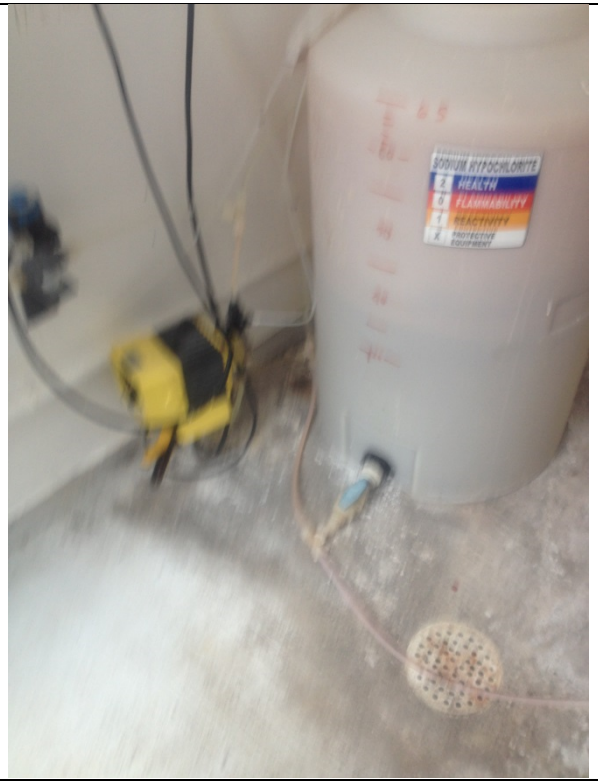
| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Blowoff directed right into creek next to facility. |
| Buildings and Structures | 3 | Exterior walls CMU and recently painted. Interior walls recently painted but crumbling at base. Interior floor cracked. No link seal at header floor penetration – 1 1/2' x 1 1/2' hole in floor. |
| Security | 4 | No fence. Has intrusion alarm. |
| Power Distribution | 3 | Age. No standby power. |
| Electrical | 3 | Access issues to electrical panels. Newer conduit, but older MCC, control cabinets, switchgear. |
| Instrumentation / Analyzers | 4 | Newer SCADA. Newer flow metering. |
| Pump | 2 | Age. No equipment history of rehab. Poor efficiency testing results. Pump not bolted down. |
| Motor | 3 | Rehab of motor in 1992. |
| Piping | 0 | Not inspected. Insulation and jacketing around header piping. Condition Unknown. |
| Valves | 3 | No equipment history. Operations are satisfactory. |
| HVAC | 2 | Age. Heaters very old. |
| Chemical Equipment | 2 | No leak detection. Chemical piping newer. No chlorine analyzer. Spill in Chemical Room, floor drain nearby. |
| Overall Facility Rating | 2.9 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Interior of Well Building is in need of some rehabilitation. |
| 2 | Access issues- electrical improvements may potentially require building modifications to meet electrical code. |
| 3 | Pump is in need of replacement. |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1- New flow meter and jacketing over piping | Photo 2 – Chlorine Room |
|---|---|
| |   |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W21 East Central | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 11:21 am |
| **RUNNING (YES/NO)** | Yes | **INSTALL DATE** | 1969 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Depression noticed at well blow off discharge pipe. |
| Buildings and Structures | 3 | Cinder block building. Interior walls in bad shape. Small footpring may not allow for electrical upgrades |
| Security | 3 | Intrusion alarm on door only, No fencing |
| Power Distribution | 3 | Older incoming power feed. No standby power |
| Electrical | 3 | Older MCC, control cabinets, switchgear |
| Instrumentation / Analyzers | 3 | Newer SCADA. Older flow metering. No Cl2 residual monitoring |
| Pump | 3 | Age. Cannot determine last rehab date. Energy efficiency study indicates pump performance is satisfactory. |
| Motor | 4 | Motor rehab in 2012. Motor runs cool no noticeable vibration. |
| Piping | 0 | Not inspected. Insulated and jacketing around header piping. Condition unknown. |
| Valves | 3 | Age. No equipment history. Operations are satisfactory. New regulating valve. |
| HVAC | 2 | Temporary fans. Heaters are old. |
| Chemical Equipment | 3 | New chemical building needed. No sealant on concrete floor. Gap between floor and wall. |
| Overall Facility Rating | 3 | Fair – Shows moderate signs of deterioration. |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 50 years old with no evidence of consistent maintenance and/or rehabilitation |
| 2 | No equipment records to indicate pump and motor rehabilitation |
| 3 | Energy efficiency study indicates well pump rehabilitation |
| 4 | . |
| 5 | |
| | |

## Photos

| Photo 1 – Circular depression at blow-off | Photo 2 – Site |
|---|---|
| | |
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W22 Intermountain | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 12:37 am |
| **RUNNING (YES/NO)** | Yes | **INSTALL DATE** | 1970 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Blow-off routed to stream. |
| Buildings and Structures | 3 | Metal Building. Interior walls in bad shape. Signs of condensation / damp pump room. |
| Security | 3 | Intrusion alarm on door only, No fencing |
| Power Distribution | 3 | Older incoming power feed. No standby power. |
| Electrical | 3 | Older MCC, control cabinets, switchgear. Surface rust on control panels |
| Instrumentation / Analyzers | 3 | Newer SCADA. Older flow metering. No Cl2 residual monitoring |
| Pump | 3 | Age. Cannot determine last rehab date. Energy efficiency study indicates pump performance is satisfactory. Pump foundation in poor condition. |
| Motor | 4 | Motor rehab in 2012. Motor runs cool no noticeable vibration. |
| Piping | 0 | Not inspected. Insulation and jacketing around header piping. Condition unknown. |
| Valves | 3 | Age. No equipment history. Operations are satisfactory. Older regulating valve. |
| HVAC | 2 | Temporary fans. Heaters are old. |
| Chemical Equipment | 3 | No sealant on containment floor. Gap between floor and wall |
| Overall Facility Rating | 3 | Fair – Shows moderate signs of deterioration. |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 44 years old with no evidence of consistent maintenance and/or rehabilitation |
| 2 | Well pump blow-off discharges to creek. |
| 3 | |
| 4 | . |
| 5 | |
| | |

## Photos

| Photo 1 – Pump foundation in poor condition | Photo 2 – Interior walls and insulation |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W23 Pattee Creek | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 11:37 am |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1973 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 3 | Cinder block building. Interior walls in bad shape. |
| Security | 4 | Intrusion alarm and fencing |
| Power Distribution | 3 | Has portable GenSet onsite with containment. Temporary power connections. |
| Electrical | 3 | Older MCC, control cabinets, switchgear. Some new electrical panels |
| Instrumentation / Analyzers | 3 | Newer SCADA. Older flow metering. No Cl2 residual monitoring |
| Pump | 3 | Age. Cannot determine last rehab date. Energy efficiency study indicates pump performance is satisfactory. |
| Motor | 4 | NO records of motor rehab. |
| Piping | 3 | Piping has moderate corrosion |
| Valves | 4 | No equipment history. Operations are satisfactory. Newer regulating valve. |
| HVAC | 2 | Temporary fans. Heaters are old. |
| Chemical Equipment | 4 | Chemical building is within the well pump house. Containment is satisfactory |
| Overall Facility Rating | 3.3 | Fair – Shows moderate signs of deterioration. |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 41 years old with no evidence of consistent maintenance and/or rehabilitation |
| 2 | No record on pump or motor rehabilitation |
| 3 | |
| 4 | . |
| 5 | |
| | |

## Photos

| Photo 1 – Temporary power connections | Photo 2 – Corroded pipe and base concrete |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W24 Pattee Creek | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 11:37 am |
| **RUNNING (YES/NO)** | Yes | **INSTALL DATE** | 1973 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Room for expansion |
| Buildings and Structures | 3 | Building footprint creates access issues to electrical cabinets. Interior walls in bad shape. |
| Security | 4 | Intrusion alarm, motion detectors and fencing |
| Power Distribution | 3 | Older incoming power feed. |
| Electrical | 3 | Older MCC, control cabinets, switchgear. |
| Instrumentation / Analyzers | 3 | Older flow metering. No Cl2 residual monitoring |
| Pump | 2 | Age. Cannot determine last rehab date. Energy efficiency study indicates pump performance is poor and recommends replacement. Pump is not properly mounted to foundation. |
| Motor | 3 | Last motor rehab in 1988 |
| Piping | 3 | Piping has surface rust. Shows evidence of replacement, but should have been primed and painted. |
| Valves | 4 | No equipment history. Operations are satisfactory. Newer regulating valve. |
| HVAC | 2 | Heaters are old. Energy efficiency study indicates building insulation is poor. |
| Chemical Equipment | 3 | Chemical building is in good condition. No sealant at secondary containment |
| Overall Facility Rating | 3.1 | Fair – Shows moderate signs of deterioration. |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 41 years old with no evidence of consistent maintenance and/or rehabilitation |
| 2 | No record on 50 hp pump rehabilitation |
| 3 | Energy Efficiency Study recommends pump replacement. |
| 4 | . |
| 5 | |
| | |

## Photos

| Photo 1 – Interior walls in bad shape | Photo 2 – Pump foundation not bolted down |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 25 – Stephens Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/1/2014 | **TIME ARRIVED ON SITE** | 12:10 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1973 |

## Condition Rankings

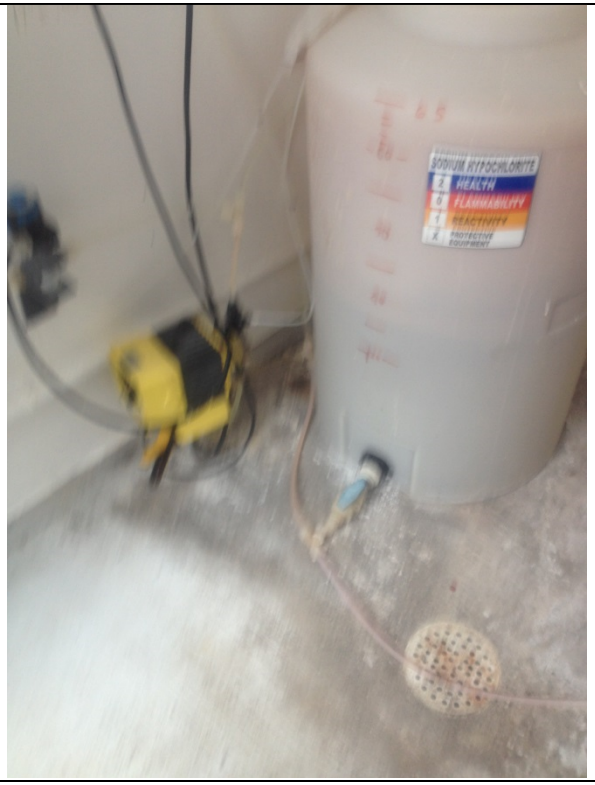
| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 3 | Wood frame vinyl siding. Interior walls recently painted but crumbling at base. Interior floor cracked. |
| Security | 4 | Fence around standby engine generator. Has intrusion alarm. |
| Power Distribution | 3 | Age. |
| Electrical | 3 | Access issues to electrical panels. Newer conduit, but older MCC, control cabinets, switchgear. |
| Instrumentation / Analyzers | 4 | Newer SCADA. Newer flow metering. |
| Pump | 2 | Age. No equipment history of rehab. Poor efficiency testing results. Pump not bolted down. |
| Motor | 3 | Rehab of motor in 2009. |
| Piping | 3 | Corrosion on piping. |
| Valves | 3 | No equipment history. Operations are satisfactory. |
| HVAC | 2 | Age. Heaters very old. |
| Chemical Equipment | 3 | No leak detection. Chemical piping newer. HVAC non-functional. |
| Overall Facility Rating | 3.1 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Interior of Well Building is in need of some rehabilitation. |
| 2 | Access issues- electrical improvements may potentially require building modifications to meet electrical code. |
| 3 | Pump is in need of replacement. |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1- Pump resting on top of pipe blind flange | Photo 2 – Chlorine Room |
|---|---|
| |   |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 26 – Benton Avenue Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/1/2014 | **TIME ARRIVED ON SITE** | 12:30 pm |
| **RUNNING (YES/NO)** | Yes | **INSTALL DATE** | 1972 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 3 | Metal building in good shape. Interior walls deteriorating at base. No link seal at header floor penetration – 1 1/2' x 1 1/2' hole in floor. |
| Security | 4 | New fence. Has intrusion alarm. |
| Power Distribution | 3 | Age. No standby power. |
| Electrical | 3 | Access issues to electrical panels. Newer conduit and motor starter, but older MCC, control cabinets, switchgear. |
| Instrumentation / Analyzers | 4 | Newer SCADA. Newer flow metering. |
| Pump | 2 | Age. No equipment history of rehab. Poor efficiency testing results. Pump not bolted down. |
| Motor | 2 | Rehab of motor in 2006. Motor felt hot and had vibration. |
| Piping | 3 | Corrosion on piping |
| Valves | 3 | No equipment history. Operations are satisfactory. |
| HVAC | 2 | Age. Heaters very old. |
| Chemical Equipment | 2 | No leak detection. Chemical piping newer. No chlorine analyzer. Spill in Chemical Room, floor drain nearby. Questionable if spill containment will hold entire amount of chemical stored. |
| Overall Facility Rating | 2.9 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Interior of Well Building is in need of some rehabilitation. |
| 2 | Access issues- electrical improvements may potentially require building modifications to meet electrical code. |
| 3 | Pump and possibly motor is in need of replacement. |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1- Corrosion on piping and floor penetration | Photo 2 – Blowoff valve and pump motor |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 27 – 26th Avenue Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/2014 | **TIME ARRIVED ON SITE** | 1:50 pm |
| **RUNNING (YES/NO)** | Yes | **INSTALL DATE** | 1972 |

## Condition Rankings

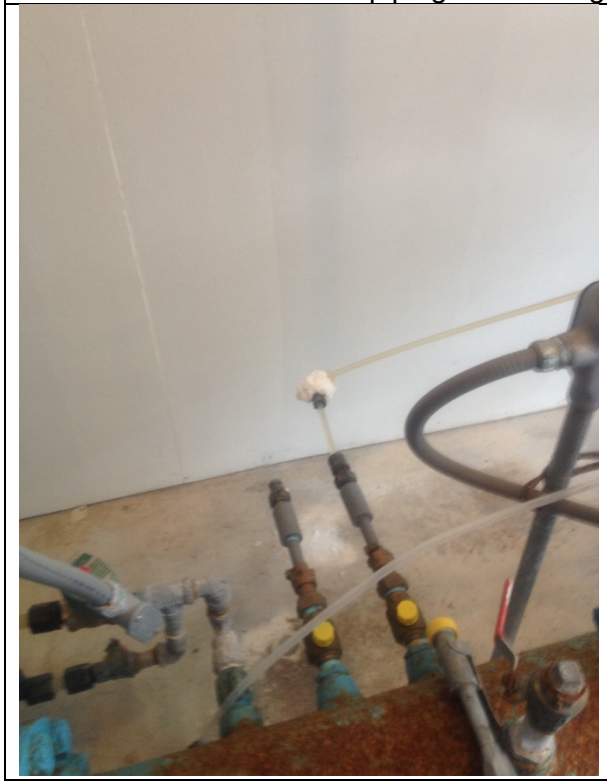
| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 3 | Exterior walls are CMU recently painted. Interior walls good shape and recently painted. Interior floor has minor cracking. No link seal at header floor penetration - 2' x 2' hole in floor. |
| Security | 4 | New fence. Has intrusion alarm. |
| Power Distribution | 3 | No standby power. |
| Electrical | 3 | Access issues to electrical panels. Newer conduit, but older MCC, control cabinets, switchgear. |
| Instrumentation / Analyzers | 3 | Newer SCADA. Newer flow metering. |
| Pump | 2 | Age. No equipment history of rehab. |
| Motor | 3 | Rehab of motor in 2001. Efficiency tests indicate a retest. |
| Piping | 3 | Corrosion on piping. |
| Valves | 3 | No equipment history. Operations are satisfactory. |
| HVAC | 2 | Age |
| Chemical Equipment | 2 | No leak detection. Chemical piping leaking. No chlorine analyzer. HVAC non-functional. |
| Overall Facility Rating | 2.9 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Access issues- electrical improvements may potentially require building modifications to meet electrical code. |
| 2 | Pump and motor are in need of replacement. |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1- Corroded header piping and leaking chlorine lines | Photo 2 – Chlorine Room |
|---|---|
|  | |

# Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 29 – Orchard Avenue Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/30/2014 | **TIME ARRIVED ON SITE** | 3:35 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1973 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 3 | Exterior walls are CMU recently painted. Interior walls good shape. Interior floor cracked. No link seal at header floor penetration (jackhammered concrete to put on header piping jacketing) - 2' x 2' hole in floor. |
| Security | 4 | New fence. Has intrusion alarm. |
| Power Distribution | 3 | No |
| Electrical | 3 | Access issues to electrical panels. Newer conduit, but older MCC, control cabinets, switchgear. |
| Instrumentation / Analyzers | 3 | Newer SCADA. Newer flow metering. |
| Pump | 2 | Age. No equipment history of rehab. Poor efficiency testing results. Bolts missing off pump base. |
| Motor | 3 | Rehab of motor in 2008. |
| Piping | 0 | Not inspected. Insulation and jacketing around header piping. Condition unknown. |
| Valves | 3 | No equipment history. Operations are satisfactory. |
| HVAC | 2 | Age |
| Chemical Equipment | 3 | No leak detection. Chemical piping newer. HVAC non-functional |
| Overall Facility Rating | 3.0 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Access issues- electrical improvements may potentially require building modifications to meet electrical code. |
| 2 | Pump is in need of replacement. |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1- Flow meter and header pipe jacketing | Photo 2 – Chlorine Room |
|---|---|
| | |

## Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W30 Bank Street | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 10:45 AM |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1974 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Site is downtown and fenced |
| Buildings and Structures | 2 | Older metal building in fair shape. No hatch for access to pump for maintenance. |
| Security | 3 | Intrusion alarms and fencing |
| Power Distribution | 3 | Has portable GenSet onsite with containment. Temporary power connections |
| Electrical | 4 | None |
| Instrumentation / Analyzers | 4 | Newer SCADA. Newer Cl2 residual |
| Pump | 3 | No record of pump rehab. Pump base badly corroded. |
| Motor | 2 | See above |
| Piping | 3 | Surface rust mainly. Needs painting. |
| Valves | 3 | Valves appear to be in OK shape |
| HVAC | 2 | Age |
| Chemical Equipment | 2 | Some containment but it appears not enough if both totes failed at the same time |
| Overall Facility Rating | 2.7 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 36 years old with no evidence of consistent maintenance and/or rehabilitation |
| 2 | No history of well pump rehab, but it appears roof had been removed in the past for access to pump. |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| | |
|---|---|
| Photo 1 – Badly corroded pump base | Photo 2 – Well site |

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## Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W31 Kiwanis Street | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 3:40 PM |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1976 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 2 | Site is poor with little apparent room for expansion |
| Buildings and Structures | 2 | Older metal building in fair shape. No hatch for access to pump for maintenance. |
| Security | 2 | Intrusion alarms and no fencing |
| Power Distribution | 3 | Temporary power connections |
| Electrical | 3 | Older panels inside and outside |
| Instrumentation / Analyzers | 4 | Newer SCADA. Newer Cl2 residual |
| Pump | 3 | No record of pump rehab. Submersible pump. |
| Motor | 2 | See above |
| Piping | 3 | Surface rust mainly. Needs painting. |
| Valves | 3 | Valves appear to be in fair shape. Older regulating valve. |
| HVAC | 2 | Age |
| Chemical Equipment | 2 | Some containment but it appears not enough if both totes failed at the same time. Tight space. |
| Overall Facility Rating | 2.7 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 38 years old with no evidence of consistent maintenance and/or rehabilitation |
| 2 | No history of well pump rehab, but it appears roof had been removed in the past for access to pump. |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Badly corroded piping | Photo 2 – Well site |
|---|---|
| | |

## Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W32 Arthur Street | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 10:45 AM |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1978 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Site is fenced. Some room for expansion |
| Buildings and Structures | 3 | Older metal building in fair shape, with enough room for maintenance. No hatch for access to pump for maintenance. |
| Security | 4 | Intrusion alarms and fencing |
| Power Distribution | 3 | Has portable GenSet onsite with containment. Temporary power connections |
| Electrical | 3 | Main disconnect corroding badly on bottom due to multiple water leaks inside building |
| Instrumentation / Analyzers | 4 | Newer SCADA. Newer Cl2 residual |
| Pump | 3 | No record of pump rehab, but it appears that roof had been removed in the past for pump R & R. Efficiency report shows pump is within its system curve |
| Motor | 2 | See above |
| Piping | 3 | Surface rust mainly, but some appurtenances badly rusted. Multiple water leaks. Needs painting. |
| Valves | 3 | Valves appear to be in OK shape, but flow meter appears to have been changed out in the last 10 years. Regulating valve shows signs of rehab |
| HVAC | 2 | Air ducting/louvers blocked off. Older heater. |
| Chemical Equipment | 2 | Some containment but it appears not enough if both totes failed at the same time. |
| Overall Facility Rating | 3.0 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 36 years old with no evidence of consistent maintenance and/or rehabilitation |
| 2 | No history of well pump rehab, but it appears roof had been removed in the past for access to pump. |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Pump room | Photo 2 – Well site |
|---|---|
| | |

| | |
|---|---|
| Corrosion on bottom of electrical panel<br> | |

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## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W33 Gerald Avenue | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/30/14 and 10/2/14 | **TIME ARRIVED ON SITE** | 11:30 AM and 10:45 AM |
| **RUNNING (YES/NO)** | Yes on second visit | **INSTALL DATE** | 1977 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Blow –off site drains down embankment towards Clark Fork River. Potential bank erosion. Sample drain puddle. |
| Buildings and Structures | 3 | Cracks in well room floor. Dents in steel building exterior walls. No access hatch to well pump/motor. No link seals at header pipe floor penetrations. |
| Security | 5 | Video surveillance, intrusion alarms, fencing, and motion detectors |
| Power Distribution | 3 | Age. No standby power. |
| Electrical | 3 | Access issues to electrical panels. Newer conduit, but older MCC, control cabinets, switchgear |
| Instrumentation / Analyzers | 3 | Newer SCADA. Older flow metering. Newer Cl2 residual |
| Pump | 2 | Age. Noticeable non-metallic knock upon first 10 minutes of start up. No equipment history of rehab. Poor efficiency testing results. |
| Motor | 3 | Rehab of motor in 2001. |
| Piping | 0 | Not inspected. Insulation and jacketing around header piping. Condition unknown |
| Valves | 3 | Age. No equipment history. Operations are satisfactory. |
| HVAC | 2 | Temporary fans. Heaters are old. |
| Chemical Equipment | 2 | New chemical building needed. No sealant on concrete floor. Gap between floor and wall. HVAC non-functional. Fire suppression installed. |
| Overall Facility Rating | 3 | Fair – Shows moderate signs of deterioration. |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 37 years old with no evidence of consistent maintenance and/or rehabilitation |
| 2 | Blow off piping discharge force overflows existing catch basin on hillside |
| 3 | Access issues- electrical improvements may potentially require building modifications to meet electrical code |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 | Photo 2 Dented building |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W34 Maurice Ave | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 10:57 AM |
| **RUNNING (YES/NO)** | NO | **INSTALL DATE** | 1978 |

## Condition Rankings

| ASSET TYPE | CR | REASON FOR RANKING |
|---|---|---|
| Site | 3 | Shared site with wastewater collection pump station. Cl2 sample draining to outside of building. |
| Buildings and Structures | 3 | Well station roof patched. |
| Security | 5 | Intrusion alarms, fencing, and motion detectors |
| Power Distribution | 3 | Temporary power leads in race track. Older switchgear. Good generator maintenance. |
| Electrical | 3 | Access issues to electrical panels. Newer conduit, but older MCC, control cabinets, switchgear. Very poor lighting. |
| Instrumentation / Analyzers | 4 | Newer SCADA. Newer flow metering. Newer Cl2 residual. |
| Pump | 2 | Age. No equipment history of rehab. Poor efficiency testing results. Volute site glass had no oil showing. |
| Motor | 3 | Last rehabilitation of motor in 1986. |
| Piping | 0 | Not inspected. Insulation and jacketing around header piping. Condition unknown. |
| Valves | 4 | Newer regulating valve and pilots. No equipment history. Operations are satisfactory. |
| HVAC | 2 | Older heaters. Internal building shows signs of high condensation. Wooden louvers. |
| Chemical Equipment | 2 | 1 inch gap in chemical room roof. Signs of settling and bracing between chemical room and well station. |
| Overall Facility Rating | 3.1 | Fair – Shows moderate signs of deterioration. |

| RANKINGS | | | | |
|---|---|---|---|---|
| 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Facility is 36 years old with no evidence of consistent maintenance and/or rehabilitation |
| 2 | Older electrical issues. |
| 3 | Access issues- electrical improvements may potentially require building modifications to meet electrical code |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 See roof in poor condition | Photo 2 Cramped space |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 35 – Southgate Mall Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/2014 | **TIME ARRIVED ON SITE** | 11:35 am |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1978 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 3 | Exterior walls are brick with backside recently painted. Upper wood fascia is aging and peeling. Interior walls in good shape. Interior floor has cracking. Header pipe penetrates floor through sump without seal around piping - 21/2' x 21/2' hole in floor. |
| Security | 4 | New fence. Has intrusion alarm. |
| Power Distribution | 3 | No standby power. |
| Electrical | 3 | Age |
| Instrumentation / Analyzers | 3 | Newer SCADA. Newer flow metering. |
| Pump | 2 | Age. No equipment history of rehab. Poor efficiency testing results. |
| Motor | 3 | Rehab of motor in 2001. |
| Piping | 0 | Not inspected. Insulation and jacketing around header piping. |
| Valves | 2 | No equipment history. Operations are satisfactory. |
| HVAC | 2 | Age |
| Chemical Equipment | 2 | No spill alarm. Chemical piping newer. No chlorine analyzer. HVAC non-functional |
| Overall Facility Rating | 2.8 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Pump and motor are in need of replacement. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1- Header piping floor penetration | Photo 2 – Non-function HVAC fan |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W26 – Dickens Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | Not Inspected – Inactive Since 2003 | **TIME ARRIVED ON SITE** | |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 0 | |
| Buildings and Structures | 0 | |
| Security | 0 | |
| Power Distribution | 0 | |
| Electrical | 0 | |
| Instrumentation / Analyzers | 0 | |
| Pump | 0 | |
| Motor | 0 | |
| Piping | 0 | |
| Valves | 0 | |
| HVAC | 0 | |
| Chemical Equipment | 0 | |
| Overall Facility Rating | 0.0 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

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## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W38 – 23rd Avenue Well – East | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/2014 | **TIME ARRIVED ON SITE** | 2:50 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1971 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 4 | Metal siding and fascia in good shape. Wood shingle roof aged. CMU interior walls good shape. Floor good shape. |
| Security | 4 | Fence. Has intrusion alarm. |
| Power Distribution | 4 | Standby power. |
| Electrical | 4 | |
| Instrumentation / Analyzers | 3 | Newer SCADA. Newer flow metering. |
| Pump | 2 | Age. No equipment history of rehab. Poor efficiency testing results. Two pitless adapters on-site (100 hp pumps, known as Booster Station B27 (east)). |
| Motor | 3 | Rehab of motor in 1992. |
| Piping | 4 | Header piping painting in good shape |
| Valves | 3 | Age. No equipment history. Operations are satisfactory. |
| HVAC | 2 | Age |
| Chemical Equipment | 3 | No leak detection. Chemical piping newer. HVAC non-functional. |
| Overall Facility Rating | 3.3 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Pump and motor are in need of replacement. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1- Pump and motor | Photo 2 – Chemical Room |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W39 – 23rd Avenue Well – West | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/2014 | **TIME ARRIVED ON SITE** | 2:50 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1971 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | |
| Buildings and Structures | 4 | Metal siding and fascia in good shape. Wood shingle roof aged. CMU interior walls good shape. Floor good shape. |
| Security | 4 | Fence. Has intrusion alarm. |
| Power Distribution | 4 | Standby power. |
| Electrical | 4 | |
| Instrumentation / Analyzers | 3 | Newer SCADA. Newer flow metering. |
| Pump | 2 | Age. No equipment history of rehab. Poor efficiency testing results. Two pitless adapters on-site (100 hp pumps, known as Booster Station B27 (west)). |
| Motor | 3 | Rehab of motor in 2011. |
| Piping | 4 | Header piping painting in good shape |
| Valves | 3 | Age. No equipment history. Operations are satisfactory. |
| HVAC | 2 | Age |
| Chemical Equipment | 3 | No leak detection. Chemical piping newer. HVAC non-functional. |
| Overall Facility Rating | 3.3 | |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Pump and motor are in need of replacement.  Even though motor was rehabbed in 2011, its age considers it for replacement. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1- Well Building | Photo 2 – |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W40 – Linda Vista Golf Course Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/2014 | **TIME ARRIVED ON SITE** | 4:10 pm |
| **RUNNING (YES/NO)** | No | **INSTALL DATE** | 1990 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 3 | Potential flooding of pitless adapters. |
| Buildings and Structures | 4 | Wood building in good shape. Roof shows signs of aging. |
| Security | 3 | No fence. Has intrusion alarm. |
| Power Distribution | 3 | Standby power capable. |
| Electrical | 4 | Newer electrical. |
| Instrumentation / Analyzers | 4 | Newer SCADA. New flow metering. |
| Pump | 0 | Pitless Adapters. Concrete bases but not sealed. |
| Motor | 0 | Pitless Adapters. |
| Piping | 3 | Corrosion on piping. |
| Valves | 3 | No equipment history. Operations are satisfactory. |
| HVAC | 2 | Age |
| Chemical Equipment | 3 | No leak detection. Chemical piping newer. HVAC non-functional. |
| Overall Facility Rating | 3.2 | |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Pitless adapters could be susceptible to flooding that occurs in the area. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1- Pitless adapter base - not sealed | Photo 2 – Corrosion on piping. |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W41 Great Northern | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 9:25 |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | 2001 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Sample drain puddle. |
| Buildings and Structures | 4 | Structure and roof in good condition. New paint. No fire suppression or extinguisher. |
| Security | 5 | Intrusion alarms, fencing, and motion detectors |
| Power Distribution | 4 | No standby power quick connects |
| Electrical | 4 | No issues. |
| Instrumentation / Analyzers | 4 | Newer SCADA. |
| Pump | 4 | Running. Excessive packing leakage. Energy efficiency testing notes pump and motor perform well. |
| Motor | 4 | New motor in 2001. See above |
| Piping | 3 | Shows moderate signs of deterioration. |
| Valves | 3 | Age. No equipment history. Operations are satisfactory. Older regulating valve that is leaking at fittings. |
| HVAC | 3 | Standard fans and heaters. Energy study recommends upgrades. |
| Chemical Equipment | 3 | New chemical building needed. No sealant on concrete floor. No alarm for eye wash usage. |
| Overall Facility Rating | 3.8 | Good – Shows age, but no apparent signs of deterioration |

| RANKINGS | | | | |
|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Recent paint on exterior of building |
| 2 | Blow off piping discharge back to well |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1- Moderate pipe corrosion | Photo 2 – Moderate valve corrosion |
|---|---|
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W42 Palmer St | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 10:14 |
| **RUNNING (YES/NO)** | YES | **INSTALL DATE** | 2001 |

## Condition Rankings

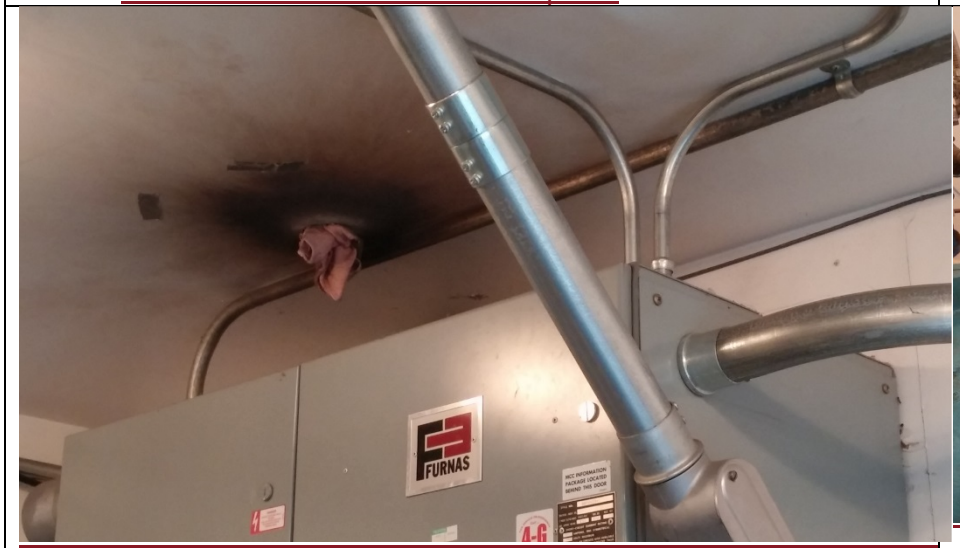
| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 4 | Sample drain puddle. |
| Buildings and Structures | 3 | Interior ceiling repairs. Interior walls in poor condition. New paint. No fire suppression. |
| Security | 5 | Intrusion alarms, fencing, and motion detectors |
| Power Distribution | 4 | Standby generator on-site. Connections are temporary. Need to make permanent. |
| Electrical | 4 | No issues. |
| Instrumentation / Analyzers | 4 | Newer SCADA. Newer Cl2 residual analyzer |
| Pump | 4 | Running. Excessive packing leakage. Energy efficiency testing notes pump and motor perform well. |
| Motor | 4 | New motor in 2001. See above |
| Piping | 3 | Shows moderate signs of deterioration. |
| Valves | 3 | Age. No equipment history. Operations are satisfactory. Older regulating valve that is leaking at fittings. |
| HVAC | 3 | Standard fans and heaters. Energy study recommends upgrades. |
| Chemical Equipment | 3 | New chemical building needed. No sealant on concrete floor. |
| Overall Facility Rating | 3.7 | Good – Shows age, but no apparent signs of deterioration |

| | | | | |
|---|---|---|---|---|
| **RANKINGS** | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | Recent paint on exterior of building |
| 2 | Blow off piping discharge back to well |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 Scorched mark above electrical panel | Photo 2 Corrosion on piping |
|---|---|
|   | |
| | |

## Facility Inspection Form - Mountain Water Company

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W43 Canyon River | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 09:40 am |
| **RUNNING (YES/NO)** | NO | **INSTALL DATE** | 2013 |

## Condition Rankings

| ASSET TYPE | CR | COMMENTS |
|---|---|---|
| Site | 5 | Good access. Blow off to rock lined sump. |
| Buildings and Structures | 5 | New |
| Security | 5 | New |
| Power Distribution | 5 | Permanent standby power installed |
| Electrical | 5 | New |
| Instrumentation / Analyzers | 5 | New |
| Pump | 5 | New |
| Motor | 5 | New |
| Piping | 5 | New |
| Valves | 5 | New |
| HVAC | 5 | New |
| Chemical Equipment | 4 | No sealant on concrete at secondary containment. |
| Overall Facility Rating | 5 | Good – Shows age, but no apparent signs of deterioration |

| RANKINGS | | | | | |
|---|---|---|---|---|---|
| | 0 | Not inspected | 3 | Fair – Shows moderate signs of deterioration. |
| | 1 | Unserviceable – Failure is imminent. | 4 | Good – Shows age, but no apparent signs of deterioration |
| | 2 | Poor – Shows severe signs of deterioration. | 5 | Excellent – Like new condition |

## Comments

| | |
|---|---|
| 1 | New facility commissioned in 2013. Facility does not appear to be in-service at this time. Hypochlorite tank has never been used. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| | |

## Photos

| Photo 1 – Rock-lined sump for well blow-off | Photo 2 – Chemical containment |
|---|---|
| | |

# Appendix H

# Condition Assessment Ratings and Improvement Costs

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## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B01 – Gharrett Street | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 3:50 pm |
| | | **INSTALL DATE** | 1992 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | $3,000 | $5,000 |
| Buildings and Structures | Install fence | | |
| Security | None | | |
| Power Distribution | Install new switchgear | $20,000 | $30,000 |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | None | | |
| Motor | None | | |
| Piping | N/A | | |
| Valves | None | | |
| HVAC | None | | |
| Chemical Equipment | None | | |
| | **TOTAL** | $23,000 | $35,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B02 – Lower Elk Ridge | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 2:39 pm |
| | | **INSTALL DATE** | 1966 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Cost for right of way analysis and relocation | $0 | $100,000 |
| Buildings and Structures | Building 48 years old and in fair shape. Interior walls need some rehabilitation. | $2,000 | $5,000 |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | Corrosion, needs painting | $1,000 | $3,000 |
| Motor | None | | |
| Piping | Prep and coat piping | $2,000 | $4,000 |
| Valves | None | | |
| HVAC | None | | |
| Chemical Equipment | None | | |
| | **TOTAL** | $5,000 | $112,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B04 – High Park | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 12:00 pm |
| | | **INSTALL DATE** | 1979 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Install measures to prevent flooding. Install concrete access steps. | $10,000 | $25,000 |
| Buildings and Structures | Due to electrical improvements construct small adjoining electrical room | $10,000 | $15,000 |
| Security | Install fence | $3,000 | $5,000 |
| Power Distribution | Install new switchgear | $20,000 | $30,000 |
| Electrical | Install new MCC, control and lighting panels | $15,000 | $20,000 |
| Instrumentation / Analyzers | Replace older flow meter | $5,000 | $8,000 |
| Pump | Replace middle pump. Install foundations to meet industry standard. | $10,000 | $35,000 |
| Motor | None | | |
| Piping | Replace a good majority of header piping. Install pipe supports. | $10,000 | $20,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Upgrade building HVAC | $2,000 | $3,000 |
| Chemical Equipment | None | | |
| | **TOTAL** | $85,000 | $181,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B05 – Upper Farviews | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 12:00 pm |
| | | **INSTALL DATE** | 1979 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Install measures to prevent flooding of pitless adapters | $2,000 | $4,000 |
| Buildings and Structures | None | | |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | None | | |
| Motor | None | | |
| Piping | Prep and coat piping | $1,000 | $2,000 |
| Valves | None | | |
| HVAC | None | | |
| Chemical Equipment | None | | |
| | **TOTAL** | $3,000 | $6,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B06 – Upper Elk Ridge | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 3:40 pm |
| | | **INSTALL DATE** | 1990 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Steps, better access needed | $2,000 | $5,000 |
| Buildings and Structures | None | | |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | None | | |
| Motor | None | | |
| Piping | None | | |
| Valves | None | | |
| HVAC | Replace heater | $1,000 | $2,000 |
| Chemical Equipment | None | | |
| | **TOTAL** | $3,000 | $7,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B07 – Upper Lincoln Hills | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 4:00 pm |
| | | **INSTALL DATE** | 1991 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | None | | |
| Security | None | | |
| Power Distribution | Replace temporary backup power connections with permanent installation | $10,000 | $15,000 |
| Electrical | Replace step down transformer | $1,000 | $2,000 |
| Instrumentation / Analyzers | Replace older flow meter | $5,000 | $8,000 |
| Pump | Contingency for 60 hp pump and motor rehab | $20,000 | $30,000 |
| Motor | See above | | |
| Piping | Contingency for pipe replacement | $5,000 | $10,000 |
| Valves | None | | |
| HVAC | Rehabilitate heating and ventilation to alleviate condensation issues | $2,000 | $3,000 |
| Chemical Equipment | None | | |
| | **TOTAL** | $43,000 | $68,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B08 – Upper Farviews | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 9:30 am |
| | | **INSTALL DATE** | Unknown |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Rehabilitate well building | $10,000 | $20,000 |
| Security | Install fence | $3,000 | $5,000 |
| Power Distribution | Install new switchgear and make standby power capable | $25,000 | $35,000 |
| Electrical | Install new MCC, control and lighting panels | $15,000 | $20,000 |
| Instrumentation / Analyzers | None | | |
| Pump | Replace two pumps and one 25 hp motor. Pump foundations to industry standards. | $27,000 | $39,000 |
| Motor | See above | | |
| Piping | Prep and coat piping | $1,000 | $2,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Upgrade building HVAC | $2,000 | $3,000 |
| Chemical Equipment | None | | |
| | **TOTAL** | $83,000 | $144,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B09 – Skyview @ Gharrett | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 3:15 pm |
| | | **INSTALL DATE** | Unknown |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Minor rehabilitation well building. | $1,000 | $3,000 |
| Security | None | | |
| Power Distribution | Install new switchgear and make standby power capable. | $25,000 | $35,000 |
| Electrical | Install new MCC, control and lighting panels. | $15,000 | $20,000 |
| Instrumentation / Analyzers | None | | |
| Pump | None | | |
| Motor | None | | |
| Piping | Prep and coat piping. | $2,000 | $4,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Upgrade building HVAC | $2,000 | $3000 |
| Chemical Equipment | None | | |
| | **TOTAL** | $45,000 | $85,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B13 – Rattlesnake | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 2:15 pm |
| | | **INSTALL DATE** | 1973 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Building needs to be replaced. Existing footprint is inadequate. Includes reroute and replacement of buried pipe. | $110,000 | $165,000 |
| Security | None | | |
| Power Distribution | Replace main feed and switchgear | $45,000 | $65,000 |
| Electrical | Remaining older panels should be replaced. | $20,000 | $30,000 |
| Instrumentation / Analyzers | Relocate into new building | $3,000 | $22,000 |
| Pump | Replace 2 pumps including new foundation | $40,000 | $60,000 |
| Motor | Replace 2 motors | $30,000 | $45,000 |
| Piping | Replace | $10,000 | $15,000 |
| Valves | Needs to be replaced. External pipe in pump room only. | $10,000 | $20,000 |
| HVAC | Replace with new building HVAC | $5,000 | $8,000 |
| Chemical Equipment | None | | |
| | **TOTAL** | $273,000 | $430,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B14 – Lower Lincoln Hills Booster | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 4:30 pm |
| | | **INSTALL DATE** | 1991 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Cost for right of way analysis | $0 | $10,000 |
| Buildings and Structures | New building will be needed for electrical upgrade and access issues | $10,000 | $15,000 |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | Install new MCC, control and lighting panels | $15,000 | $20,000 |
| Instrumentation / Analyzers | None | | |
| Pump | Expected pump rehab | $3,000 | $5,000 |
| Motor | See above | | |
| Piping | Prep and coat piping | $1,000 | $2,000 |
| Valves | Nearing life expectancy | $10,000 | $15,000 |
| HVAC | Upgrade building HVAC | $2,000 | $3,000 |
| Chemical Equipment | None | | |
| | **TOTAL** | $41,000 | $70,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B15 – Highpark @ S Reservoir | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 11:30 am |
| | | **INSTALL DATE** | Unknown |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | None | | |
| Security | None | | |
| Power Distribution | Replace temporary backup power connections with permanent installation. | $10,000 | $15,000 |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | None | | |
| Motor | See above | | |
| Piping | Prep and coat piping | $2,000 | $4,000 |
| Valves | None | | |
| HVAC | None | | |
| Chemical Equipment | None | | |
| | **TOTAL** | $12,000 | $19,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B16 – Lower Farviews | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 9:15 am |
| | | **INSTALL DATE** | Unknown |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Minor rehabilitation well building. | $1,000 | $3,000 |
| Security | Install fence. | $3,000 | $5,000 |
| Power Distribution | Install new switchgear and make standby power capable. | $25,000 | $35,000 |
| Electrical | Install new MCC, control and lighting panels. | $15,000 | $20,000 |
| Instrumentation / Analyzers | None | | |
| Pump | Replace pump and motor | $20,000 | $40,000 |
| Motor | See above | | |
| Piping | Prep and coat piping. | $2,000 | $4,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Upgrade building HVAC | $2,000 | $3000 |
| Chemical Equipment | None | | |
| | **TOTAL** | $68,000 | $130,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B17 – Hillview @ Skyview | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 3:40 pm |
| | | **INSTALL DATE** | 1992 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | None | | |
| Security | None | | |
| Power Distribution | Replace temporary backup power connections with permanent installation | $10,000 | $15,000 |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | Contingency for 100hp pump and motor rehab | $30,000 | $40,000 |
| Motor | See above | | |
| Piping | Prep and coat piping | $2,000 | $3,000 |
| Valves | None | | |
| HVAC | None | | |
| Chemical Equipment | None | | |
| | **TOTAL** | $42,000 | $58,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B18 – Upper Hillview | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 4:00 pm |
| | | **INSTALL DATE** | 1992 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | None | | |
| Security | None | | |
| Power Distribution | Replace temporary backup power connections with permanent installation. | $10,000 | $15,000 |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | None | | |
| Motor | Replace motors | $0 | $10,000 |
| Piping | Prep and coat piping. | $2,000 | $4,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | None | | |
| Chemical Equipment | None | | |
| | **TOTAL** | $12,000 | $49,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B20 – East Missoula | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 10:08 am |
| | | **INSTALL DATE** | |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Building needs some exterior patch work, finish painting | $1,000 | $2,000 |
| Security | Install fence | $3,000 | $5,000 |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | None | | |
| Motor | None | | |
| Piping | None | | |
| Valves | None | | |
| HVAC | None | | |
| Chemical Equipment | None | | |
| | **TOTAL** | $4,000 | $7,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B21 – Upper Linda Vista | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 2:00 pm |
| | | **INSTALL DATE** | 1993 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Minor rehabilitation well building | $1,000 | $3,000 |
| Security | Install fence | $3,000 | $5,000 |
| Power Distribution | Install new switchgear and make standby power capable | $25,000 | $35,000 |
| Electrical | Install new MCC, control and lighting panels | $15,000 | $20,000 |
| Instrumentation / Analyzers | None | | |
| Pump | Bolt pumps to foundation | $1,000 | 2,000 |
| Motor | See above | | |
| Piping | Replace and/or prep and coat piping | $2,000 | $10,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Upgrade building HVAC | $2,000 | $3,000 |
| Chemical Equipment | None | | |
| | **TOTAL** | $49,000 | $98,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B23 Upper Prospect | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/30/14 and 10/2/14 | **TIME ARRIVED ON SITE** | 11:48 AM and 12:08 PM |
| | | **INSTALL DATE** | 1981 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Stabilize slope and install retaining wall. Install wider concrete steps. | $10,000 | $25,000 |
| Buildings and Structures | Due to electrical improvements construct small adjoining electrical room | $10,000 | $15,000 |
| Security | Replace fencing | $3,000 | $5,000 |
| Power Distribution | Install new switchgear | $20,000 | $30,000 |
| Electrical | Install new pump disconnect, motor starter cabinet, and 110v panel | $20,000 | $25,000 |
| Instrumentation / Analyzers | Replace older flow meter | $5,000 | $8,000 |
| Pump | Replace middle pump. Install foundations to meet industry standard. Reconfigure drainage. | $10,000 | $20,000 |
| Motor | See above | | |
| Piping | Replace remaining older pipe. Prep and coat piping. | $5,000 | $10,000 |
| Valves | None | | |
| HVAC | Upgrade building HVAC | $2,000 | $3,000 |
| Chemical Equipment | None | | |
| | **TOTAL** | $85,000 | $141,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B24 – Grant Creek | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 12:06 pm |
| | | **INSTALL DATE** | 2001 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | None | | |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | Corrosion, needs painting | $1,000 | $3,000 |
| Motor | None | | |
| Piping | Prep and coat piping. Install pipe link seals at floor penetration. Install adequate thrust blocking. | $2,000 | $5,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | None | | |
| Chemical Equipment | None | | |
| | **TOTAL** | $3,000 | $28,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B25 – Hillview @ Miller Creek | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 2:40 pm |
| | | **INSTALL DATE** | 1999 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | None | | |
| Security | Install fence | $3,000 | $5,000 |
| Power Distribution | Install new switchgear and make standby power capable. | $25,000 | $35,000 |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | None | | |
| Motor | See above | | |
| Piping | Prep and coat piping | $1,000 | $2,000 |
| Valves | None | | |
| HVAC | Get HVAC system operational | $0 | $1,000 |
| Chemical Equipment | None | | |
| | **TOTAL** | $29,000 | $43,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | B26 – Mansion Heights | **TYPE OF FACILITY** | Booster Station |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 10:20 am |
| | | **INSTALL DATE** | 2002 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Install fence | $3,000 | $5,000 |
| Buildings and Structures | Fix spalling | $1,000 | $2,000 |
| Security | None | $3,000 | $5,000 |
| Power Distribution | Install spill containment. Replace temporary backup power connections with permanent installation. | $11,000 | $18,000 |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | None | | |
| Motor | See above | | |
| Piping | Replace and/or prep and coat piping. | $2,000 | $10,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Upgrade Building HVAC | $2,000 | $3,000 |
| Chemical Equipment | None | | |
| | **TOTAL** | $22,000 | $63,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R01 North | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 10:45 am |
| | | **INSTALL DATE** | 1978 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | None | | |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | N/A | | |
| Motor | N/A | | |
| Piping | None | | |
| Valves | Unknown condition of buried valves, Contingency | $0 | $3,000 |
| HVAC | N/A | | |
| Chemical Equipment | N/A | | |
| | **TOTAL** | $0 | $3,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R12 East Missoula | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 10/24/18 | **TIME ARRIVED ON SITE** | 10:03 am |
| | | **INSTALL DATE** | |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Determine leaking overflow pipe and make repairs. | $5,000 | $10,000 |
| Buildings and Structures | Repair corrosion and concrete spalling. | $2,500 | $5,000 |
| Security | | | |
| Power Distribution | | | |
| Electrical | | | |
| Instrumentation / Analyzers | | | |
| Pump | | | |
| Motor | | | |
| Piping | Unknown condition of buried pipe, Contingency. | | $10,000 |
| Valves | Unknown condition of buried valves, Contingency. | | $4,000 |
| HVAC | | | |
| Chemical Equipment | | | |
| | **TOTAL** | $7,500 | $29,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R03 South | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 11:30 am |
| | | **INSTALL DATE** | 1979 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | None | | |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | N/A | | |
| Motor | N/A | | |
| Piping | None | | |
| Valves | Unknown condition of buried valves, Contingency | $0 | $3,000 |
| HVAC | N/A | | |
| Chemical Equipment | N/A | | |
| | **TOTAL** | $0 | $3,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R04 Lower Linda Vista | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 2:30 pm |
| | | **INSTALL DATE** | 1989 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | None | | |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | N/A | | |
| Motor | N/A | | |
| Piping | None | | |
| Valves | Unknown condition of buried valves, Contingency | $0 | $3,000 |
| HVAC | N/A | | |
| Chemical Equipment | N/A | | |
| | **TOTAL** | $0 | $3,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R05 Upper Linda Vista | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 3:00 pm |
| | | **INSTALL DATE** | 1998 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Painting of backside of structure | $20,000 | $30,000 |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | N/A | | |
| Motor | N/A | | |
| Piping | None | | |
| Valves | Unknown condition of buried valves, Contingency | $0 | $3,000 |
| HVAC | N/A | | |
| Chemical Equipment | N/A | | |
| | **TOTAL** | $20,000 | $33,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R10 Skyview | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 3:40 pm |
| | | **INSTALL DATE** | 2000 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | None | | |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | N/A | | |
| Motor | N/A | | |
| Piping | None | | |
| Valves | Unknown condition of buried valves, Contingency | $0 | $3,000 |
| HVAC | N/A | | |
| Chemical Equipment | N/A | | |
| | **TOTAL** | $0 | $3,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R11 Upper Prospect | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 10/24/18 | **TIME ARRIVED ON SITE** | 3:30 pm |
| | | **INSTALL DATE** | |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | | | |
| Buildings and Structures | | | |
| Security | Fence site (If possible due to adjacent homeowner concerns) | $7,500 | $10,000 |
| Power Distribution | | | |
| Electrical | | | |
| Instrumentation / Analyzers | | | |
| Pump | | | |
| Motor | | | |
| Piping | Unknown condition of buried pipe, Contingency. | | $10,000 |
| Valves | Unknown condition of buried valves, Contingency. | | $4,000 |
| HVAC | | | |
| Chemical Equipment | | | |
| | **TOTAL** | $7,500 | $24,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W43 Canyon River | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 9:40 am |
| | | **INSTALL DATE** | 2013 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | 0 | 0 |
| Buildings and Structures | None | 0 | 0 |
| Security | None | 0 | 0 |
| Power Distribution | None | 0 | 0 |
| Electrical | None | 0 | 0 |
| Instrumentation / Analyzers | None | 0 | 0 |
| Pump | None | 0 | 0 |
| Motor | None | 0 | 0 |
| Piping | None | 0 | 0 |
| Valves | None | 0 | 0 |
| HVAC | None | 0 | 0 |
| Chemical Equipment | Install sealant on concrete at secondary containment | $1,000 | $2,000 |
| | **TOTAL** | $1,000 | $2,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R12 East Missoula | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 10/24/18 | **TIME ARRIVED ON SITE** | 10:03 am |
| | | **INSTALL DATE** | |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Repair corrosion and concrete spalling. | $2,500 | $5,000 |
| Security | Repair 3-strand barb wire fence. | $500 | $1,000 |
| Power Distribution | | | |
| Electrical | | | |
| Instrumentation / Analyzers | | | |
| Pump | | | |
| Motor | | | |
| Piping | Unknown condition of buried pipe, Contingency. | | $10,000 |
| Valves | Unknown condition of buried valves, Contingency. | | $4,000 |
| HVAC | | | |
| Chemical Equipment | | | |
| | **TOTAL** | $3,000 | $20,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R13 High Park | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 11:00 am |
| | | **INSTALL DATE** | Unknown |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Paint and fix leaks in structure. | $15,000 | $25,000 |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | N/A | | |
| Motor | N/A | | |
| Piping | None | | |
| Valves | Unknown condition of buried valves, Contingency | $0 | $3,000 |
| HVAC | N/A | | |
| Chemical Equipment | N/A | | |
| | **TOTAL** | $15,000 | $28,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | R14 Hillview | **TYPE OF FACILITY** | Reservoir |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 4:00 pm |
| | | **INSTALL DATE** | Unknown |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | None | | |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | N/A | | |
| Motor | N/A | | |
| Piping | Correct overflow outlet | $1,000 | $3,000 |
| Valves | Unknown condition of buried valves, Contingency | $0 | $3,000 |
| HVAC | N/A | | |
| Chemical Equipment | N/A | | |
| | **TOTAL** | $1,000 | $6,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T01 East Missoula | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 4:20 pm |
| | | **INSTALL DATE** | 1964 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Minor swale around tank | $1,000 | $2,000 |
| Buildings and Structures | Paint exterior of tank | $20,000 | $30,000 |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | N/A | | |
| Motor | N/A | | |
| Piping | None | | |
| Valves | Unknown condition of buried valves, Contingency | $0 | $3,000 |
| HVAC | N/A | | |
| Chemical Equipment | N/A | | |
| | **TOTAL** | $21,000 | $35,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T02 Lower Elk Ridge | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 3:40 pm |
| | | **INSTALL DATE** | 1988 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Site in good shape and drainage | | |
| Buildings and Structures | Tank in good shape | | |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | N/A | | |
| Motor | N/A | | |
| Piping | None | | |
| Valves | Unknown condition of buried valves, Contingency | $0 | $3,000 |
| HVAC | N/A | | |
| Chemical Equipment | N/A | | |
| | **TOTAL** | $0 | $3,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T04 - Gharrett Ave | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 3:15 pm |
| | | **INSTALL DATE** | 2007 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | None | | |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | N/A | | |
| Motor | N/A | | |
| Piping | None | | |
| Valves | Unknown condition of buried valves, Contingency | $0 | $3,000 |
| HVAC | N/A | | |
| Chemical Equipment | N/A | | |
| | **TOTAL** | $0 | $3,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T06 Lincoln Hills | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 4:20 pm |
| | | **INSTALL DATE** | 1985 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Rip-rapped swale or settling basin for tank overflow pipe discharge. Rip-rap tank drain pipe outlet. | $1,000 | $3,000 |
| Buildings and Structures | None | | |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | N/A | | |
| Motor | N/A | | |
| Piping | None | | |
| Valves | Unknown condition of buried valves, Contingency | $0 | $3,000 |
| HVAC | N/A | | |
| Chemical Equipment | N/A | | |
| | **TOTAL** | $1,000 | $6,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T09, 13, 14 Lower Farview | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 10:00 AM |
| | | **INSTALL DATE** | T09 1945 T13 &14 Unknown |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Exterior painting on tanks | $20,000 | $30,000 |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | N/A | | |
| Motor | N/A | | |
| Piping | Install Tank Overflow or Vent in T09 | $0 | $10,000 |
| Valves | Unknown condition of buried valves, Contingency | $0 | $3,000 |
| HVAC | N/A | | |
| Chemical Equipment | N/A | | |
| | **TOTAL** | $20,000 | $43,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T15 High Park | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 11:00 AM |
| | | **INSTALL DATE** | Unknown |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Paint exterior of tank | $20,000 | $30,000 |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | N/A | | |
| Motor | N/A | | |
| Piping | None | | |
| Valves | Unknown condition of buried valves. Contingency | $0 | $3,000 |
| HVAC | N/A | | |
| Chemical Equipment | N/A | | |
| | **TOTAL** | $20,000 | $33,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T16 Upper Lincoln Hills | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 4:20 pm |
| | | **INSTALL DATE** | 1985 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Rip-rapped swale or settling basin for tank overflow pipe discharge. Rip-rap tank drain pipe outlet. | $1,000 | $3,000 |
| Buildings and Structures | Bullet hole in back of tank. Existing repair with bolt and epoxy. Repair properly. Paint exterior of tank. | $21,000 | $33,000 |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | N/A | | |
| Motor | N/A | | |
| Piping | None | | |
| Valves | Unknown condition of buried valves, Contingency | $0 | $3,000 |
| HVAC | N/A | | |
| Chemical Equipment | N/A | | |
| | **TOTAL** | $22,000 | $39,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T18 Hillview | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 4:00 pm |
| | | **INSTALL DATE** | 1985 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Paint exterior of tank | $20,000 | $30,000 |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | N/A | | |
| Motor | N/A | | |
| Piping | None | | |
| Valves | Unknown condition of buried valves. Contingency | $0 | $3,000 |
| HVAC | N/A | | |
| Chemical Equipment | N/A | | |
| | **TOTAL** | $20,000 | $33,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T19 Upper Fairview | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 10:20 am |
| | | **INSTALL DATE** | 1993 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Improve drainage around tank. | $3,000 | $6,000 |
| Buildings and Structures | Paint exterior of tank. | $20,000 | $30,000 |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | N/A | | |
| Motor | N/A | | |
| Piping | None | | |
| Valves | Unknown condition of buried valves. Contingency | $0 | $3,000 |
| HVAC | N/A | | |
| Chemical Equipment | N/A | | |
| | **TOTAL** | $23,000 | $39,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | T20 Mansion Heights | **TYPE OF FACILITY** | Tank |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 10:45 AM |
| | | **INSTALL DATE** | 1998 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Improve site drainage | $2,000 | $5,000 |
| Buildings and Structures | Paint exterior of tank | $20,000 | $30,000 |
| Security | Install locking ladder and cage | $2,000 | $3,000 |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | N/A | | |
| Motor | N/A | | |
| Piping | Install tank overflow screen. Unknown condition of underground piping. | $1,000 | $2,000 |
| Valves | Unknown condition of buried valves, Contingency | 0 | $3,000 |
| HVAC | N/A | | |
| Chemical Equipment | N/A | | |
| | **TOTAL** | $25,000 | $43,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W01 – 6th Street Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 10:20 am |
| | | **INSTALL DATE** | 1935 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Improve drainage drywell from pump blowoff | $1,000 | $2,000 |
| Buildings and Structures | Replace interior walls and repair floor crack. Fix header pipe floor penetration and install link seals. | $4,000 | $7,000 |
| Security | None | | |
| Power Distribution | Install new switchgear and manual transfer switch | $25,000 | $35,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | None | | |
| Pump | Replace pump and 100 HP Motor | $50,000 | $100,000 |
| Motor | See above | | |
| Piping | Prep and coat piping | $1,000 | $3,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | Install chlorine analyzer, HVAC, and leak detection | $4,000 | $14,000 |
| | **TOTAL** | $112,000 | $224,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W02 – 14th Street Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 11:10 am |
| | | **INSTALL DATE** | 1935/1993 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Preform minor cleanup | $1,000 | $2,000 |
| Buildings and Structures | Replace interior walls in Well Building and Chlorine Room. Fix header pipe floor penetration and install link seals. | $4,000 | $7,000 |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | Replace pump and 100 HP Motor | $50,000 | $100,000 |
| Motor | See above | | |
| Piping | Prep and coat piping | $1,000 | $3,000 |
| Valves | Contingency | 0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | Install chlorine analyzer, HVAC, and leak detection. | $4,000 | $14,000 |
| | **TOTAL** | $62,000 | $149,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W3 South Ave | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 12:15 pm |
| | | **INSTALL DATE** | 1993 / 1998 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Determine if new building foot print to meet code can be accommodated on present site | $0 | $5,000 |
| Buildings and Structures | Replace building | $15,000 | $20,000 |
| Security | Install security fence | $3,000 | $5,000 |
| Power Distribution | Install new switchgear and manual transfer switch | $25,000 | $35,000 |
| Electrical | None | $25,000 | $40,000 |
| Instrumentation / Analyzers | None | | |
| Pump | Per the Energy Efficiency Study rehabilitate the 100HP pump | $20,000 | $30,000 |
| Motor | Rehabilitate the 200 HP motor | $10,000 | $15,000 |
| Piping | Replace piping | $10,000 | $15,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | Seal secondary containment and install leak detection | $2,000 | $3,000 |
| | **TOTAL** | $112,000 | $191,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W4 Sommers St | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 9:17 AM |
| | | **INSTALL DATE** | 1996 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | 0 | 0 |
| Buildings and Structures | Repair interior walls | $2,000 | $3,000 |
| Security | None | 0 | 0 |
| Power Distribution | None | 0 | 0 |
| Electrical | None | 0 | 0 |
| Instrumentation / Analyzers | Upgrade flow metering | $6,000 | $8,000 |
| Pump | Replace or rehabilitate pump | $30,000 | $60,000 |
| Motor | None | 0 | 0 |
| Piping | Prep and coat piping and/or replace piping | $2,000 | $15,000 |
| Valves | Contingency | 0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | None | 0 | 0 |
| | **TOTAL** | $42,000 | $109,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 08 – Schilling Street Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 1:15 pm |
| | | **INSTALL DATE** | Rehabilitation - 2014 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Fix header pipe floor penetration and install link seals. | $1,000 | $2,000 |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | Replace pump and 100 HP Motor | $50,000 | $100,000 |
| Motor | See above | | |
| Piping | None | | |
| Valves | Contingency | $0 | $20,000 |
| HVAC | None | | |
| Chemical Equipment | None | | |
| | **TOTAL** | $51,000 | $122,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 09 – Dixon Avenue Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 2:15 pm |
| | | **INSTALL DATE** | 1955 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Site visual improvements | $1,000 | $3,000 |
| Buildings and Structures | New foundation for Chlorine Room. Repair floor crack. Fix header pipe floor penetration and install link seals. | $4,000 | $6,000 |
| Security | Install security fence | $3,000 | $5,000 |
| Power Distribution | Install new switchgear and manual transfer switch | $25,000 | $35,000 |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | Replace pump and 100 HP Motor | $50,000 | $100,000 |
| Motor | See above | | |
| Piping | Install new header piping | $10,000 | $15,000 |
| Valves | Contingency | 0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | Install chlorine analyzer, HVAC, leak detection, and increase capacity of spill containment. | $5,000 | $15,000 |
| | **TOTAL** | $100,000 | $202,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W10 Hilda Avenue | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 10:58 am |
| | | **INSTALL DATE** | 1957 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Site in public alley way. Determine if new building foot print to meet code can be accommodated on present site | $0 | $5,000 |
| Buildings and Structures | Replace building | $15,000 | $20,000 |
| Security | Install security fence | $3,000 | $5,000 |
| Power Distribution | Install new switchgear and manual transfer switch | $25,000 | $35,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | Upgrade flow metering and Cl2 residual analyzer . | $12,000 | $16,000 |
| Pump | Unknown condition. Contingency. Rehabilitate pump and 60 HP Motor | $15,000 | $20,000 |
| Motor | See above | | |
| Piping | Replace piping | $10,000 | $15,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | New chemical building. New storage, pump, HVAC, leak detection, fire suppression | $20,000 | $30,000 |
| | **TOTAL** | $127,000 | $209,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W11 Agnes Ave | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 11:57 am |
| | | **INSTALL DATE** | 1957 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Determine if new building foot print to meet code can be accommodated on present site | $0 | $5,000 |
| Buildings and Structures | None | | |
| Security | Install security fence | $3,000 | $5,000 |
| Power Distribution | Install new switchgear and manual transfer switch | $25,000 | $35,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | Upgrade flow metering and Cl2 residual analyzer. | $12,000 | $16,000 |
| Pump | Unknown condition. Contingency. Replace pump and 60 HP Motor | $30,000 | $60,000 |
| Motor | See above | | |
| Piping | Replace piping | $10,000 | $15,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | New chemical building. New storage, pump, HVAC, leak detection, fire suppression. | $20,000 | $30,000 |
| | **TOTAL** | $127,000 | $229,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W12 Judi Ave | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 4:35 pm |
| | | **INSTALL DATE** | 1964 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Determine if new building foot print to meet code can be accommodated on present site | $0 | $5,000 |
| Buildings and Structures | Repair interior walls | $2,000 | $3,000 |
| Security | Install security fence | $3,000 | $5,000 |
| Power Distribution | Replace temporary backup power connections with permanent installations. | $10,000 | $15,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | Upgrade flow metering and Cl2 residual analyzer | $12,000 | $16,000 |
| Pump | Unknown condition. Contingency. Replace pump and 60 HP Motor | $30,000 | $60,000 |
| Motor | See above | | |
| Piping | Prep and coat piping and/or replace piping | $2,000 | $15,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | New chemical building. New storage, pump, HVAC, leak detection, fire suppression. | $20,000 | $30,000 |
| | **TOTAL** | $106,000 | $212,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W13 Mountainview | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 4:35 pm |
| | | **INSTALL DATE** | 1968 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Improve blow off discharge. Reroute pipe and provide dry well sump. | $15,000 | $25,000 |
| Buildings and Structures | Repair floor cracks. Fix header pipe floor penetration and install link seals. | $2,000 | $4,000 |
| Security | None | | |
| Power Distribution | Install new switchgear and manual transfer switch | $25,000 | $35,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | Upgrade flow metering | $6,000 | $8,000 |
| Pump | Replace pump and 50 HP Motor | $25,000 | $50,000 |
| Motor | See above | | |
| Piping | Remove header pipe insulation and jacketing. Prep and coat piping. | $5,000 | $10,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | New chemical building. New storage, pump, HVAC, leak detection | $20,000 | $30,000 |
| | **TOTAL** | $125,000 | $225,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 16 – 24th Street Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 3:10 pm |
| | | **INSTALL DATE** | 1969 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Rehabilitate Well Building. Build Chlorine Room. | $15,000 | $25,000 |
| Security | Upgrade security. | $10,000 | $15,000 |
| Power Distribution | Upgrade power distribution. | $25,000 | $40,000 |
| Electrical | Upgrade electrical. | $35,000 | $50,000 |
| Instrumentation / Analyzers | Install instrumentation and analyzers. | $20,000 | $30,000 |
| Pump | Install pump and motor | $50,000 | $100,000 |
| Motor | See above | | |
| Piping | Install header piping. | $15,000 | $25,000 |
| Valves | Install valves. | $20,000 | $30,000 |
| HVAC | Install new HVAC system. | $2,000 | $3,000 |
| Chemical Equipment | New chemical building. New storage, pump, HVAC, leak detection. | $20,000 | $30,000 |
| | **TOTAL** | $212,000 | $348,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W17 Momont | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 10:46 |
| | | **INSTALL DATE** | 1968 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Improve blow off discharge. Reroute pipe and provide dry well sump | $15,000 | $25,000 |
| Buildings and Structures | Due to electrical improvements construct small adjoining electrical room. Repair interior walls | $12,000 | $18,000 |
| Security | None | | |
| Power Distribution | Replace temporary backup power connections with permanent installation | $10,000 | $15,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | None | | |
| Pump | Replace pump and 500 HP Motor (in progress) | | |
| Motor | See above | | |
| Piping | None | | |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | New chemical bldg. New storage, pump, HVAC, leak detection, fire suppression, | $20,000 | $30,000 |
| | **TOTAL** | $84,000 | $151,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 18 – Willowwood Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 3:20 pm |
| | | **INSTALL DATE** | 1968 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Improve pump blowoff discharge | $4,000 | $6,000 |
| Buildings and Structures | Repair floor crack. Fix header pipe floor penetration and install link seals. | $2,000 | $4,000 |
| Security | None | | |
| Power Distribution | Install new switchgear and manual transfer switch. | $25,000 | $35,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | None | | |
| Pump | Replace pump and 100 HP Motor | $50,000 | $100,000 |
| Motor | See above | | |
| Piping | Remove header pipe insulation and jacketing. Prep and coat piping. | $5,000 | $10,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | Install chlorine analyzer, spill containment , HVAC, leak detection | $5,000 | $15,000 |
| | **TOTAL** | $118,000 | $233,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W19 N Russell | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 11:30 AM and 10:45 AM |
| | | **INSTALL DATE** | 1969 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Reroute sample drain | $0 | $2,000 |
| Buildings and Structures | Misc repairs to interior and exterior. | $3,000 | $10,000 |
| Security | Install security fence | $3,000 | $5,000 |
| Power Distribution | Install new switchgear and manual transfer switch | $25,000 | $35,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | None | | |
| Pump | Rehabilitate 100 hp pump | $20,000 | $40,000 |
| Motor | None | | |
| Piping | Replace piping. Install link seals. | $10,000 | $20,000 |
| Valves | Contingency | 0 | $20,000 |
| HVAC | Install new HVAC system. | $2,000 | $3,000 |
| Chemical Equipment | New chemical bldg. New storage, pump, HVAC, leak detection, fire suppression, | $20,000 | $30,000 |
| | **TOTAL** | $108,000 | $205,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 20 – Catlin Street Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 10:20 am |
| | | **INSTALL DATE** | 1969 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Improve pump blowoff situation | $4,000 | $6,000 |
| Buildings and Structures | Repair interior walls. Repair floor crack. Fix header pipe floor penetration and install link seals | $4,000 | $7,000 |
| Security | Install security fence | $3,000 | $5,000 |
| Power Distribution | Install new switchgear and manual transfer switch | $25,000 | $35,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | None | | |
| Pump | Replace pump | $25,000 | $50,000 |
| Motor | None | | |
| Piping | Remove header pipe insulation and jacketing. Prep and coat piping. | $5,000 | $10,000 |
| Valves | Contingency | 0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | Install chlorine analyzer, spill containment, HVAC, and leak detection | $5,000 | $15,000 |
| | **TOTAL** | $98,000 | $191,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W21 East Central | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 11:21 am |
| | | **INSTALL DATE** | 1969 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Determine if new building foot print to meet code can be accommodated on present site | $0 | $5,000 |
| Buildings and Structures | Repair interior walls. | $2,000 | $3,000 |
| Security | Install security fence | $3,000 | $5,000 |
| Power Distribution | Install new switchgear and manual transfer switch | $25,000 | $35,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | Upgrade flow metering and Cl2 residual analyzer | $12,000 | $16,000 |
| Pump | None | | |
| Motor | None | | |
| Piping | Remove header pipe insulation and jacketing. Prep and coat piping. | $5,000 | $10,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Install new HVAC system. | $2,000 | $3,000 |
| Chemical Equipment | New chemical bldg. New storage, pump, HVAC, leak detection, fire suppression | $20,000 | $30,000 |
| | **TOTAL** | $94,000 | $167,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W22 Intermountain | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 12:37 am |
| | | **INSTALL DATE** | 1970 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Repair interior walls | $2,000 | $3,000 |
| Security | Install security fence | $3,000 | $5,000 |
| Power Distribution | Install new switchgear and manual transfer switch | $25,000 | $35,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | Upgrade flow metering and Cl2 residual analyzer | $12,000 | $16,000 |
| Pump | Repair pump foundation | $12,000 | $25,000 |
| Motor | See above | | |
| Piping | Remove header pipe insulation and jacketing. Prep and coat piping. | $5,000 | $10,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Install new HVAC system. | $2,000 | $3,000 |
| Chemical Equipment | Install sealant on concrete at secondary containment. | $1,000 | $2,000 |
| | **TOTAL** | $87,000 | $159,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W23 Pattee Creek | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/01/14 | **TIME ARRIVED ON SITE** | 11:37 am |
| | | **INSTALL DATE** | 1973 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Repair interior walls. | $2,000 | $3,000 |
| Security | Install security fence | $3,000 | $5,000 |
| Power Distribution | Replace temporary backup power connections with permanent installation | $10,000 | $15,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | Upgrade flow metering and Cl2 residual analyzer | $12,000 | $16,000 |
| Pump | Replace pump and motor | $12,000 | $25,000 |
| Motor | See above | | |
| Piping | Prep and coat piping | $1,000 | $3,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | None | | |
| | **TOTAL** | $67,000 | $130,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 25 – Stephens Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/1/2014 | **TIME ARRIVED ON SITE** | 12:10 pm |
| | | **INSTALL DATE** | 1973 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Repair interior walls. Repair floor crack. | $3,000 | $4,000 |
| Security | None | | |
| Power Distribution | Upgrade power | $10,000 | $20,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | None | | |
| Pump | Replace pump | $25,000 | $50,000 |
| Motor | None | | |
| Piping | Prep and coat piping | $1,000 | $3,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Install new HVAC system. | $2,000 | $3,000 |
| Chemical Equipment | Install HVAC and leak detection. | $3,000 | $4,000 |
| | **TOTAL** | $69,000 | $144,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 26 – Benton Avenue Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/1/2014 | **TIME ARRIVED ON SITE** | 12:30 pm |
| | | **INSTALL DATE** | 1972 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Repair interior walls. Fix header pipe floor penetration and install link seals. | $4,000 | $7,000 |
| Security | None | | |
| Power Distribution | Install new switchgear and manual transfer switch | $25,000 | $35,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | None | | |
| Pump | Replace pump and 100 HP Motor | $50,000 | $100,000 |
| Motor | See above | | |
| Piping | Prep and coat piping | $1,000 | $3,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | Install chlorine analyzer, spill containment, HVAC, leak detection | $5,000 | $15,000 |
| | **TOTAL** | $112,000 | $223,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W 29 – Orchard Avenue Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 3:35 pm |
| | | **INSTALL DATE** | 1973 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Repair floor crack. Fix header pipe floor penetration and install link seals | $2,000 | $4,000 |
| Security | None | | |
| Power Distribution | Install new switchgear and manual transfer switch | $25,000 | $35,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | None | | |
| Pump | Replace pump | $25,000 | $75,000 |
| Motor | See above | | |
| Piping | Remove header pipe insulation and jacketing. Prep and coat piping | $5,000 | $10,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | Install HVAC and leak detection | $3,000 | $4,000 |
| | **TOTAL** | $87,000 | $191,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W30 Bank Street | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 10/1/14 | **TIME ARRIVED ON SITE** | 4:20 PM |
| | | **INSTALL DATE** | 1978 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | 0 | 0 |
| Buildings and Structures | Perform minor building repairs | $2,000 | $6,000 |
| Security | None | 0 | 0 |
| Power Distribution | Replace temporary backup power connections with permanent installation. | $10,000 | $15,000 |
| Electrical | None | 0 | 0 |
| Instrumentation / Analyzers | None | 0 | 0 |
| Pump | Contingency. | $20,000 | $30,000 |
| Motor | See above | 0 | 0 |
| Piping | Exposed piping needs prep and painting | $2,000 | $3,000 |
| Valves | Contingency | 0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | Seal containment floor | $1,000 | $2,000 |
| | **TOTAL** | $37,000 | $79,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W31 Kiwanis Street | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 3:40 PM |
| | | **INSTALL DATE** | 1976 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | 0 | 0 |
| Buildings and Structures | Perform minor building repairs | $2,000 | $6,000 |
| Security | Install security fence | $3,000 | $5,000 |
| Power Distribution | Replace temporary backup power connections with permanent installation | $10,000 | $15,000 |
| Electrical | Replace older panels | $10,000 | $20,000 |
| Instrumentation / Analyzers | None | 0 | 0 |
| Pump | Contingency | $20,000 | $30,000 |
| Motor | See above | 0 | 0 |
| Piping | Exposed piping needs prep and painting | $2,000 | $3,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | Seal containment floor, inadequate size, new structure needed | $5,000 | $20,000 |
| | **TOTAL** | $54,000 | $122,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W32 Arthur Street | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 10:45 AM |
| | | **INSTALL DATE** | 1978 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Pump blow off discharge down embankment needs stabilization/rip-rap | $10,000 | $12,000 |
| Buildings and Structures | Older building but in OK shape. | | |
| Security | none | | |
| Power Distribution | Replace temporary backup power connections with permanent installation | $10,000 | $15,000 |
| Electrical | Install new main disconnect | $20,000 | $30,000 |
| Instrumentation / Analyzers | none | | |
| Pump | Unknown when pump and motor were last re-habilitated. Contigency | $20,000 | $30,000 |
| Motor | See above | | |
| Piping | Prep and coat piping and/or replace piping | $2,000 | $15,000 |
| Valves | none | | |
| HVAC | Install new HVAC system. | $2,000 | $3,000 |
| Chemical Equipment | New chemical bldg. New storage, pump, HVAC, leak detection | $20,000 | $30,000 |
| | **TOTAL** | $84,000 | $135,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W33 Gerald Avenue | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/30/14 and 10/2/14 | **TIME ARRIVED ON SITE** | 11:30 AM and 10:45 AM |
| | | **INSTALL DATE** | 1977 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Improve blow off discharge to prevent erosion. Reroute pipe and provide dry well sump | $15,000 | $25,000 |
| Buildings and Structures | Due to electrical improvements construct small adjoining electrical room. Repair floor cracks. Fix header pipe floor penetration and install link seals. | $20,000 | $35,000 |
| Security | None | | |
| Power Distribution | Install new switchgear and manual transfer switch | $75,000 | $100,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | Upgrade flow metering | $6,000 | $8,000 |
| Pump | Replace pump and 300 HP Motor | $150,000 | $250,000 |
| Motor | See above | | |
| Piping | Remove header pipe insulation and jacketing. Prep and coat piping. | $5,000 | $10,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | New chemical bldg. New storage, pump, HVAC, leak detection | $20,000 | $30,000 |
| | **TOTAL** | $318,000 | $521,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W34 Maurice Ave | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/30/14 | **TIME ARRIVED ON SITE** | 10:57 AM |
| | | **INSTALL DATE** | 1978 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Provide dry well sump | $10,000 | $15,000 |
| Buildings and Structures | Due to electrical improvements construct small adjoining electrical room. | $20,000 | $35,000 |
| | Repair roof | $2,000 | $5,000 |
| Security | None | | |
| Power Distribution | Install new switchgear. Replace temporary backup power connections with permanent installation. | $75,000 | $100,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | None | | |
| Pump | Replace pump and 500 HP Motor | $200,000 | $300,000 |
| Motor | See above | | |
| Piping | Remove header pipe insulation and jacketing. Prep and coat piping. | $5,000 | $10,000 |
| Valves | Contingency | $0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | New chemical bldg. New storage, pump, HVAC, leak detection, fire suppression, | $20,000 | $30,000 |
| | **TOTAL** | $359,000 | $558,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W35 – Southgate Mall Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 11:35 am |
| | | **INSTALL DATE** | 1978 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | Repair floor cracks. Fix header pipe floor penetration and install link seals | $2,000 | $4,000 |
| Security | None | | |
| Power Distribution | Install new switchgear and manual transfer switch | $25,000 | $35,000 |
| Electrical | Install new MCC, control and lighting panels | $25,000 | $40,000 |
| Instrumentation / Analyzers | None | | |
| Pump | Replace pump and 150 HP Motor | $125,000 | $200,000 |
| Motor | See above | | |
| Piping | Remove header pipe insulation and jacketing. Prep and coat piping. | $5,000 | $10,000 |
| Valves | Contingency | 0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | Install chlorine analyzer, HVAC, leak detection | $4,000 | $14,000 |
| | **TOTAL** | $188,000 | $326,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W38 – 23rd Avenue Well – East | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 2:50 pm |
| | | **INSTALL DATE** | 1971 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | None | | |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | Replace pump and 300 HP Motor | $150,000 | $250,000 |
| Motor | See above | | |
| Piping | None | | |
| Valves | Contingency | 0 | $30,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | Install HVAC and leak detection | $3,000 | $4,000 |
| | **TOTAL** | $155,000 | $287,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W39 – 23rd Avenue Well – West | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 2:50 pm |
| | | **INSTALL DATE** | 1971 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | | |
| Buildings and Structures | None | | |
| Security | None | | |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | Replace pump and 300 HP Motor | $150,000 | $250,000 |
| Motor | See above | | |
| Piping | None | | |
| Valves | Contingency | 0 | $30,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | Install HVAC and leak detection | $3,000 | $4,000 |
| | **TOTAL** | $155,000 | $287,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W40 – Linda Vista Golf Course Well | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 4:10 pm |
| | | **INSTALL DATE** | 1990 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | Remove flooding potential of pitless adapters | $2,000 | $5,000 |
| Buildings and Structures | None | | |
| Security | Install security fence | $3,000 | $5,000 |
| Power Distribution | None | | |
| Electrical | None | | |
| Instrumentation / Analyzers | None | | |
| Pump | Seal pitless adapter bases | $2,000 | $4,000 |
| Motor | None | | |
| Piping | Prep and coat piping | $1,000 | $3,000 |
| Valves | Contingency | 0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | Install HVAC and leak detection | $3,000 | $4,000 |
| | **TOTAL** | $13,000 | $44,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W41 Great Northern | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 9:25 |
| | | **INSTALL DATE** | 2001 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | 0 | 0 |
| Buildings and Structures | Repair interior walls | $2,000 | $3,000 |
| Security | None | 0 | 0 |
| Power Distribution | Install new switchgear and make standby power capable | $25,000 | $35,000 |
| Electrical | None | 0 | 0 |
| Instrumentation / Analyzers | None | 0 | 0 |
| Pump | None | 0 | 0 |
| Motor | None | 0 | 0 |
| Piping | Prep and coat piping and/or replace piping | $2,000 | $15,000 |
| Valves | Contingency | 0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | New chemical bldg. New storage, pump, HVAC, leak detection, fire suppression | $20,000 | $30,000 |
| | **TOTAL** | $51,000 | $106,000 |

## Mountain Water Company

## Improvement Costs

| | | | |
|---|---|---|---|
| **FACILITY NAME** | W42 Palmer St | **TYPE OF FACILITY** | Well |
| **DATE INSPECTED** | 9/29/14 | **TIME ARRIVED ON SITE** | 10:14 |
| | | **INSTALL DATE** | 2001 |

## Potential Improvements

| DISCIPLINE | DESCRIPTION | LOW | HIGH |
|---|---|---|---|
| Site | None | 0 | 0 |
| Buildings and Structures | None | 0 | 0 |
| Security | None | 0 | 0 |
| Power Distribution | Replace temporary backup power connections with permanent installation | $10,000 | $15,000 |
| Electrical | None | 0 | 0 |
| Instrumentation / Analyzers | None | 0 | 0 |
| Pump | None | 0 | 0 |
| Motor | None | 0 | 0 |
| Piping | Prep and coat piping and/or replace piping | $2,000 | $15,000 |
| Valves | Contingency | 0 | $20,000 |
| HVAC | Install new HVAC system | $2,000 | $3,000 |
| Chemical Equipment | New chemical bldg. New storage, pump, HVAC, leak detection, fire suppression | $20,000 | $30,000 |
| | **TOTAL** | $34,000 | $83,000 |

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# Appendix I

# Water Storage Facility Inspection Reports

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Liquid Engineering Corporation

# Concrete Water Reservoir Interior Condition Survey

Job Number: 52761 | Utility: MISSOULA WATER | Tank: LINDA VISTA

Inspector: S. SANCHEZ | Dive Controller: A. JAMES | Date: 10/20/2018

**AMERICAN CONCRETE INSTITUTE**
**ACI 201.1R-08 / 311.1R**

**CONCRETE CONDITION CODE**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| A – Abrasion | D - Cracking | G - contraction | J - Curling | M - Void | P - Pitting | S - Bugholes | V - Exudation | Y - Corrosion |
| B – Erosion | E - Deflection | H - Deformation | K - Checking | N – Cold Pour | Q - Spalling | T - Chalking | W - Efflorescence | Z – Exposed |
| C - Blistering | F - Expansion | I - Settling | L - Delamination | O - Honeycomb | R - Popouts | U - Leaching | X - Stains | Reinforcement |

## INTERIOR RESERVOIR ROOF

| | QUADRANT 1 | QUADRANT 2 | QUADRANT 3 | QUADRANT 4 |
|---|---|---|---|---|
| Roof Slab(s) | R, X | R, X | R, X | R, X |
| Expansion Joint(s) | GOOD CONDITION | | | |
| Support Beam(s) | R, X | R, X | R, X | R, X |
| Beam Joint(s) | Q | Q | Q | Q |
| ~~Roof-Column Joint~~ | | | | |

General Appearance: Good | Coating: N/A | Vents: Good | Level Sensors: Good

All expansion Joints | Uniform width: Yes | Uniform Level: Yes | Gaskets Intact: No

## INTERIOR RESERVOIR WALLS

| | | | | |
|---|---|---|---|---|
| Wall-Roof Joint | R, X, Q | R, X, Q | R, X, Q | R, X, Q |
| Wall Structure | R, X, Q | R, X, Q | R, X, Q | R, X, Q |

General Appearance: Good | Coating: N/A | Ladder: Good | Leaking: None observed | Dye Tested: No

All expansion Joints | Uniform width: Yes | Uniform Level: Yes | Gaskets Intact: No

## ~~INTERIOR RESERVOIR SUPPORT COLUMNS~~

| | | | | |
|---|---|---|---|---|
| Columns | | | | |
| Clmn Floor Plates | | | | |

General Appearance: ------ | Coating: N/A | ColumnBase Leaking: ------ | Dye Tested: ------

All expansion Joints | Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

## INTERIOR RESERVOIR FLOOR

| | | | | |
|---|---|---|---|---|
| Perimeter Joint | R, X | R, X | R, X | R, X |
| Floor Slabs | R, X | R, X | R, X | R, X |

General Appearance: Good | Coating: N/A | Inlet Structure: Poor | Outlet Structure: Poor

Overflow Structure: Good | Sump System: ------ | Leaking: None observed | Dye Tested: No

All expansion Joints | Uniform width: Yes | Uniform Level: Yes | Gaskets Intact: No

**Additional Interior Notes / Comments**

**DISCLAIMER**

Liquid Engineering does not provide consulting engineering services. Unless otherwise noted, the findings contained in this report were neither prepared nor reviewed by a licensed Professional Engineer, but are based on experience, training and visual examination of the Dive Maintenance Technician

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Liquid Engineering Corporation

# Concrete Water Reservoir Exterior Condition Survey

Job Number: 52761 | Utility: MISSOULA WATER | Tank: LINDA VISTA

Inspector: S. SANCHEZ | Dive Controller: A. JAMES | Date: 10/20/2018

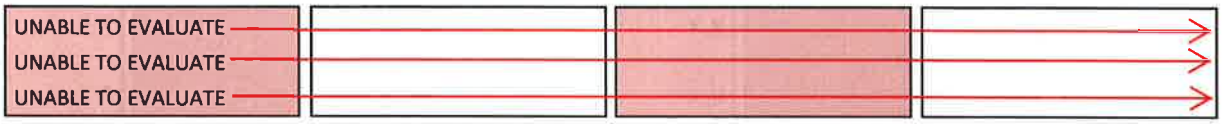
**AMERICAN CONCRETE INSTITUTE**
**ACI 201.1R-08 / 311.1R**

**CONCRETE CONDITION CODE**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| A – Abrasion | D - Cracking | G - contraction | J - Curling | M - Void | P - Pitting | S - Bugholes | V - Exudation | Y - Corrosion |
| B – Erosion | E - Deflection | H - Deformation | K - Checking | N – Cold Pour | Q - Spalling | T - Chalking | W - Efflorescence | Z – Exposed |
| C - Blistering | F - Expansion | I - Settling | L - Delamination | O - Honeycomb | R - Popouts | U - Leaching | X - Stains | Reinforcement |

| QUADRANT 1 | QUADRANT 2 | QUADRANT 3 | QUADRANT 4 |
|---|---|---|---|

## EXTERIOR RESERVOIR ROOF




General Appearance: Good | Coating: N/A | Vents: Good | Level Indicator: ------

Hatch & Gaskets: Good | Hatch hinges: Good | Lock & Hasp: Good | Hatch Cage & Railing: ------

All expansion Joints | Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

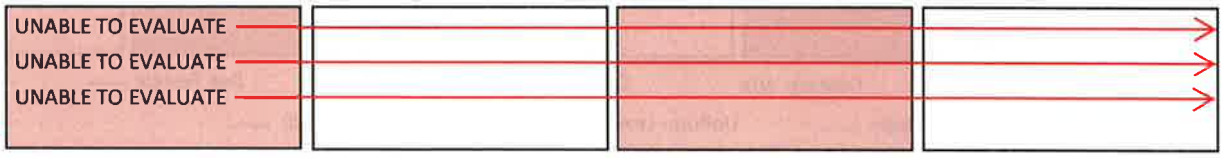
## EXTERIOR RESERVOIR WALLS

General Appearance: ------ | Coating: N/A | Ladder: ------ | Safety Climb: ------

Overflow Structure: Good | Clean out hatch: ------ | Leaking: None observed

All expansion Joints | Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

## EXTERIOR RESERVOIR FOOTINGS / FOUNDATION




General Appearance: ------ | Coating: N/A | Leaking: ------ | Ground Subsidence: ------

All expansion Joints | Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------ | Overflow: ------

**Additional Exterior Notes / Comments**

UNABLE TO EVALUATE DUE TO BURIED

**DISCLAIMER**

Liquid Engineering does not provide consulting engineering services. Unless otherwise noted, the findings contained in this report were neither prepared nor reviewed by a licensed Professional Engineer, but are based on experience, training and visual examination of the Dive Maintenance Technician

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Liquid Engineering Corporation

# Potable Water Reservoir Contamination, Health and Safety Report

Job Number: 52761 | Utility: MISSOULA WATER | Tank: LINDA VISTA

Inspector: S. SANCHEZ | Dive Controller: A. JAMES | Date: 10/20/2018

**Complies With: AWWA • OSHA • ANSI • NIOSH • NAVFAC • NFPAC**

## CONTAMINATION & HEALTH

| | | | | | |
|---|---|---|---|---|---|
| **Air Vents** | Type: J TUBE | | #: 1 | Screen Condition(s): Good | |
| **Hatches** | Type: Square | | #: 1 | Secured Properly: Yes | Properly Sealed: Yes |
| **Exterior Overflow** | Flapper: No | Screen: Yes | | Gasket: Yes | Condition: Good |
| ~~**Cathodic Covers**~~ | ~~In-Place: ----~~ | | ~~#: ----~~ | ~~Gasket: ----~~ | ~~Properly Sealed: ----~~ |
| **Roof to Wall Joint** | Welded: No | Properly Sealed: Yes | | | |
| **Roof Integrity** | Holes: No | Cracking: No | Standing Water: No | | |
| **Wall Integrity** | Holes: No | Cracking: No | | | |
| **Manway Integrity** | Leaks: No | Condition: Good | | | |
| **Water Clarity** | General Appearance: Clear | | | Odor: None | |
| **Floating Surface Debris** | Type: N/A | | | Source: N/A | |
| ~~**Hypalon Floating Cover**~~ | ~~Condition: ----~~ | ~~Holes: ----~~ | ~~Tears: ----~~ | | |
| **Telemetry Penetrations** | Properly Sealed: ---- | | | | |

## FACILITY SAFETY COMPLIANCE

~~**Exterior Ladder**~~

| | | | | | |
|---|---|---|---|---|---|
| **Overall Ladder** | Condition: ---- | #: ---- | Offset Landing: ---- | Height: | |
| **Vandal Guard** | Present: None | Vandal Guard Locked: ---- | | | |
| **Ladder Rails & Rungs** | Condition: Good | Missing/Damaged Rungs: No | | | |
| **Rung Spacing & Depth** | Spacing: in. *(max 12")* | Toe Depth: in. *(min 7")* | | | |
| **Rail Spacing & Size** | Width: in. *(min 2")* | Thickness: in. *(min 1/4")* | Rail to Rail: | in.*(min 16")* | |
| **Safety Climb System** | Type: ------ | Condition: ---- | | | |
| **Number & Locations** | Wall: | Leg: | Roof: | Riser Pipe: | Other: |
| **Ladder Attachments** | | | | | |

~~**Manways**~~

| | | | | |
|---|---|---|---|---|
| **Type and size** | Type: ------ | #: ---- | Size: | inches *(24" – 18'x22" min)* |
| **Support Structure** | Type: ------- | Condition: ---- | | |
| **Number & Locations** | Wall: | Roof: | Riser Pipe: | Other: |

**Hatches**

| | | | | |
|---|---|---|---|---|
| **Hatch Type & Size** | Type: Square | #: 1 | Size: 26X50 | in. *(24" – 24"x15" min)* |
| **Hatch & Lid Lip Height** | Hatch: 31.75 in. *(min 4")* | Lid: 2 | in. *(min 2")* | |

~~**Balconies & Railing**~~

| | | | | |
|---|---|---|---|---|
| **Deck / Walkways** | Condition: ---- | Width: | | |
| **Hand Rails** | Condition: ---- | Height: | in. *(min 42")* | No. Rails: *(min 2)* |
| **Toe Rail** | Condition: ---- | Height: | in. *(min 4")* | |
| **Welds / Attachments** | Condition: ---- | | | |

~~**Roof**~~

| | | |
|---|---|---|
| **Safety Tie-Off Points** | Condition: ---- | #: ---- |
| **Antennas** | Type: ------- | #: ---- |

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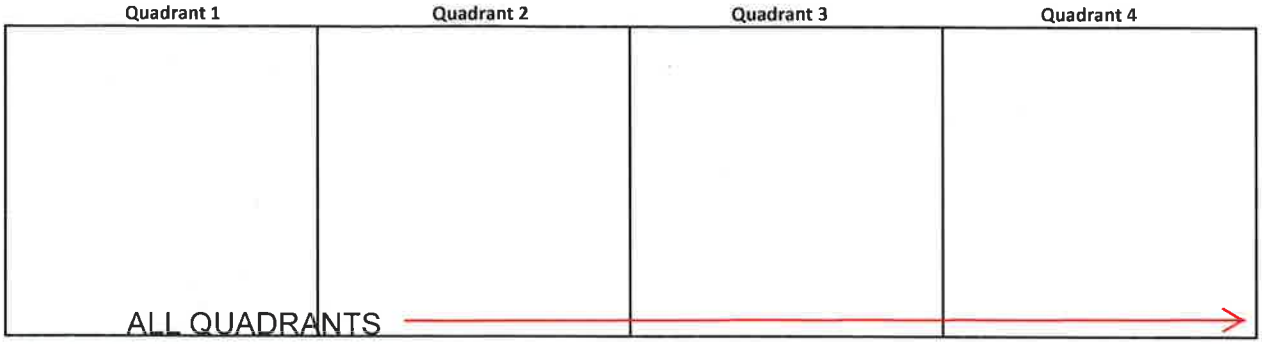
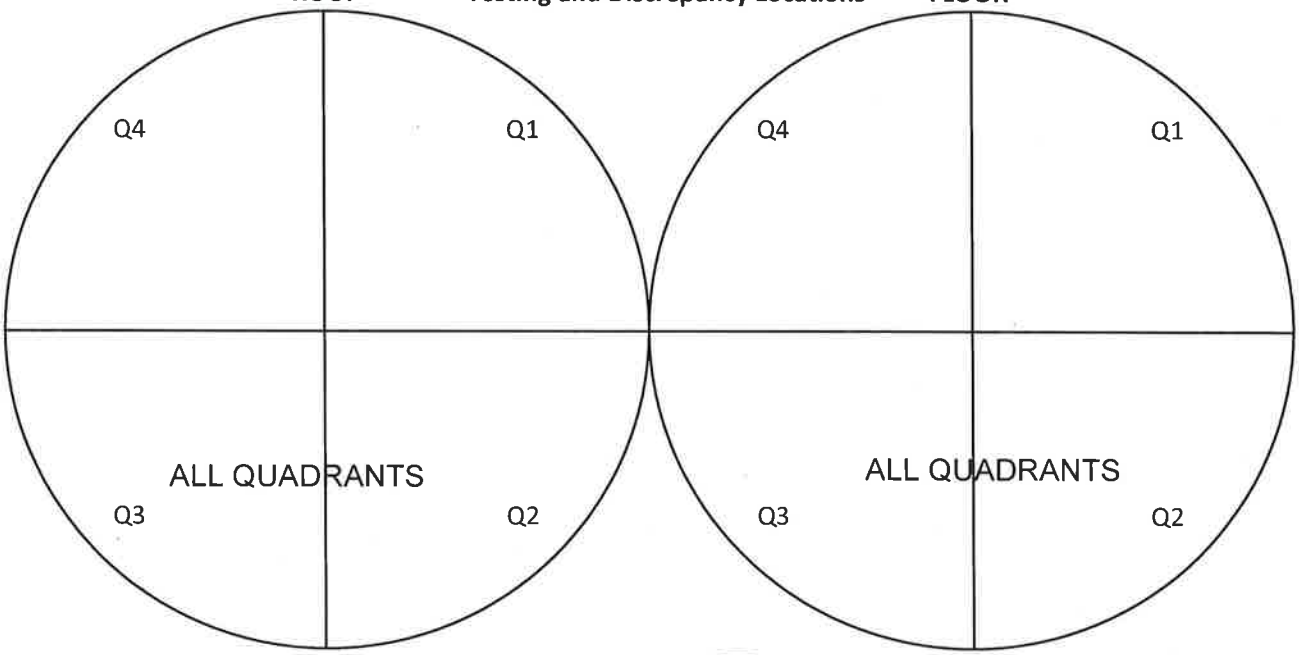
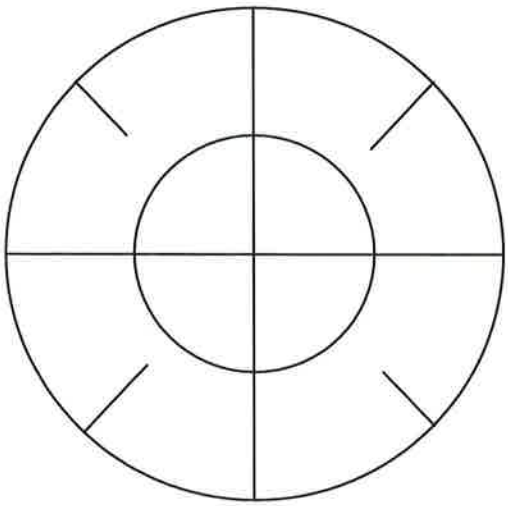
# Circular Tank Diagram / Information Worksheet

Job Number 52761 Utility Name MISSOULA WATER Tank Name LINDA VISTA




**ROOF** **Testing and Discrepancy Locations** **FLOOR**

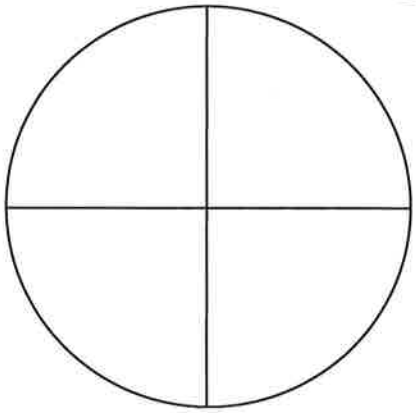


**Sediment Depth Measurements**

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

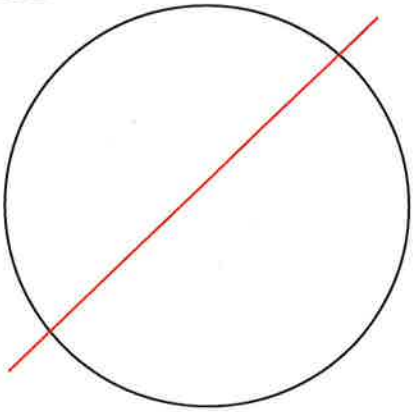
**Avg. Depth** **Cubic Yardage** **Sediment Type**



**Plumbing & Structure location**

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry



**Column Placement**

Type of Column

Base Structure

Top Structure

Column Construction ------

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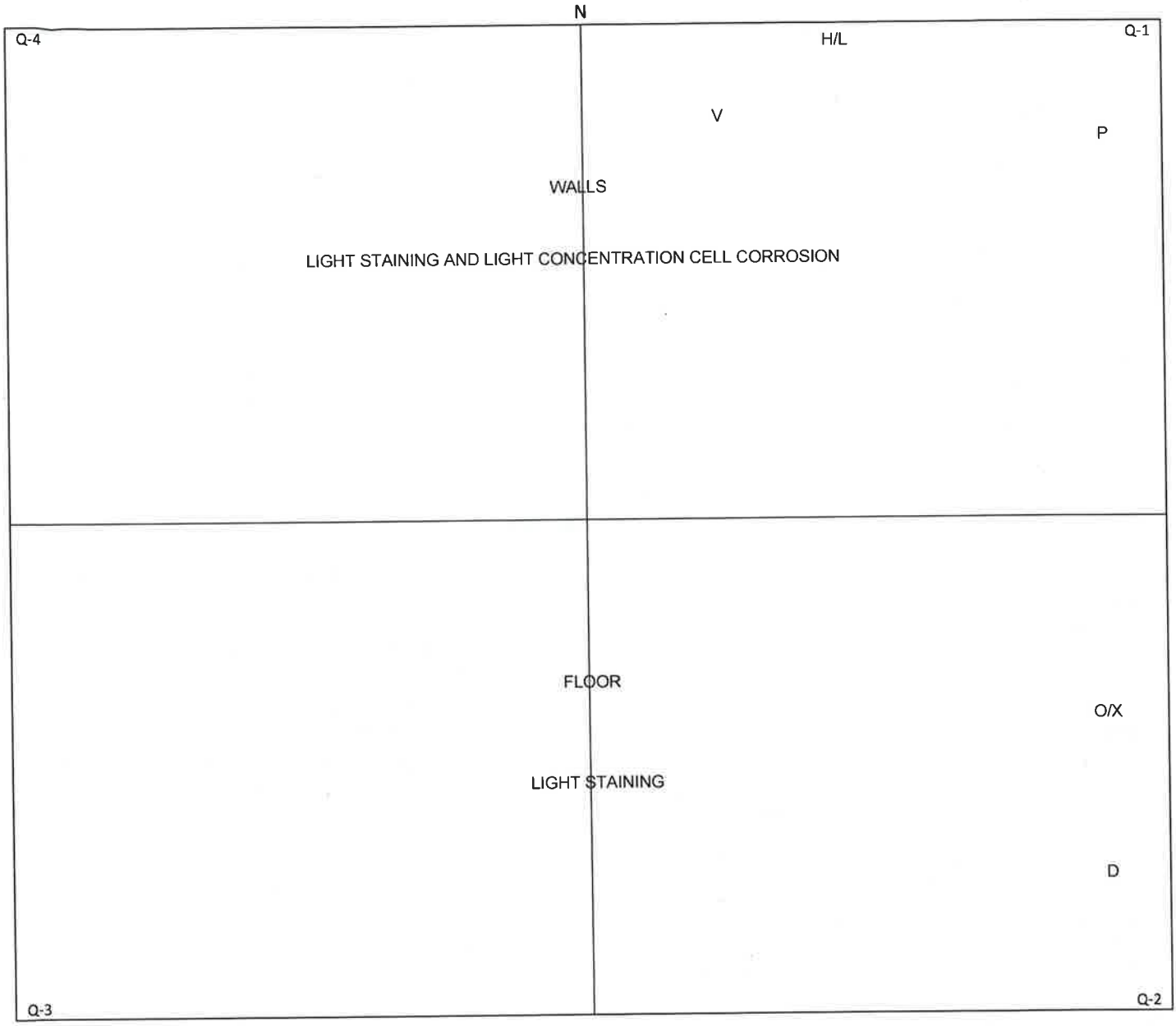
# Rectangular Tank Diagram / Information Worksheet

Job Number 52761 Utility Name MISSOULA WATER Tank Name LINDA VISTA




**Sediment Depth Measurements**

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

**Avg. Depth** SKIFF **Cubic Yardage** **Sediment Type** IRON

**Plumbing & Structure location**

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry

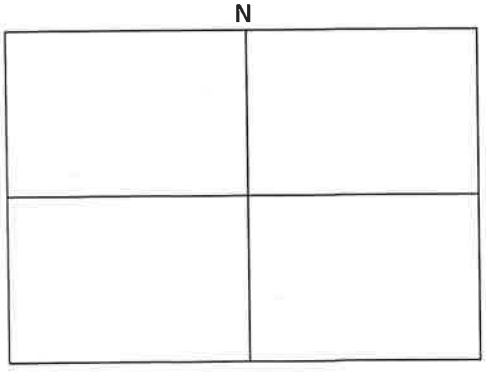
**Column Placement**

Type of Column

Base Structure

Top Structure

Column Construction ------

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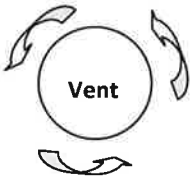
# Steel Potable Water Reservoir Security / Measurement Worksheet

Job Number 52761 Utility Name MISSOULA WATER Tank Name LINDA VISTA

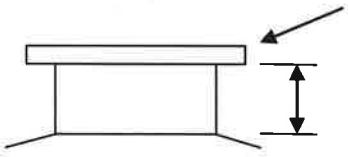
## Security

| | |
|---|---|
| Is the area surrounding the tank well lit? | No |
| Is the tank surrounded by a Security Fence? | Yes |
| Are the access gates locked? | Yes |
| Is the tank equipped with a Vandal Guard on the primary access ladder? | N/A |
| If so, is the Vandal Guard locked? | N/A |
| Are the vents equipped with security vent shrouds? | No |
| Are all of the hatches equipped with electronic monitoring devices? | No |
| Are the external plumbing components housed in a secure vault or out-building? | Yes |
| Does the surrounding geography of the tank obscure it from public view? | No |
| Does the exterior of the tank show signs of trespass? | No |

## Measurements




**Outside Circumference**
35 **Inches**




**Flange Metal Thickness** **Inches**

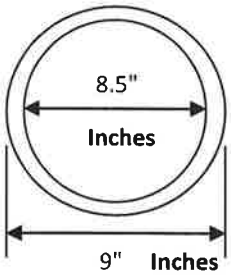
**Roof to Screen or Flange** 24.5 **Inches**

**Flange** ----

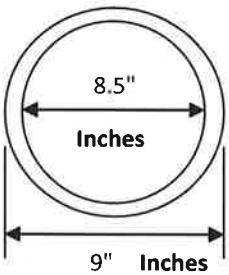
**Number of Bolt Holes** **Inches**

**Size of Bolts** **Inches**

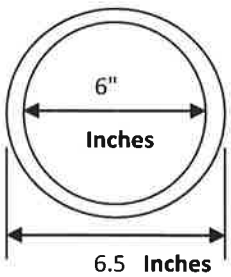
**Inlet**



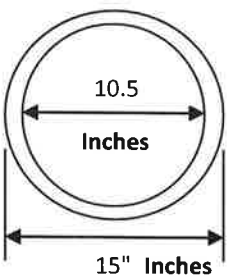

**Outlet**



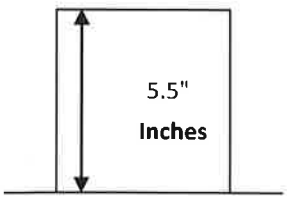

**Drain**



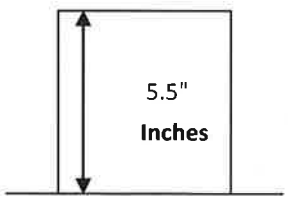

**Overflow**




**Inlet Riser**

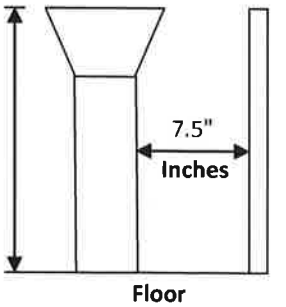



**Outlet Riser**




**Overflow** **Wall**

13'
**Feet/Inches**

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# Steel Potable Water Reservoir Immediate Needs Assessment

Job Number: 52761 | Utility: MISSOULA WATER | Tank: LINDA VISTA

Inspector: S. SANCHEZ | Dive Controller: A. JAMES | Date: 10/20/2018

**1. Health and Safety Items**

- ☐ Safety Climb System Installation: NOT RECOMMENDED
- ☐ Vent Screen Repairs: NOT RECOMMENDED

**2. Testing Items**

- ☐ Dye Testing for Leak Evaluation: NOT RECOMMENDED
- ☐ Presence of Lead Test (Interior/Exterior): NOT RECOMMENDED

**3. Destructive Testing Items**

- ☐ % of Lead Test (Interior/Exterior) *(Coating samples are removed for laboratory analysis)* NOT RECOMMENDED
- ☐ Coating Adhesion Test (Interior/Exterior): NOT RECOMMENDED

*Specific written authorization required to perform destructive testing. Destructive tests include touch-up of coating system.*

**4. Repair Items**

- ☐ Epoxy Coating Repairs: NOT RECOMMENDED
- ☐ Temporary Leak Repairs: NOT RECOMMENDED
- ☐ Float Operated Level Indicator Repairs / Maintenance: NOT RECOMMENDED
- ☐ Hypalon Repairs: NOT RECOMMENDED

**5. Security Related Items** *(Critical security upgrade information is immediately available)*

- ☑ Tank vents are not equipped with a security vent shroud:
- ☐ Tank hatches are not equipped with a security hatch locking device:
- ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

## Reservoir Inspection Condition Supplemental

(S. SANCHEZ) -
Upon entering the reservoir, the diver found the ladder to be in good condition with light staining and minimal concentration cell corrosion. The diver then reached bottom and found the sediment to be a light skiff of iron sand. The diver found what appeared to be protective casing for the water level. Although the casing has heavily corroded, the water level indicators did appear to be in good condition. The floor slabs appeared to be in good condition with light staining. The diver noted that the walls were all in good condition with a light stain, concentration cell corrosion and pop-outs throughout. The common inlet/outlet appeared to be in good condition other than medium to heavy concentration cell corrosion. The drain was found to be near with mild concentration cell corrosion as well. The roof supports appeared to be in excellent shape with light staining as well as some pop-outs. The diver did find some heavy spalling in the third quadrant, but no leaking was observed. The overflow was found near the access hatch and appeared to be in excellent shape with light uniform surface corrosion.

Liquid Engineering recommends a clean and inspect every 3-5 years.

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# Concrete Water Reservoir Interior Condition Survey

Job Number: 52761 | Utility: MISSOULA WATER | Tank: NORTH RESERVOIR

Inspector: S. SANCHEZ | Dive Controller: A. JAMES | Date: 10/21/2018

**AMERICAN CONCRETE INSTITUTE**
**ACI 201.1R-08 / 311.1R**

**CONCRETE CONDITION CODE**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| A – Abrasion | D - Cracking | G - contraction | J - Curling | M - Void | P - Pitting | S - Bugholes | V - Exudation | Y - Corrosion |
| B – Erosion | E - Deflection | H - Deformation | K - Checking | N – Cold Pour | Q - Spalling | T - Chalking | W - Efflorescence | Z – Exposed |
| C - Blistering | F - Expansion | I - Settling | L - Delamination | O - Honeycomb | R - Popouts | U - Leaching | X - Stains | Reinforcement |

| | QUADRANT 1 | QUADRANT 2 | QUADRANT 3 | QUADRANT 4 |
|---|---|---|---|---|

## INTERIOR RESERVOIR ROOF

| | |
|---|---|
| Roof Slab(s) | GOOD CONDITION |
| ~~Expansion Joint(s)~~ | |
| Support Beam(s) | GOOD CONDITION |
| Beam Joint(s) | UNABLE TO EVALUATE |
| ~~Roof-Column Joint~~ | |

General Appearance: Good | Coating: N/A | Vents: Good | Level Sensors: Good

~~All expansion Joints~~ Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

## INTERIOR RESERVOIR WALLS

| | |
|---|---|
| Wall-Roof Joint | GOOD CONDITION |
| Wall Structure | GOOD CONDITION |

General Appearance: Good | Coating: N/A | Ladder: ------ | Leaking: None observed | Dye Tested: No

~~All expansion Joints~~ Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

## ~~INTERIOR RESERVOIR SUPPORT COLUMNS~~

| | |
|---|---|
| Columns | |
| Clmn Floor Plates | |

General Appearance: ------ | Coating: N/A | ColumnBase Leaking: ------ | Dye Tested: ------

All expansion Joints Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

## INTERIOR RESERVOIR FLOOR

| | |
|---|---|
| Perimeter Joint | GOOD CONDITION |
| Floor Slabs | GOOD CONDITION |

General Appearance: Good | Coating: N/A | Inlet Structure: Good | Outlet Structure: Good

Overflow Structure: Good | Sump System: Good | Leaking: None observed | Dye Tested: No

~~All expansion Joints~~ Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

**Additional Interior Notes / Comments**

UNABLE TO EVALUATE SUPPORT JOINTS DUE TO AIR GAP TO ROOF.

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# Concrete Water Reservoir Exterior Condition Survey

Job Number: 52761 | Utility: MISSOULA WATER | Tank: NORTH RESERVOIR

Inspector: S. SANCHEZ | Dive Controller: A. JAMES | Date: 10/21/2018

**AMERICAN CONCRETE INSTITUTE**
**ACI 201.1R-08 / 311.1R**

**CONCRETE CONDITION CODE**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| A – Abrasion | D - Cracking | G - contraction | J - Curling | M - Void | P - Pitting | S - Bugholes | V - Exudation | Y - Corrosion |
| B – Erosion | E - Deflection | H - Deformation | K - Checking | N – Cold Pour | Q - Spalling | T - Chalking | W - Effloresence | Z – Exposed |
| C - Blistering | F - Expansion | I - Settling | L - Delamination | O - Honeycomb | R - Popouts | U - Leaching | X - Stains | Reinforcement |

| QUADRANT 1 | QUADRANT 2 | QUADRANT 3 | QUADRANT 4 |
|---|---|---|---|

## EXTERIOR RESERVOIR ROOF

| | QUADRANT 1 | QUADRANT 2 | QUADRANT 3 | QUADRANT 4 |
|---|---|---|---|---|
| Roof Slab(s) | N/A | | | |
| Expansion Joint(s) | N/A | | | |
| Roof-Wall Joint | ID, Q, W, S | ID, Q, W, S | ID, Q, W, S | ID, Q, W, S |

General Appearance: Good | Coating: N/A | Vents: Good | Level Indicator: Good

Hatch & Gaskets: Good | Hatch hinges: Good | Lock & Hasp: Good | Hatch Cage & Railing: ------

All expansion Joints | Uniform width: Yes | Uniform Level: Yes | Gaskets Intact: Yes

## EXTERIOR RESERVOIR WALLS

| | QUADRANT 1 | QUADRANT 2 | QUADRANT 3 | QUADRANT 4 |
|---|---|---|---|---|
| Wall-Roof Joint | ID, S, W | ID, S, W | ID, S, W | ID, S, W |
| Wall Structure | ID, Q, W, S | ID, Q, W, S | ID, Q, W, S | ID, Q, W, S |

General Appearance: Good | Coating: N/A | Ladder: ------ | Safety Climb: ------

Overflow Structure: Good | Clean out hatch: ------ | Leaking: None observed

All expansion Joints | Uniform width: Yes | Uniform Level: Yes | Gaskets Intact: Yes

## EXTERIOR RESERVOIR FOOTINGS / FOUNDATION

| | QUADRANT 1 | QUADRANT 2 | QUADRANT 3 | QUADRANT 4 |
|---|---|---|---|---|
| Perimeter Joint | UNABLE TO EVALUATE | | | |
| Floor Slab | UNABLE TO EVALUATE | | | |
| Footing Ring | UNABLE TO EVALUATE | | | |
| ~~Sump-Valve Vault~~ | | | | |

General Appearance: ------ | Coating: N/A | Leaking: ------ | Ground Subsidence: ------

All expansion Joints | Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------ | Overflow: ------

**Additional Exterior Notes / Comments**

UNABLE TO EVALUATE DUE TO BURIED

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# Potable Water Reservoir Contamination, Health and Safety Report

Job Number: 52761 | Utility: MISSOULA WATER | Tank: NORTH RESERVOIR

Inspector: S. SANCHEZ | Dive Controller: A. JAMES | Date: 10/21/2018

**Complies With: AWWA • OSHA • ANSI • NIOSH • NAVFAC • NFPAC**

## CONTAMINATION & HEALTH

| | | | | | |
|---|---|---|---|---|---|
| **Air Vents** | Type: MUSHROOM | | #: 1 | Screen Condition(s): Good | |
| **Hatches** | Type: Square | | #: 3 | Secured Properly: Yes | Properly Sealed: Yes |
| **Exterior Overflow** | Flapper: No | Screen: Yes | | Gasket: ---- | Condition: Good |
| ~~**Cathodic Covers**~~ | ~~In- Place: ----~~ | | ~~#: ----~~ | ~~Gasket: ----~~ | ~~Properly Sealed: ----~~ |
| **Roof to Wall Joint** | Welded: No | Properly Sealed: Yes | | | |
| **Roof Integrity** | Holes: No | Cracking: No | Standing Water: Yes | | |
| **Wall Integrity** | Holes: Yes | Cracking: Yes | | | |
| ~~**Manway Integrity**~~ | Leaks: ---- | Condition: ---- | | | |
| **Water Clarity** | General Appearance: Clear | | | Odor: None | |
| **Floating Surface Debris** | Type: N/A | | | Source: N/A | |
| ~~**Hypalon Floating Cover**~~ | ~~Condition: ----~~ | ~~Holes: ----~~ | ~~Tears: ----~~ | | |
| **Telemetry Penetrations** | Properly Sealed: Yes | | | | |

## FACILITY SAFETY COMPLIANCE

~~**Exterior Ladder**~~

| | | | | | | |
|---|---|---|---|---|---|---|
| **Overall Ladder** | Condition: ---- | #: ---- | Offset Landing: ---- | Height: | | |
| **Vandal Guard** | Present: ---- | Vandal Guard Locked: ---- | | | | |
| **Ladder Rails & Rungs** | Condition: ---- | Missing/Damaged Rungs: ---- | | | | |
| **Rung Spacing & Depth** | Spacing: | in. *(max 12")* | Toe Depth: | in. *(min 7")* | | |
| **Rail Spacing & Size** | Width: | in. *(min 2")* | Thickness: | in. *(min 1/4")* | Rail to Rail: | in.*(min 16")* |
| **Safety Climb System** | Type: ------ | Condition: ---- | | | | |
| **Number & Locations** | Wall: | Leg: | Roof: | Riser Pipe: | Other: | |
| **Ladder Attachments** | | | | | | |

~~**Manways**~~

| | | | | |
|---|---|---|---|---|
| **Type and size** | Type: ------ | #: ---- | Size: | inches *(24" – 18'x22" min)* |
| **Support Structure** | Type: ------- | Condition: ---- | | |
| **Number & Locations** | Wall: | Roof: | Riser Pipe: | Other: |

**Hatches**

| | | | | | |
|---|---|---|---|---|---|
| **Hatch Type & Size** | Type: Square | #: 3 | Size: 36X36 | in. *(24" – 24"x15" min)* | |
| **Hatch & Lid Lip Height** | Hatch: 3.75 | in. *(min 4")* | Lid: 2 | in. *(min 2")* | |

~~**Balconies & Railing**~~

| | | | | | |
|---|---|---|---|---|---|
| **Deck / Walkways** | Condition: ---- | Width: | | | |
| **Hand Rails** | Condition: ---- | Height: | in. *(min 42")* | No. Rails: | *(min 2)* |
| **Toe Rail** | Condition: ---- | Height: | in. *(min 4")* | | |
| **Welds / Attachments** | Condition: ---- | | | | |

~~**Roof**~~

| | | |
|---|---|---|
| **Safety Tie-Off Points** | Condition: ---- | #: ---- |
| **Antennas** | Type: ------- | #: ---- |

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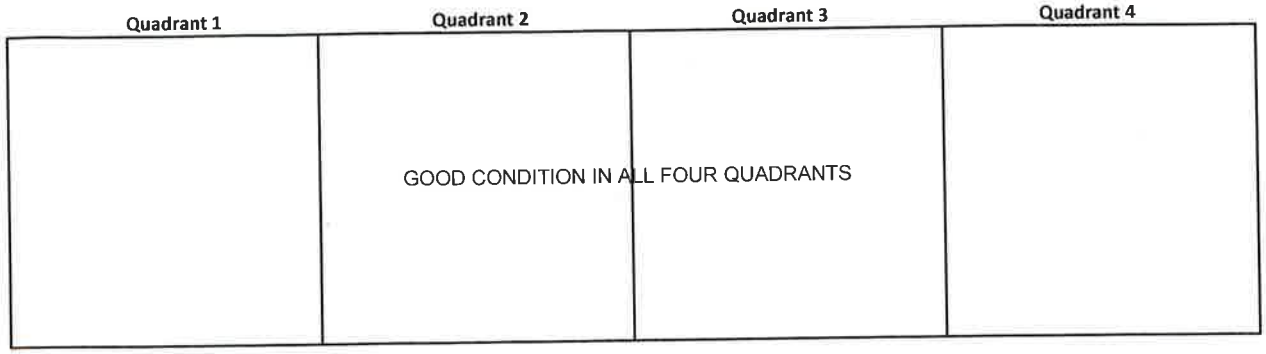
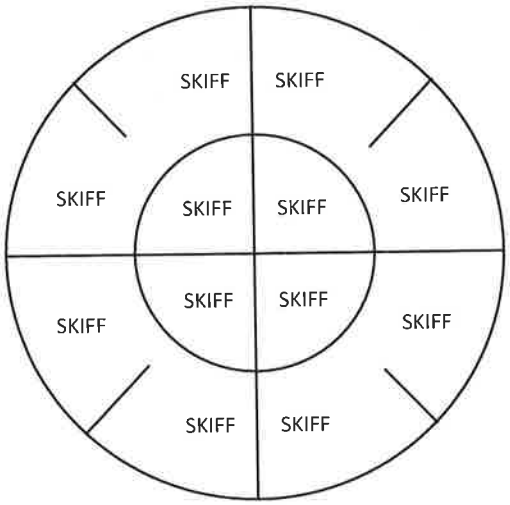
# Circular Tank Diagram / Information Worksheet

Job Number 52761 Utility Name MISSOULA WATER Tank Name NORTH RESERVOIR



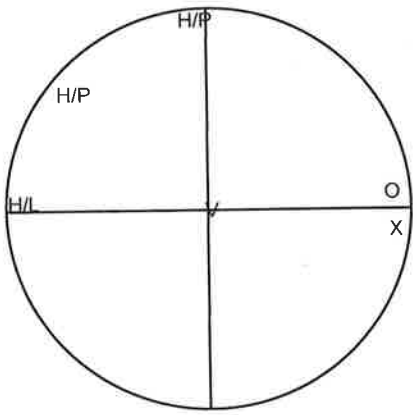

## Testing and Discrepancy Locations




**Sediment Depth Measurements**

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

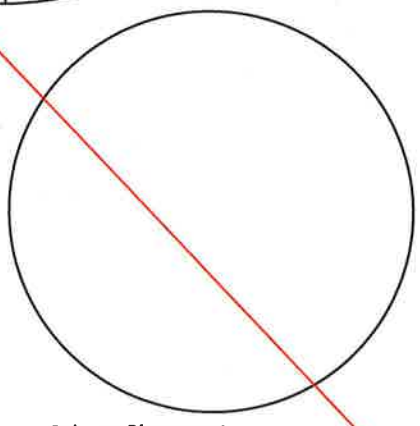
**Avg. Depth** SKIFF **Cubic Yardage** **Sediment Type** IRON/SAND




**Plumbing & Structure location**

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry



**Column Placement**

Type of Column

Base Structure

Top Structure

Column Construction ------

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# Rectangular Tank Diagram / Information Worksheet

Job Number 52761 Utility Name MISSOULA WATER Tank Name NORTH RESERVOIR

N

Q-4 Q-1

Q-3 Q-2

**Sediment Depth Measurements**

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

**Avg. Depth** **Cubic Yardage** **Sediment Type**

**Plumbing & Structure location**

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway

V=Vent D=Drain S=Sump

L=Ladder H=Hatch P=Overflow

F=Float Level Indicator

T=Telemetry

**Column Placement**

Type of Column

Base Structure

Top Structure

Column Construction ------

N

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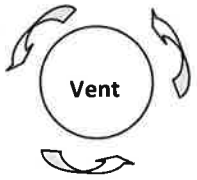
# Steel Potable Water Reservoir Security / Measurement Worksheet

Job Number 52761 Utility Name MISSOULA WATER Tank Name NORTH RESERVOIR

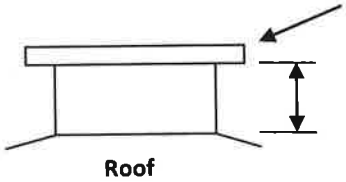
## Security

| | |
|---|---|
| Is the area surrounding the tank well lit? | Yes |
| Is the tank surrounded by a Security Fence? | Yes |
| Are the access gates locked? | Yes |
| Is the tank equipped with a Vandal Guard on the primary access ladder? | N/A |
| If so, is the Vandal Guard locked? | N/A |
| Are the vents equipped with security vent shrouds? | Yes |
| Are all of the hatches equipped with electronic monitoring devices? | Yes |
| Are the external plumbing components housed in a secure vault or out-building? | Yes |
| Does the surrounding geography of the tank obscure it from public view? | Yes |
| Does the exterior of the tank show signs of trespass? | No |

## Measurements

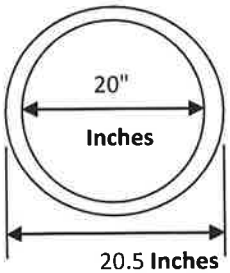



**Outside Circumference**
N/A **Inches**

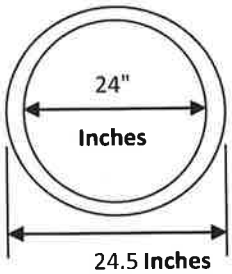



| | | |
|---|---|---|
| **Flange Metal Thickness** | N/A | **Inches** |
| **Roof to Screen or Flange** | n/a | **Inches** |
| **Flange** | N/A | |
| **Number of Bolt Holes** | N/A | **Inches** |
| **Size of Bolts** | N/A | **Inches** |

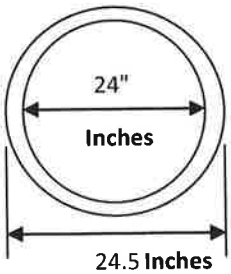
**Inlet**



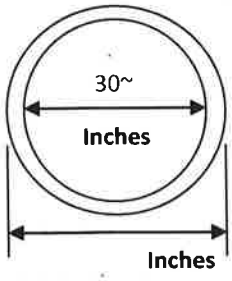

**Outlet**



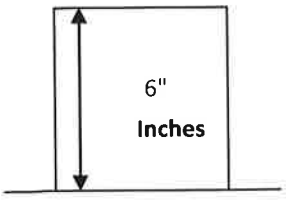

**Drain**



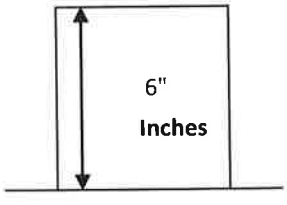

**Overflow**




**Inlet Riser**

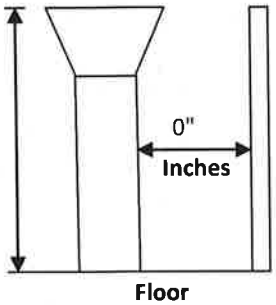



**Outlet Riser**




**Overflow** **Wall**

15'~
**Feet/Inches**

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# Steel Potable Water Reservoir Immediate Needs Assessment

Job Number: 52761 | Utility: MISSOULA WATER | Tank: NORTH RESERVOIR

Inspector: S. SANCHEZ | Dive Controller: A. JAMES | Date: 10/21/2018

**1. Health and Safety Items**

- ☐ Safety Climb System Installation: NOT RECOMMENDED
- ☐ Vent Screen Repairs: NOT RECOMMENDED

**2. Testing Items**

- ☐ Dye Testing for Leak Evaluation: NOT RECOMMENDED
- ☐ Presence of Lead Test (Interior/Exterior): NOT RECOMMENDED

**3. Destructive Testing Items**

- ☐ % of Lead Test (Interior/Exterior) *(Coating samples are removed for laboratory analysis)* NOT RECOMMENDED
- ☐ Coating Adhesion Test (Interior/Exterior): NOT RECOMMENDED

*Specific written authorization required to perform destructive testing. Destructive tests include touch-up of coating system.*

**4. Repair Items**

- ☐ Epoxy Coating Repairs: NOT RECOMMENDED
- ☐ Temporary Leak Repairs: NOT RECOMMENDED
- ☐ Float Operated Level Indicator Repairs / Maintenance: NOT RECOMMENDED
- ☐ Hypalon Repairs: NOT RECOMMENDED

**5. Security Related Items** *(Critical security upgrade information is immediately available)*

- ☑ Tank vents are not equipped with a security vent shroud:
- ☐ Tank hatches are not equipped with a security hatch locking device:
- ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

## Reservoir Inspection Condition Supplemental

(S. SANCHEZ) -
Upon entering the reservoir the diver found a light skiff of iron, sand sediment. The floor panels and floor joints all appeared to be in good condition with light staining. All three hatches appeared to be in good condition with no staining. There was a ladder found in the third quadrant that appeared to be in good condition other than galvanic corrosion that was concentrated mostly on the safety rail and bottom 4 rungs. The roof has light surface corrosion in both the first and fourth quadrants, but was otherwise in good condition. The vent also appeared to be in good condition with light surface corrosion. Upper, mid, and lower walls all appeared to be in good condition with one small settling crack traveling from the second to the fourth quadrant. The inlet and outlet were found to be in about the 3 o'clock position and appeared to be in good condition other than mild concentration cell corrosion. In quadrants one and four, the diver found platforms that appeared to be on top of overflow structures. The structures all appeared to have mild staining, concentration cells corrosion and some flaking. Overall this reservoir appears to be in excellent shape.

Liquid Engineering recommends a clean and inspect every 3-5 years.

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# Concrete Water Reservoir Interior Condition Survey

Job Number: 52761 | Utility: MISSOULA WATER | Tank: SOUTH RESERVOIR

Inspector: A. JAMES | Dive Controller: S. SANCHEZ | Date: 10/20/2018

**AMERICAN CONCRETE INSTITUTE**
**ACI 201.1R-08 / 311.1R**

**CONCRETE CONDITION CODE**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| A – Abrasion | D - Cracking | G - contraction | J - Curling | M - Void | P - Pitting | S - Bugholes | V - Exudation | Y - Corrosion |
| B – Erosion | E - Deflection | H - Deformation | K - Checking | N – Cold Pour | Q - Spalling | T - Chalking | W - Efflorescence | Z – Exposed |
| C - Blistering | F - Expansion | I - Settling | L - Delamination | O - Honeycomb | R - Popouts | U - Leaching | X - Stains | Reinforcement |

## INTERIOR RESERVOIR ROOF

| | QUADRANT 1 | QUADRANT 2 | QUADRANT 3 | QUADRANT 4 |
|---|---|---|---|---|
| Roof Slab(s) | GOOD CONDITION | GOOD CONDITION | ID | ID, U, W |
| Expansion Joint(s) | GOOD CONDITION | | | |
| ~~Support Beam(s)~~ | | | | |
| ~~Beam Joint(s)~~ | | | | |
| Roof-Column Joint | Q, S | Q, S | Q, S | Q, S |

General Appearance: Good | Coating: N/A | Vents: Good | Level Sensors: Good

All expansion Joints | Uniform width: Yes | Uniform Level: Yes | Gaskets Intact: No

## INTERIOR RESERVOIR WALLS

| | | | | |
|---|---|---|---|---|
| Wall-Roof Joint | Q, S | Q, S | Q, S | Q, S |
| Wall Structure | X, Y | X, Y | X, Y | X, Y |

General Appearance: Good | Coating: N/A | Ladder: Poor | Leaking: None observed | Dye Tested: No

All expansion Joints | Uniform width: Yes | Uniform Level: Yes | Gaskets Intact: No

## INTERIOR RESERVOIR SUPPORT COLUMNS

| | | | | |
|---|---|---|---|---|
| Columns | Q, S, Y, Z | Q, S, U, W, Y, Z | Q, S, U, W, Y, Z | Q, S, Y, Z |
| Clmn Floor Plates | Q, S, Y | Q, S, Y | Q, S, Y, Z | Q, S, Y, Z |

General Appearance: Good | Coating: N/A | ColumnBase Leaking: None observed | Dye Tested: No

All expansion Joints | Uniform width: Yes | Uniform Level: Yes | Gaskets Intact: Yes

## INTERIOR RESERVOIR FLOOR

| | | | | |
|---|---|---|---|---|
| Perimeter Joint | X | X | X | X |
| Floor Slabs | R, X | R, X | R, X | R, X |

General Appearance: Good | Coating: N/A | Inlet Structure: Good | Outlet Structure: Good

Overflow Structure: Good | Sump System: ------ | Leaking: None observed | Dye Tested: No

All expansion Joints | Uniform width: Yes | Uniform Level: Yes | Gaskets Intact: Yes

**Additional Interior Notes / Comments**

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# Concrete Water Reservoir Exterior Condition Survey

Job Number: 52761 | Utility: MISSOULA WATER | Tank: SOUTH RESERVOIR

Inspector: A. JAMES | Dive Controller: S. SANCHEZ | Date: 10/20/2018

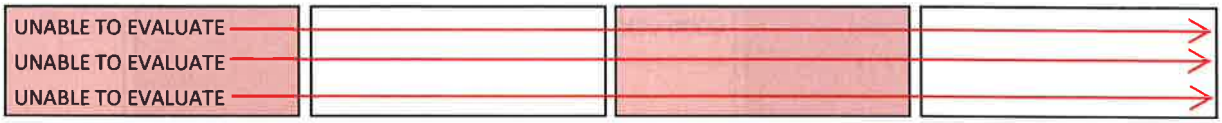
**AMERICAN CONCRETE INSTITUTE**
**ACI 201.1R-08 / 311.1R**

**CONCRETE CONDITION CODE**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| A – Abrasion | D - Cracking | G - contraction | J - Curling | M - Void | P - Pitting | S - Bugholes | V - Exudation | Y - Corrosion |
| B – Erosion | E - Deflection | H - Deformation | K - Checking | N – Cold Pour | Q - Spalling | T - Chalking | W - Efflorescence | Z – Exposed |
| C - Blistering | F - Expansion | I - Settling | L - Delamination | O - Honeycomb | R - Popouts | U - Leaching | X - Stains | Reinforcement |

| QUADRANT 1 | QUADRANT 2 | QUADRANT 3 | QUADRANT 4 |
|---|---|---|---|

## EXTERIOR RESERVOIR ROOF




General Appearance: ------ Coating: N/A Vents: Good Level Indicator: ------

Hatch & Gaskets: Good Hatch hinges: Good Lock & Hasp: Good Hatch Cage & Railing: ------

All expansion Joints Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

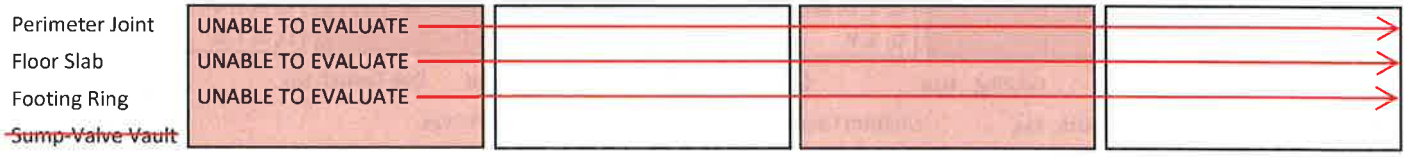
## EXTERIOR RESERVOIR WALLS

General Appearance: ------ Coating: N/A Ladder: ------ Safety Climb: ------

Overflow Structure: Good Clean out hatch: ------ Leaking: None observed

All expansion Joints Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

## EXTERIOR RESERVOIR FOOTINGS / FOUNDATION




General Appearance: ------ Coating: N/A Leaking: ------ Ground Subsidence: ------

All expansion Joints Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------ Overflow: ------

**Additional Exterior Notes / Comments**

UNABLE TO EVALUATE DUE TO BURIED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# Potable Water Reservoir Contamination, Health and Safety Report

Job Number: 52761 | Utility: MISSOULA WATER | Tank: SOUTH RESERVOIR

Inspector: A. JAMES | Dive Controller: S. SANCHEZ | Date: 10/20/2018

**Complies With: AWWA • OSHA • ANSI • NIOSH • NAVFAC • NFPAC**

## CONTAMINATION & HEALTH

| | | | | | |
|---|---|---|---|---|---|
| **Air Vents** | Type: J TUBE | | #: 2 | Screen Condition(s): Good | |
| **Hatches** | Type: Square | | #: 1 | Secured Properly: Yes | Properly Sealed: Yes |
| **Exterior Overflow** | Flapper: No | Screen: Yes | | Gasket: Yes | Condition: Good |
| ~~**Cathodic Covers**~~ | ~~In- Place: ----~~ | | ~~#: ----~~ | ~~Gasket: ----~~ | ~~Properly Sealed: ----~~ |
| **Roof to Wall Joint** | Welded: No | Properly Sealed: Yes | | | |
| **Roof Integrity** | Holes: No | Cracking: No | Standing Water: No | | |
| **Wall Integrity** | Holes: No | Cracking: No | | | |
| **Manway Integrity** | Leaks: No | Condition: Good | | | |
| **Water Clarity** | General Appearance: Clear | | | Odor: None | |
| **Floating Surface Debris** | Type: N/A | | | Source: N/A | |
| ~~**Hypalon Floating Cover**~~ | ~~Condition: ----~~ | ~~Holes: ----~~ | ~~Tears: ----~~ | | |
| **Telemetry Penetrations** | Properly Sealed: ---- | | | | |

## FACILITY SAFETY COMPLIANCE

~~**Exterior Ladder**~~

| | | | | | |
|---|---|---|---|---|---|
| **Overall Ladder** | Condition: ---- | #: ---- | Offset Landing: ---- | Height: | |
| **Vandal Guard** | Present: None | Vandal Guard Locked: ---- | | | |
| **Ladder Rails & Rungs** | Condition: Good | Missing/Damaged Rungs: No | | | |
| **Rung Spacing & Depth** | Spacing: in. *(max 12")* | Toe Depth: in. *(min 7")* | | | |
| **Rail Spacing & Size** | Width: in. *(min 2")* | Thickness: in. *(min 1/4")* | Rail to Rail: | in.*(min 16")* | |
| **Safety Climb System** | Type: ------ | Condition: ---- | | | |
| **Number & Locations** | Wall: | Leg: | Roof: | Riser Pipe: | Other: |
| **Ladder Attachments** | | | | | |

~~**Manways**~~

| | | | | |
|---|---|---|---|---|
| **Type and size** | Type: ------ | #: ---- | Size: | inches *(24" – 18'x22" min)* |
| **Support Structure** | Type: ------- | Condition: ---- | | |
| **Number & Locations** | Wall: | Roof: | Riser Pipe: | Other: |

**Hatches**

| | | | | |
|---|---|---|---|---|
| **Hatch Type & Size** | Type: Square | #: 1 | Size: 49X49 | in. *(24" – 24"x15" min)* |
| **Hatch & Lid Lip Height** | Hatch: 4" in. *(min 4")* | Lid: 3" | in. *(min 2")* | |

~~**Balconies & Railing**~~

| | | | | |
|---|---|---|---|---|
| **Deck / Walkways** | Condition: ---- | Width: | | |
| **Hand Rails** | Condition: ---- | Height: | in. *(min 42")* | No. Rails: *(min 2)* |
| **Toe Rail** | Condition: ---- | Height: | in. *(min 4")* | |
| **Welds / Attachments** | Condition: ---- | | | |

~~**Roof**~~

| | | |
|---|---|---|
| **Safety Tie-Off Points** | Condition: ---- | #: ---- |
| **Antennas** | Type: ------- | #: ---- |

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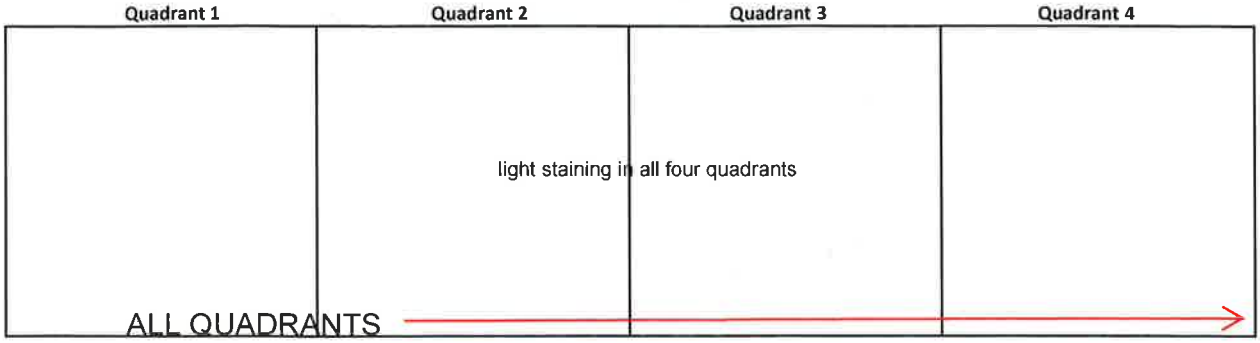
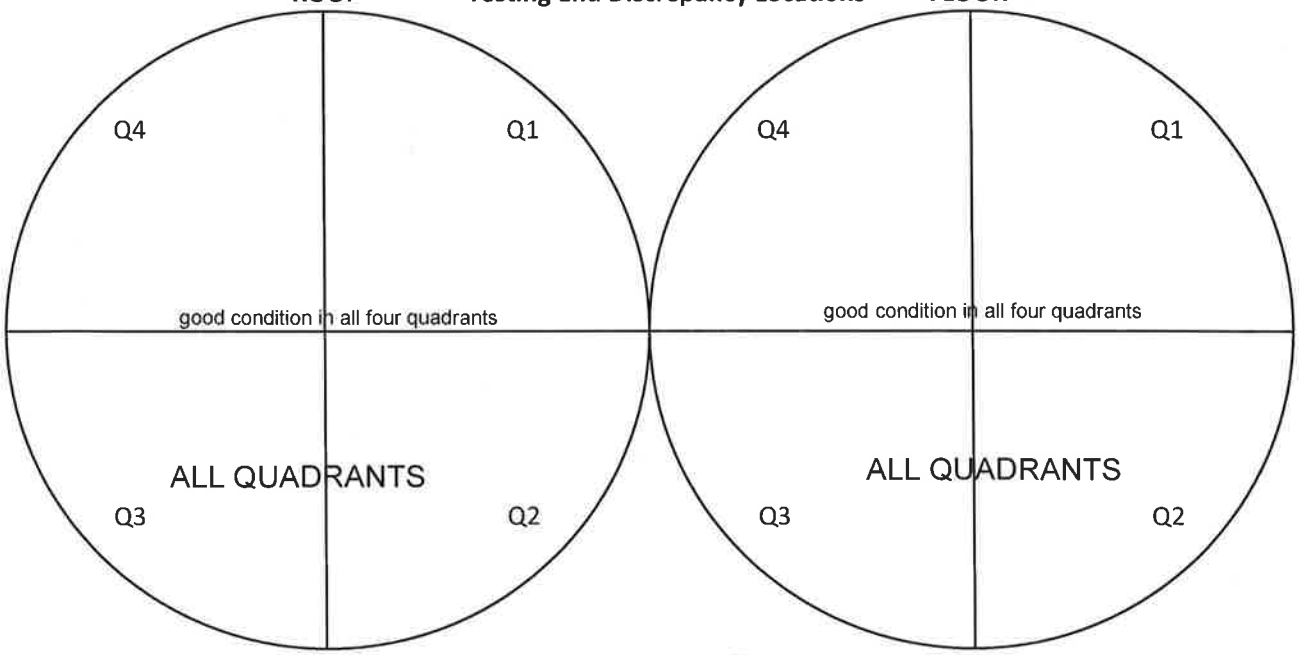
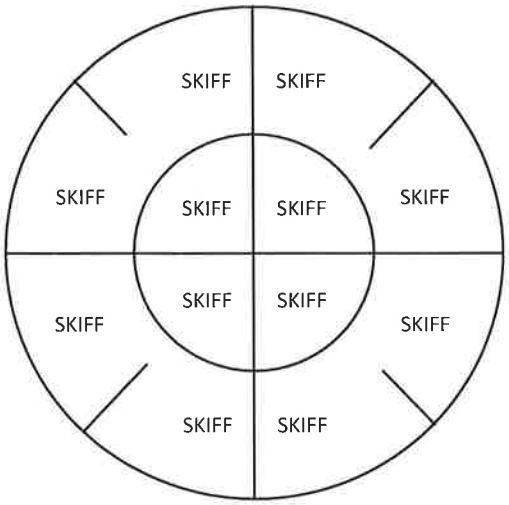
# Circular Tank Diagram / Information Worksheet

Job Number 52761 Utility Name MISSOULA WATER Tank Name SOUTH RESERVOIR




**Testing and Discrepancy Locations**

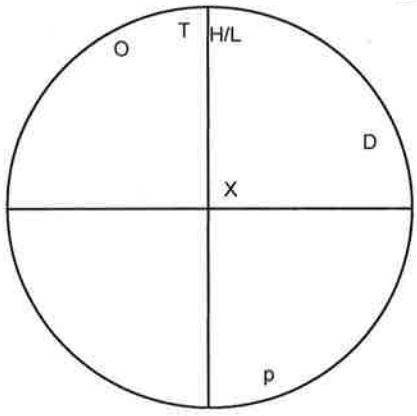



**Sediment Depth Measurements**

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

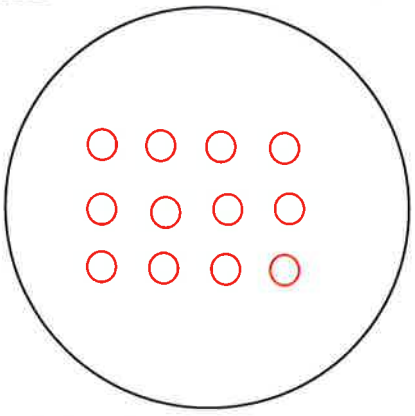
**Avg. Depth** SKIFF **Cubic Yardage** **Sediment Type** IRON SAND




**Plumbing & Structure location**

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry



**Column Placement**

Type of Column

Base Structure

Top Structure

Column Construction Concrete

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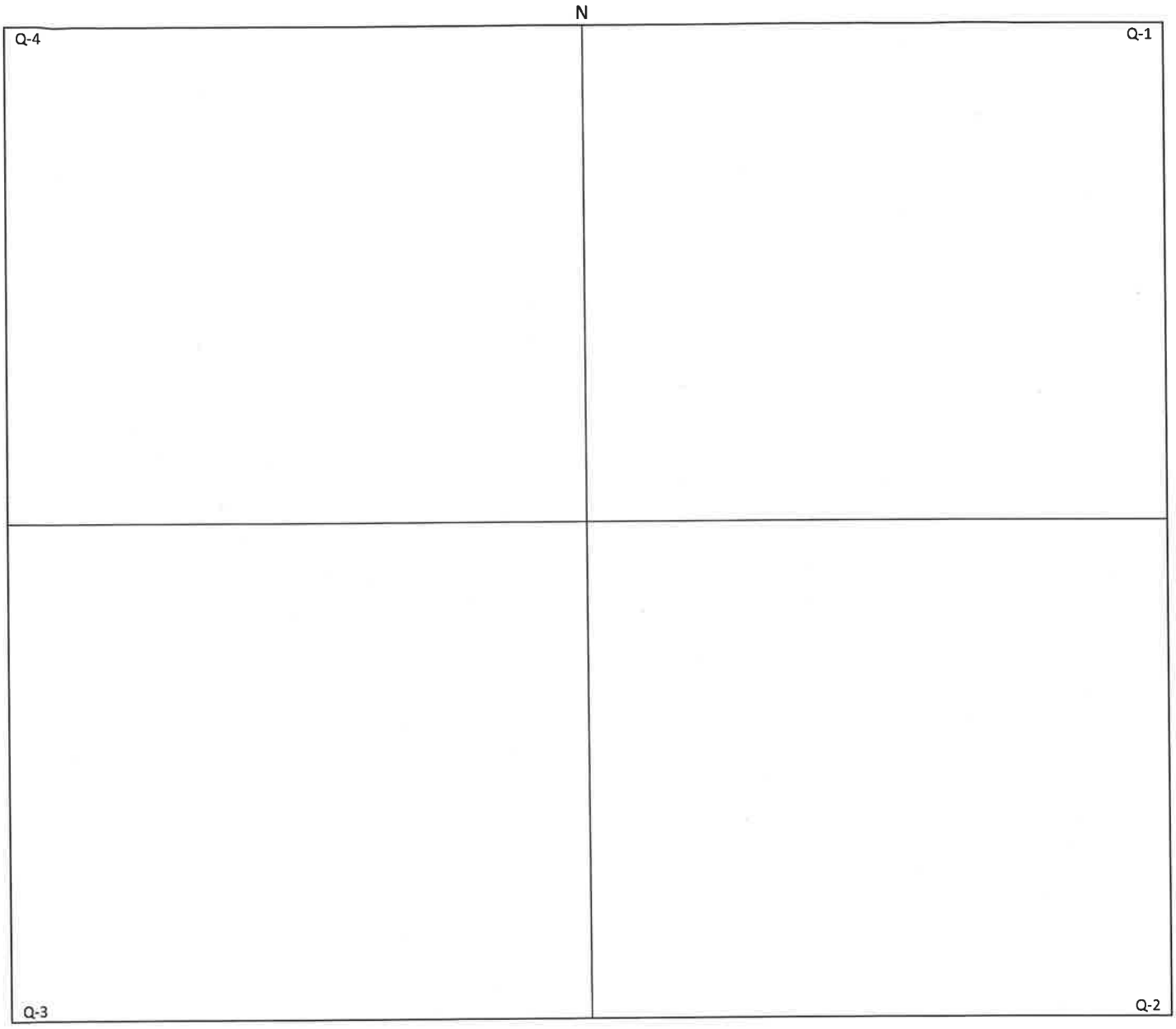
# Rectangular Tank Diagram / Information Worksheet

Job Number 52761 Utility Name MISSOULA WATER Tank Name SOUTH RESERVOIR




**Sediment Depth Measurements**

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

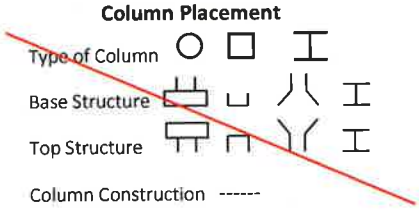
**Avg. Depth** **Cubic Yardage** **Sediment Type**

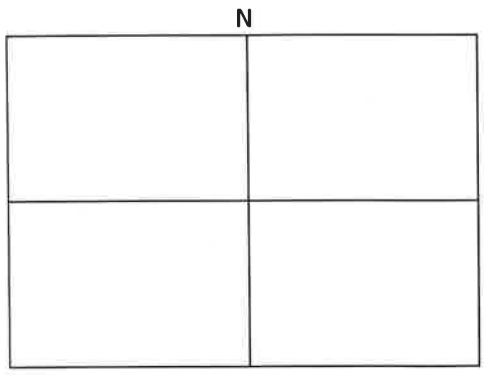
**Plumbing & Structure location**

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry

**Column Placement**

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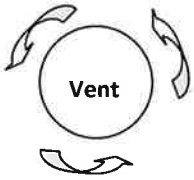
# Steel Potable Water Reservoir Security / Measurement Worksheet

Job Number 52761 Utility Name MISSOULA WATER Tank Name SOUTH RESERVOIR

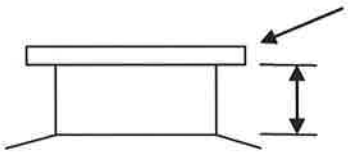
## Security

| | |
|---|---|
| Is the area surrounding the tank well lit? | Yes |
| Is the tank surrounded by a Security Fence? | Yes |
| Are the access gates locked? | Yes |
| Is the tank equipped with a Vandal Guard on the primary access ladder? | N/A |
| If so, is the Vandal Guard locked? | N/A |
| Are the vents equipped with security vent shrouds? | No |
| Are all of the hatches equipped with electronic monitoring devices? | Yes |
| Are the external plumbing components housed in a secure vault or out-building? | Yes |
| Does the surrounding geography of the tank obscure it from public view? | No |
| Does the exterior of the tank show signs of trespass? | No |

## Measurements

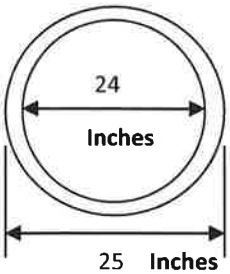



**Outside Circumference**
30 **Inches**



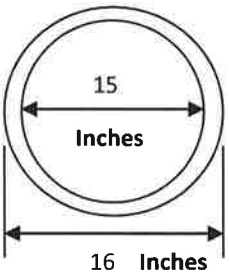

| | | |
|---|---|---|
| **Flange Metal Thickness** | N/A | **Inches** |
| **Roof to Screen or Flange** | 25" | **Inches** |
| **Flange** | N/A | |
| **Number of Bolt Holes** | N/A | **Inches** |
| **Size of Bolts** | N/A | **Inches** |

**Inlet**



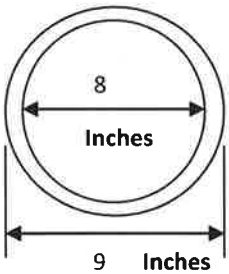

25 **Inches**

**Outlet**



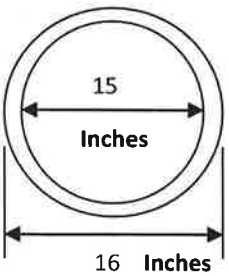

16 **Inches**

**Drain**



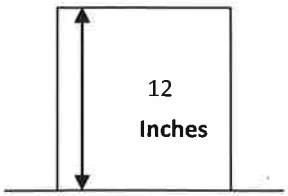

9 **Inches**

**Overflow**



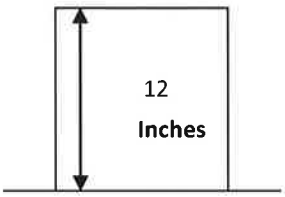

16 **Inches**

**Inlet Riser**




**Floor**

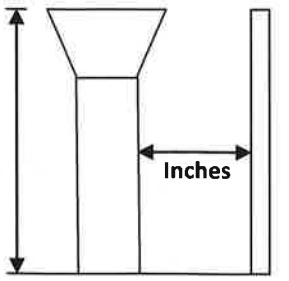
**Outlet Riser**




**Floor**

**Overflow** **Wall**

28
**Feet/Inches**




**Floor**

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# Steel Potable Water Reservoir Immediate Needs Assessment

Job Number: 52761 | Utility: MISSOULA WATER | Tank: SOUTH RESERVOIR

Inspector: A. JAMES | Dive Controller: S. SANCHEZ | Date: 10/20/2018

**1. Health and Safety Items**

- ☐ Safety Climb System Installation: NOT RECOMMENDED
- ☐ Vent Screen Repairs: NOT RECOMMENDED

**2. Testing Items**

- ☐ Dye Testing for Leak Evaluation: NOT RECOMMENDED
- ☐ Presence of Lead Test (Interior/Exterior): NOT RECOMMENDED

**3. Destructive Testing Items**

- ☐ % of Lead Test (Interior/Exterior) *(Coating samples are removed for laboratory analysis)* NOT RECOMMENDED
- ☐ Coating Adhesion Test (Interior/Exterior): NOT RECOMMENDED

*Specific written authorization required to perform destructive testing. Destructive tests include touch-up of coating system.*

**4. Repair Items**

- ☐ Epoxy Coating Repairs: NOT RECOMMENDED
- ☐ Temporary Leak Repairs: NOT RECOMMENDED
- ☐ Float Operated Level Indicator Repairs / Maintenance: NOT RECOMMENDED
- ☐ Hypalon Repairs: NOT RECOMMENDED

**5. Security Related Items** *(Critical security upgrade information is immediately available)*

- ☑ Tank vents are not equipped with a security vent shroud:
- ☐ Tank hatches are not equipped with a security hatch locking device:
- ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

## Reservoir Inspection Condition Supplemental

(A. JAMES) -
Upon reaching bottom the diver found a light skiff of iron sediment that was typical of all four quadrants. The internal ladder was found to have heavy galvanic corrosion. The inlet was found traveling from the 1 o'clock position to the center of the reservoir and did have some mild to heavy concentration cell corrosion. The floor and walls all appeared to be in good condition with light staining, concentration cell corrosion, and bug holes. The columns in the reservoir appeared to be in good condition as well, with a light stain and some more of the concentration cell corrosion that was found on the walls. The diver then returned to the ladder and found an outlet at about the 11 to 12 o'clock position that appeared to be in good condition other than some mild concentration cell corrosion. The upper walls had some of more concentration cell corrosion as well as some spalling. The roof did appear to be in good condition with no discrepancies. Overall this reservoir appears to be in good condition.

Liquid Engineering recommends a clean and inspect every 3-5 years.

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# Steel Potable Water Reservoir Inspection Report

Job Number: 52761 | Utility: MISSOULA WATER | Tank: LOWER ELK RIDGE

Inspector: A. LEON | Dive Controller: S.SANCHEZ | Date: 10/21/2018

**AMERICAN WATER WORKS ASSOCIATION**
**ANSI/AWWA M42 / D101-53**

### SSPC Legend

| Grade | Description |
|---|---|
| 10 | No Rusting, or <0.01% of surface is rusted |
| 9 | Minor rusting, or <0.03% of surface is rusted |
| 8 | Isolated rust, <.01% of surface is rusted |
| 7 | Isolated rust, <.03% of surface is rusted |
| 6 | Extensive rusting, <1% of surface is rusted |
| 5 | Approximately 3% of the surface is rusted |
| 4 | Approximately 10% of the surface is rusted |
| 3 | Approximately 17% of the surface is rusted |
| 2 | Approximately 33% of the surface is rusted |
| 1 | Approximately 50% of the surface is rusted |
| 0 | Approximately 100% of the surface is rusted |

### NACE Legend

| Grade | Description |
|---|---|
| A | None |
| B | Uniform Surface Corrosion |
| C | Pitting |
| D | Concentration Cell Corrosion |
| E | Galvanic Corrosion |
| F | Stress Corrosion Cracking |
| G | Erosion Corrosion |
| H | Intergranular Corrosion |
| I | Dealloying |

### AWS Legend

| Grade | Description |
|---|---|
| L | Satisfactory |
| M | Spatter |
| N | Porosity |
| O | Convexity / Concavity |
| P | Cracks |
| Q | Inclusions |
| R | Incomplete Fusion |
| S | Incomplete Penetration |
| T | Undercut |
| U | Underfill |
| V | Overlap |
| W | Unable to evaluate |

## INTERIOR RESERVOIR ROOF

| | QUADRANT 1 | | | QUADRANT 2 | | | QUADRANT 3 | | | QUADRANT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
| Vents | 9 | B | N/A | 9 | B | N/A | 9 | B | N/A | 9 | B | N/A |
| Roof Panels | 9 | B | N/A | 9 | B | N/A | 9 | B | N/A | 9 | B | N/A |
| Roof Support | 9 | B | N/A | 9 | B | N/A | 9 | B | N/A | 9 | B | N/A |
| ~~Roof Gussets~~ | 9 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| ~~Painting Ring~~ | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Overall Coating Rating Good | Average Blister Diameter | Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☐

## INTERIOR RESERVOIR WALLS

| | QUADRANT 1 | | | QUADRANT 2 | | | QUADRANT 3 | | | QUADRANT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
| ~~Wall to Roof weld~~ | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Lower Ring Panels | 9 | D | N/A | 9 | D | N/A | 9 | D | N/A | 9 | D | N/A |
| Middle Ring Panels | 9 | D | N/A | 9 | D | N/A | 9 | D | N/A | 9 | D | N/A |
| Upper Ring Panels | 9 | D | N/A | 9 | N/A | N/A | 9 | D | N/A | 9 | D | N/A |
| Interior Ladder | 4 | D | L | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Overall Coating Rating Good | Average Blister Diameter | Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☑

## INTERIOR RESERVOIR FLOOR

| | QUADRANT 1 | | | QUADRANT 2 | | | QUADRANT 3 | | | QUADRANT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
| ~~Perimeter Weld~~ | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Floor Panels | 9 | D | N/A | 9 | D | N/A | 9 | D | N/A | 9 | D | N/A |

Overall Coating Rating Good | Average Blister Diameter | Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☐

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# Steel Potable Water Reservoir Inspection Report

Job Number: 52761 | Utility: MISSOULA WATER | Tank: LOWER ELK RIDGE

Inspector: A. LEON | Dive Controller: S.SANCHEZ | Date: 10/21/2018

## INTERIOR RESERVOIR SUPPORT COLUMNS

| | QUADRANT 1 | | | QUADRANT 2 | | | QUADRANT 3 | | | QUADRANT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
| Column Structures | 9 | D | N/A | 9 | D | N/A | 9 | D | N/A | 9 | D | N/A |
| Column Bases | 9 | D | N/A | 9 | D | N/A | 9 | D | N/A | 9 | D | N/A |
| Column to Roof | 9 | B | N/A | 9 | B | N/A | 9 | B | N/A | 9 | B | N/A |

Overall Coating Rating Good | Average Blister Diameter | Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☐

## INTERIOR RESERVOIR PLUMBING COMPONENTS

| | QUADRANT 1 | | | QUADRANT 2 | | | QUADRANT 3 | | | QUADRANT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
| Inlet Plumbing | 9 | D | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Outlet Plumbing | 9 | D | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Manways | N/A | N/A | N/A | 8 | D | N/A | N/A | N/A | N/A | 8 | D | N/A |
| Floor Drains | 9 | D | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Interior Overflow | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 9 | B | N/A |

## EXTERIOR RESERVOIR ROOF

| | QUADRANT 1 | | | QUADRANT 2 | | | QUADRANT 3 | | | QUADRANT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
| Vents | 9 | B | N/A | 9 | B | N/A | 9 | B | N/A | 9 | B | N/A |
| Roof Panels | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A |
| Access Hatches | 9 | B | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Overall Coating Rating Good | Average Blister Diameter | Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☐

## EXTERIOR RESERVOIR WALLS

| | QUADRANT 1 | | | QUADRANT 2 | | | QUADRANT 3 | | | QUADRANT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
| ~~Wall to Roof Weld~~ | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Lower Ring Panels | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A |
| Mid Ring Panels | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A |
| Upper Ring Panels | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A |
| Exterior Overflow | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 10 | A | N/A |

Overall Coating Rating Good | Average Blister Diameter | Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☐

## FOOTINGS / FOUNDATION

| | | | | |
|---|---|---|---|---|
| Footings / Foundations: | Satisfactory ☑ | Cracking ☐ | Spalling ☐ | Erosion/Exposed Aggregate ☐ |
| Anchor Bolts: | Satisfactory ☑ | Loose ☐ | Rusted Corroded ☐ | (If excessive) Diameter = |

## ~~TOWER SUPPORT STRUCTURES~~

| | | | | |
|---|---|---|---|---|
| Tower Legs/Columns: | Satisfactory ☐ | Alignment ---- | Settling ---- | Rust /Corrosion ---- |
| Riser Pipe: | Satisfactory ☐ | Alignment ---- | Frost Casing ---- | Rust /Corrosion ---- |
| Rods & Turnbuckles: | Satisfactory ☐ | Turnbuckle Tension ---- | Rod Tension ---- | Cotter Pins/Rod Nuts ---- |
| Leg shoes/Brackets: | Satisfactory ☐ | Coating ---- | Rust/Corrosion ---- | Pitting/Cracking ---- |

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# Potable Water Reservoir Contamination, Health and Safety Report

Job Number: 52761 | Utility: MISSOULA WATER | Tank: LOWER ELK RIDGE

Inspector: A. LEON | Dive Controller: S.SANCHEZ | Date: 10/21/2018

**Complies With: AWWA • OSHA • ANSI • NIOSH • NAVFAC • NFPAC**

## CONTAMINATION & HEALTH

| | | | | | |
|---|---|---|---|---|---|
| **Air Vents** | Type: MUSHROOM | | #: 1 | Screen Condition(s): Good | |
| **Hatches** | Type: Square | | #: 1 | Secured Properly: Yes | Properly Sealed: Yes |
| **Exterior Overflow** | Flapper: No | Screen: Yes | | Gasket: No | Condition: Good |
| ~~**Cathodic Covers**~~ | In- Place: ---- | | #: | Gasket: ---- | Properly Sealed: ---- |
| **Roof to Wall Joint** | Welded: No | Properly Sealed: Yes | | | |
| **Roof Integrity** | Holes: No | Cracking: No | Standing Water: No | | |
| **Wall Integrity** | Holes: No | Cracking: No | | | |
| **Manway Integrity** | Leaks: No | Condition: Good | | | |
| **Water Clarity** | General Appearance: CLEAR | | | Odor: NONE | |
| **Floating Surface Debris** | Type: NONE | | | Source: N/A | |
| ~~**Hypalon Floating Cover**~~ | Condition: ---- | Holes: ---- | Tears: ---- | | |
| **Telemetry Penetrations** | Properly Sealed: Yes | | | | |

## FACILITY SAFETY COMPLIANCE

~~**Exterior Ladder**~~

| | | | | | |
|---|---|---|---|---|---|
| **Overall Ladder** | Condition: ---- | #: ---- | Offset Landing: ---- | Height: | |
| **Vandal Guard** | Present: ---- | Vandal Guard Locked: ---- | | | |
| **Ladder Rails & Rungs** | Condition: ---- | Missing/Damaged Rungs: ---- | | | |
| **Rung Spacing & Depth** | Spacing: in. *(max 12")* | Toe Depth: in. *(min 7")* | | | |
| **Rail Spacing & Size** | Width: in. *(min 2")* | Thickness: in. *(min 1/4")* | Rail to Rail: | in.*(min 16")* | |
| **Safety Climb System** | Type: ------ | Condition: ---- | | | |
| **Number & Locations** | Wall: | Leg: | Roof: | Riser Pipe: | Other: |
| **Ladder Attachments** | WELD, GOOD CONDITION | | | | |

**Manways**

| | | | | |
|---|---|---|---|---|
| **Type and size** | Type: Round | #: 2 | Size: 33 | inches *(24" – 18'x22" min)* |
| **Support Structure** | Type: Bolted | Condition: Good | | |
| **Number & Locations** | Wall: 2 | Roof: | Riser Pipe: | Other: |

**Hatches**

| | | | | |
|---|---|---|---|---|
| **Hatch Type & Size** | Type: Square | #: 1 | Size: 24X24 | in. *(24" – 24"x15" min)* |
| **Hatch & Lid Lip Height** | Hatch: 3.5 in. *(min 4")* | Lid: 2 | in. *(min 2")* | |

~~**Balconies & Railing**~~

| | | | | |
|---|---|---|---|---|
| **Deck / Walkways** | Condition: ---- | Width: | | |
| **Hand Rails** | Condition: ---- | Height: | in. *(min 42")* | No. Rails: *(min 2)* |
| **Toe Rail** | Condition: ---- | Height: | in. *(min 4")* | |
| **Welds / Attachments** | Condition: ---- | | | |

**Roof**

| | | | |
|---|---|---|---|
| **Safety Tie-Off Points** | Condition: Fair | #: 2 | |
| **Antennas** | Type: ------- | #: ---- | |

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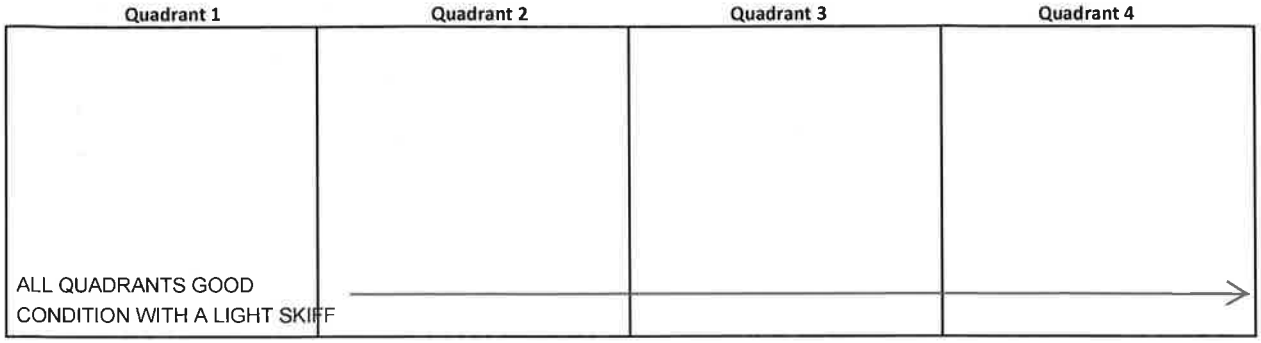
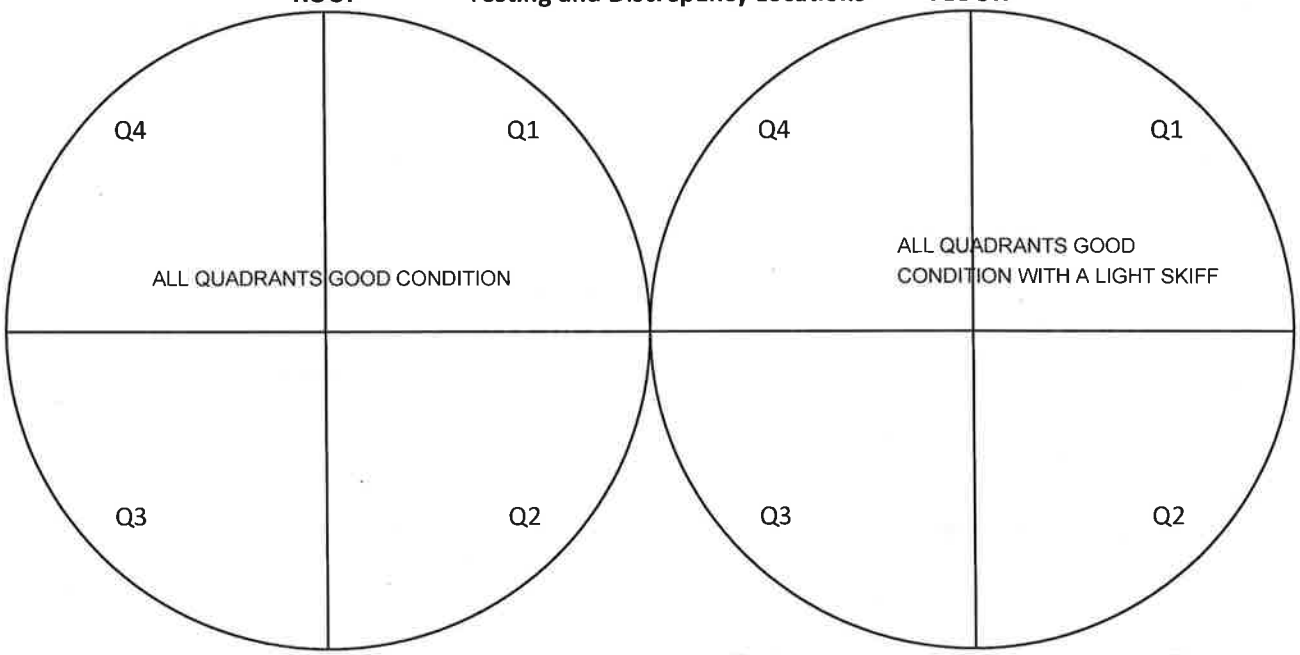
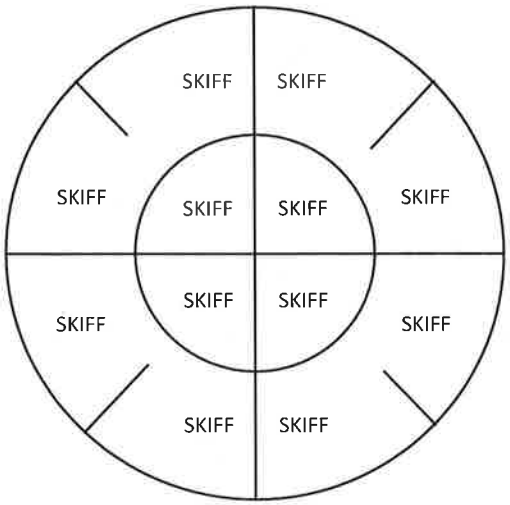
# Circular Tank Diagram / Information Worksheet

Job Number 52761 Utility Name MISSOULA WATER Tank Name LOWER ELK RIDGE



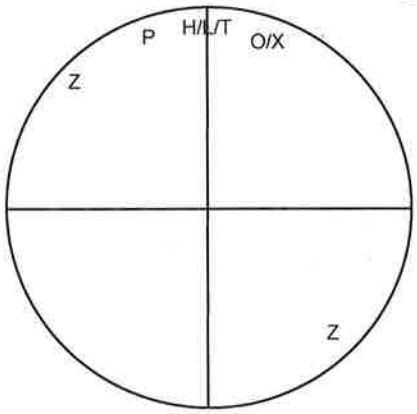

**Testing and Discrepancy Locations**



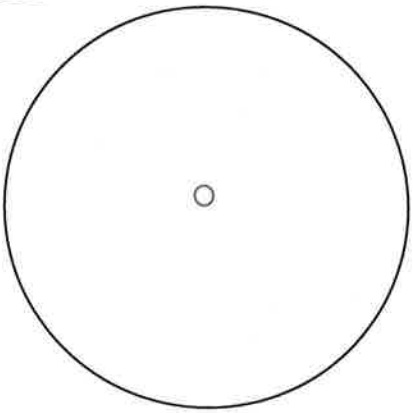

**Sediment Depth Measurements**

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken




**Plumbing & Structure location**

Plumbing and structure codes
O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry




**Column Placement**

Type of Column

Base Structure

Top Structure

**Avg. Depth** SKIFF **Cubic Yardage** **Sediment Type** LIME/IRON SAND

Column Construction Steel

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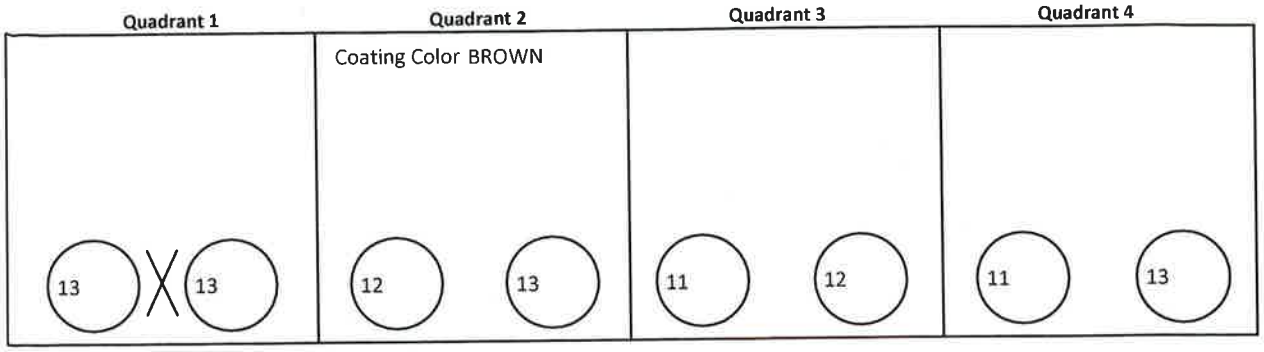
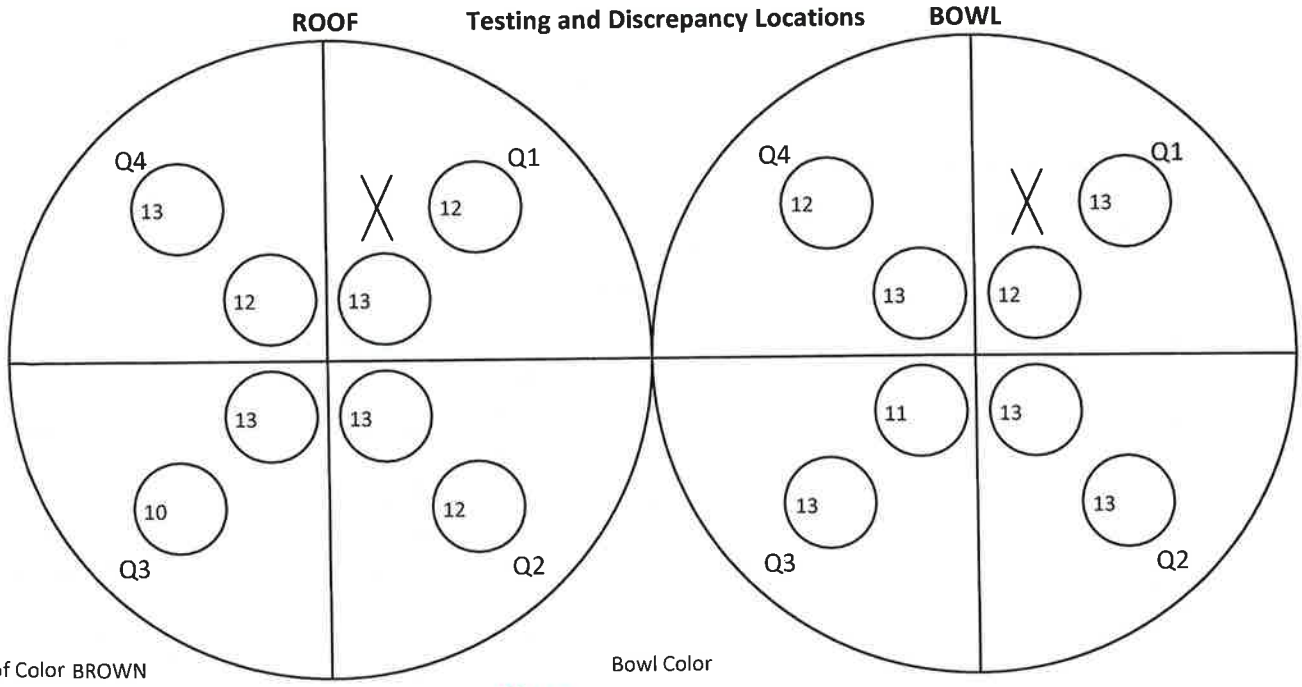
## Circular Tank Diagram / NDT ☐ DFT ☐ Coating Adhesion ☐ Presence of lead ☐

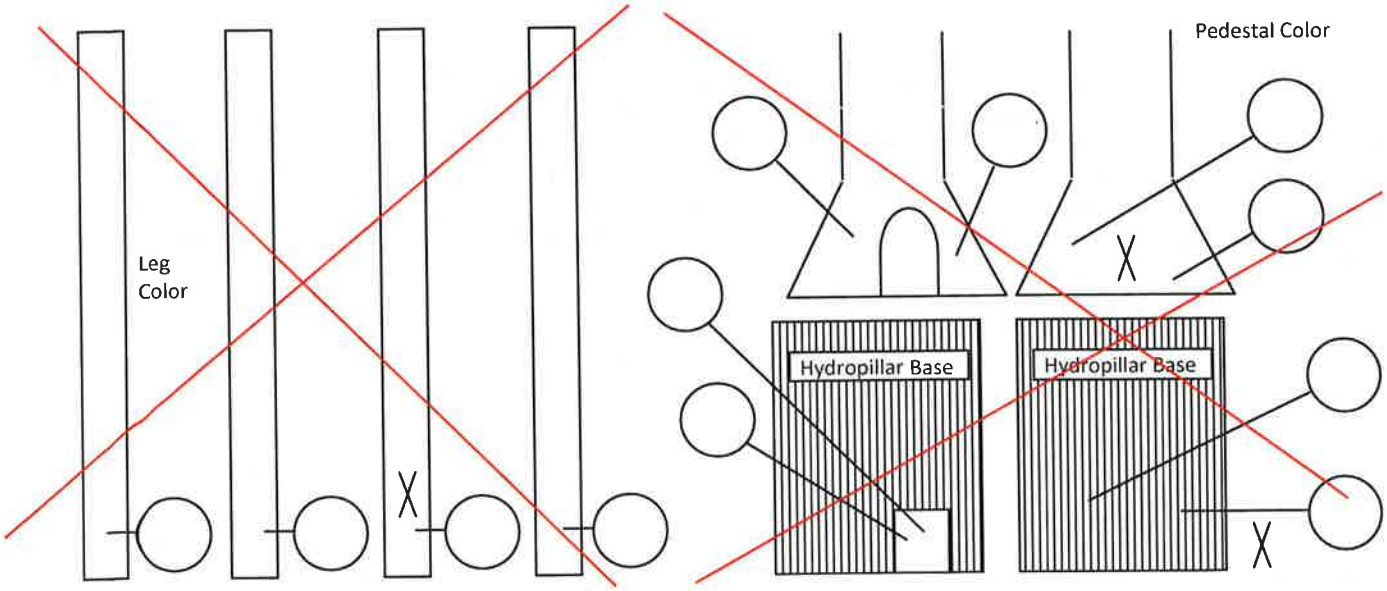
Job Number 52761 Utility Name MISSOULA WATER Tank Name LOWER ELK RIDGE




Roof Color BROWN

Bowl Color

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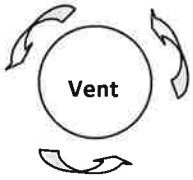
# Steel Potable Water Reservoir Security / Measurement Worksheet

Job Number 52761 Utility Name MISSOULA WATER Tank Name LOWER ELK RIDGE

## Security

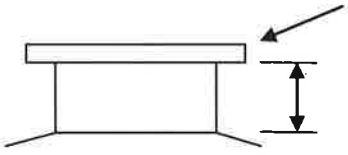
| | |
|---|---|
| Is the area surrounding the tank well lit? | No |
| Is the tank surrounded by a Security Fence? | Yes |
| Are the access gates locked? | Yes |
| Is the tank equipped with a Vandal Guard on the primary access ladder? | N/A |
| If so, is the Vandal Guard locked? | N/A |
| Are the vents equipped with security vent shrouds? | Yes |
| Are all of the hatches equipped with electronic monitoring devices? | Yes |
| Are the external plumbing components housed in a secure vault or out-building? | N/A |
| Does the surrounding geography of the tank obscure it from public view? | Yes |
| Does the exterior of the tank show signs of trespass? | No |

## Measurements



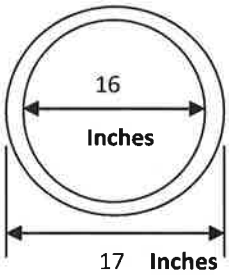

**Outside Circumference**

34X3 **Inches**

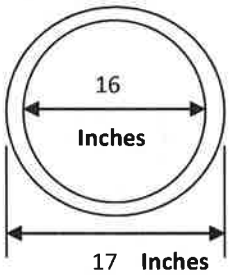



| | | |
|---|---|---|
| **Flange Metal Thickness** | N/A | **Inches** |
| **Roof to Screen or Flange** | N/A | **Inches** |
| **Flange** | N/A | |
| **Number of Bolt Holes** | N/A | **Inches** |
| **Size of Bolts** | N/A | **Inches** |

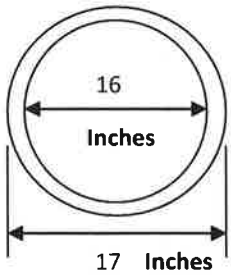
**Inlet**



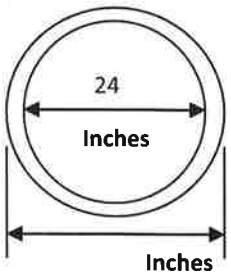

**Outlet**



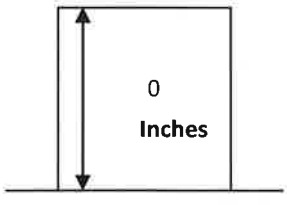

**Drain**



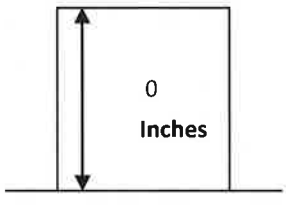

**Overflow**




**Inlet Riser**




**Outlet Riser**

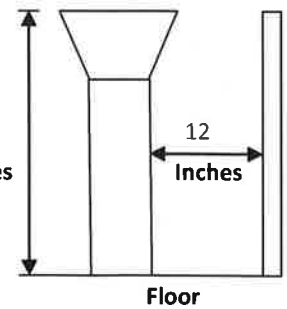



**Overflow** **Wall**

15' **Feet/Inches**

12 **Inches**

**Floor**



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# Steel Potable Water Reservoir Immediate Needs Assessment

Job Number: 52761 | Utility: MISSOULA WATER | Tank: LOWER ELK RIDGE

Inspector: A. LEON | Dive Controller: S.SANCHEZ | Date: 10/21/2018

**1. Health and Safety Items**

- ☐ Safety Climb System Installation: NOT RECOMMENDED
- ☐ Vent Screen Repairs: NOT RECOMMENDED

**2. Testing Items**

- ☐ Dye Testing for Leak Evaluation: NOT RECOMMENDED
- ☐ Presence of Lead Test (Interior/Exterior): NOT RECOMMENDED

**3. Destructive Testing Items**

- ☐ % of Lead Test (Interior/Exterior) *(Coating samples are removed for laboratory analysis)* NOT RECOMMENDED
- ☐ Coating Adhesion Test (Interior/Exterior): NOT RECOMMENDED

*Specific written authorization required to perform destructive testing. Destructive tests include touch-up of coating system.*

**4. Repair Items**

- ☐ Epoxy Coating Repairs: NOT RECOMMENDED
- ☐ Temporary Leak Repairs: NOT RECOMMENDED
- ☐ Float Operated Level Indicator Repairs / Maintenance: NOT RECOMMENDED
- ☐ Hypalon Repairs: NOT RECOMMENDED

**5. Security Related Items** *(Critical security upgrade information is immediately available)*

- ☐ Tank vents are not equipped with a security vent shroud:
- ☐ Tank hatches are not equipped with a security hatch locking device:
- ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

## Reservoir Inspection Condition Supplemental

A. LEON (LOWER ELK RIDGE) -
Upon entering the reservoir, the diver found the hatch and ladder to be in good condition with light surface corrosion. When the diver reached bottom, they found the ladder had some heavy concentration cell corrosion from the floor to about six feet off the ground. There was a light skiff of lime and iron sediment found throughout the reservoir. The floors were found to have light staining as well as some concentration cell corrosion. The common inlet/outlet was found in the first quadrant and appeared to be in good condition with some concentration cell corrosion. The walls all through the reservoir were found to have a light stain. The two manways in the reservoir were found to have a light stain as well as some concentration cell corrosion. In the center of the reservoir the diver found a supporting column that did appear to have light staining and surface corrosion. Upon reaching surface, the diver found the roof and roof supports to be in good condition with light surface corrosion as well as some staining. The vent and column to roof structure was found to be in good condition with light staining and surface corrosion as well. In the 11 o'clock position, the diver found the overflow which appeared to be in good condition with a light stain. Overall this reservoir does appear to be in good condition.

As per AWWA M42, Liquid Engineering recommends a clean and inspect every 3 years.

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# Steel Potable Water Reservoir Inspection Report

Job Number: 52761 | Utility: MISSOULA WATER | Tank: LOWER LINCOLN HILL

Inspector: A. JAMES | Dive Controller: S. SANCHEZ | Date: 10/21/2018

**AMERICAN WATER WORKS ASSOCIATION**
**ANSI/AWWA M42 / D101-53**

### SSPC Legend

| Grade | Description |
|---|---|
| 10 | No Rusting, or <0.01% of surface is rusted |
| 9 | Minor rusting, or <0.03% of surface is rusted |
| 8 | Isolated rust, <.01% of surface is rusted |
| 7 | Isolated rust, <.03% of surface is rusted |
| 6 | Extensive rusting, <1% of surface is rusted |
| 5 | Approximately 3% of the surface is rusted |
| 4 | Approximately 10% of the surface is rusted |
| 3 | Approximately 17% of the surface is rusted |
| 2 | Approximately 33% of the surface is rusted |
| 1 | Approximately 50% of the surface is rusted |
| 0 | Approximately 100% of the surface is rusted |

### NACE Legend

| Grade | Description |
|---|---|
| A | None |
| B | Uniform Surface Corrosion |
| C | Pitting |
| D | Concentration Cell Corrosion |
| E | Galvanic Corrosion |
| F | Stress Corrosion Cracking |
| G | Erosion Corrosion |
| H | Intergranular Corrosion |
| I | Dealloying |

### AWS Legend

| Grade | Description |
|---|---|
| L | Satisfactory |
| M | Spatter |
| N | Porosity |
| O | Convexity / Concavity |
| P | Cracks |
| Q | Inclusions |
| R | Incomplete Fusion |
| S | Incomplete Penetration |
| T | Undercut |
| U | Underfill |
| V | Overlap |
| W | Unable to evaluate |

## INTERIOR RESERVOIR ROOF

| | QUADRANT 1 | | | QUADRANT 2 | | | QUADRANT 3 | | | QUADRANT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
| Vents | N/A | N/A | N/A | 9 | B | L | 9 | B | L | N/A | N/A | N/A |
| Roof Panels | 9 | B | L | 9 | B | L | 9 | B | L | 9 | B | L |
| ~~Roof Support~~ | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| ~~Roof Gussets~~ | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| ~~Painting Ring~~ | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Overall Coating Rating Good | Average Blister Diameter | Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☑

## INTERIOR RESERVOIR WALLS

| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wall to Roof weld | 10 | A | L | 10 | A | L | 10 | A | L | 10 | A | L |
| Lower Ring Panels | 10 | A | L | 10 | A | L | 10 | A | L | 10 | A | L |
| Middle Ring Panels | 10 | A | L | 10 | A | L | 10 | A | L | 10 | A | L |
| Upper Ring Panels | 10 | A | L | 10 | A | L | 10 | A | L | 10 | A | L |
| Interior Ladder | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Overall Coating Rating Good | Average Blister Diameter | Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☑

## INTERIOR RESERVOIR FLOOR

| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Perimeter Weld | 10 | A | L | 9 | D | L | 9 | D | L | 10 | A | L |
| Floor Panels | 10 | A | L | 9 | D | L | 9 | D | L | 10 | A | L |

Overall Coating Rating Good | Average Blister Diameter | Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☑

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# Steel Potable Water Reservoir Inspection Report

Job Number: 52761 | Utility: MISSOULA WATER | Tank: LOWER LINCOLN HILL

Inspector: A. JAMES | Dive Controller: S. SANCHEZ | Date: 10/21/2018

## INTERIOR RESERVOIR SUPPORT COLUMNS

| | QUADRANT 1 | | | QUADRANT 2 | | | QUADRANT 3 | | | QUADRANT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
| Column Structures | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Column Bases | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Column to Roof | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Overall Coating Rating ---- Average Blister Diameter Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☐ Sags/Runs ☐

## INTERIOR RESERVOIR PLUMBING COMPONENTS

| | QUADRANT 1 | | | QUADRANT 2 | | | QUADRANT 3 | | | QUADRANT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
| Inlet Plumbing | N/A | N/A | N/A | 9 | D | L | 9 | D | L | N/A | N/A | N/A |
| Outlet Plumbing | N/A | N/A | N/A | 9 | D | L | 9 | D | L | N/A | N/A | N/A |
| Manways | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Floor Drains | N/A | N/A | N/A | 9 | D | L | 9 | D | L | N/A | N/A | N/A |
| Interior Overflow | N/A | N/A | N/A | 9 | D | L | 9 | D | L | N/A | N/A | N/A |

## EXTERIOR RESERVOIR ROOF

| | QUADRANT 1 | | | QUADRANT 2 | | | QUADRANT 3 | | | QUADRANT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
| Vents | N/A | N/A | N/A | 10 | A | L | 10 | A | L | N/A | N/A | N/A |
| Roof Panels | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Access Hatches | 10 | A | L | 10 | A | L | 10 | A | L | 10 | A | L |

Overall Coating Rating ---- Average Blister Diameter Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☐ Sags/Runs ☐

## EXTERIOR RESERVOIR WALLS

| | QUADRANT 1 | | | QUADRANT 2 | | | QUADRANT 3 | | | QUADRANT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
| Wall to Roof Weld | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Lower Ring Panels | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Mid Ring Panels | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Upper Ring Panels | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Exterior Overflow | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Overall Coating Rating ---- Average Blister Diameter Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☐ Sags/Runs ☐

## FOOTINGS / FOUNDATION

| | | | | |
|---|---|---|---|---|
| Footings / Foundations: | Satisfactory ☐ | Cracking ☐ | Spalling ☐ | Erosion/Exposed Aggregate ☐ |
| Anchor Bolts: | Satisfactory ☐ | Loose ☐ | Rusted Corroded ☐ | (If excessive) Diameter = |

## TOWER SUPPORT STRUCTURES

| | | | | |
|---|---|---|---|---|
| Tower Legs/Columns: | Satisfactory ☐ | Alignment ---- | Settling ---- | Rust /Corrosion ---- |
| Riser Pipe: | Satisfactory ☐ | Alignment ---- | Frost Casing ---- | Rust /Corrosion ---- |
| Rods & Turnbuckles: | Satisfactory ☐ | Turnbuckle Tension ---- | Rod Tension ---- | Cotter Pins/Rod Nuts ---- |
| Leg shoes/Brackets: | Satisfactory ☐ | Coating ---- | Rust/Corrosion ---- | Pitting/Cracking ---- |

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# Potable Water Reservoir Contamination, Health and Safety Report

Job Number: 52761 | Utility: MISSOULA WATER | Tank: LOWER LINCOLN HILL

Inspector: A. JAMES | Dive Controller: S. SANCHEZ | Date: 10/21/2018

**Complies With: AWWA • OSHA • ANSI • NIOSH • NAVFAC • NFPAC**

## CONTAMINATION & HEALTH

| | | | | | |
|---|---|---|---|---|---|
| **Air Vents** | Type: J TUBE | | #: 1 | Screen Condition(s): Good | |
| **Hatches** | Type: Square | | #: 2 | Secured Properly: Yes | Properly Sealed: Yes |
| ~~Exterior Overflow~~ | Flapper: ---- | Screen: ---- | | Gasket: ---- | Condition: ---- |
| ~~Cathodic Covers~~ | In- Place: ---- | | #: | Gasket: ---- | Properly Sealed: ---- |
| **Roof to Wall Joint** | Welded: Yes | Properly Sealed: Yes | | | |
| ~~Roof Integrity~~ | Holes: ---- | Cracking: ---- | Standing Water: ---- | | |
| ~~Wall Integrity~~ | Holes: ---- | Cracking: ---- | | | |
| ~~Manway Integrity~~ | Leaks: ---- | Condition: ---- | | | |
| **Water Clarity** | General Appearance: CLEAR | | | Odor: NONE | |
| **Floating Surface Debris** | Type: NONE | | | Source: N/A | |
| ~~Hypalon Floating Cover~~ | Condition: ---- | Holes: ---- | Tears: ---- | | |
| **Telemetry Penetrations** | Properly Sealed: Yes | | | | |

## FACILITY SAFETY COMPLIANCE

~~Exterior Ladder~~

| | | | | | |
|---|---|---|---|---|---|
| **Overall Ladder** | Condition: ---- | #: ---- | Offset Landing: ---- | Height: | |
| **Vandal Guard** | Present: ---- | Vandal Guard Locked: ---- | | | |
| **Ladder Rails & Rungs** | Condition: ---- | Missing/Damaged Rungs: ---- | | | |
| **Rung Spacing & Depth** | Spacing: in. *(max 12")* | Toe Depth: in. *(min 7")* | | | |
| **Rail Spacing & Size** | Width: in. *(min 2")* | Thickness: in. *(min 1/4")* | Rail to Rail: | in.*(min 16")* | |
| **Safety Climb System** | Type: ------ | Condition: ---- | | | |
| **Number & Locations** | Wall: | Leg: | Roof: | Riser Pipe: | Other: |
| **Ladder Attachments** | WELD, GOOD CONDITION | | | | |

~~Manways~~

| | | | | |
|---|---|---|---|---|
| **Type and size** | Type: ------ | #: ---- | Size: | inches *(24" – 18'x22" min)* |
| **Support Structure** | Type: ------- | Condition: ---- | | |
| **Number & Locations** | Wall: | Roof: | Riser Pipe: | Other: |

Hatches

| | | | | |
|---|---|---|---|---|
| **Hatch Type & Size** | Type: Square | #: 2 | Size: 33X56 | in. *(24" – 24"x15" min)* |
| **Hatch & Lid Lip Height** | Hatch: 5.5 in. *(min 4")* | Lid: 3 | in. *(min 2")* | |

~~Balconies & Railing~~

| | | | | | |
|---|---|---|---|---|---|
| **Deck / Walkways** | Condition: ---- | Width: | | | |
| **Hand Rails** | Condition: ---- | Height: | in. *(min 42")* | No. Rails: | *(min 2)* |
| **Toe Rail** | Condition: ---- | Height: | in. *(min 4")* | | |
| **Welds / Attachments** | Condition: ---- | | | | |

~~Roof~~

| | | |
|---|---|---|
| **Safety Tie-Off Points** | Condition: ---- | #: ---- |
| **Antennas** | Type: ------- | #: ---- |

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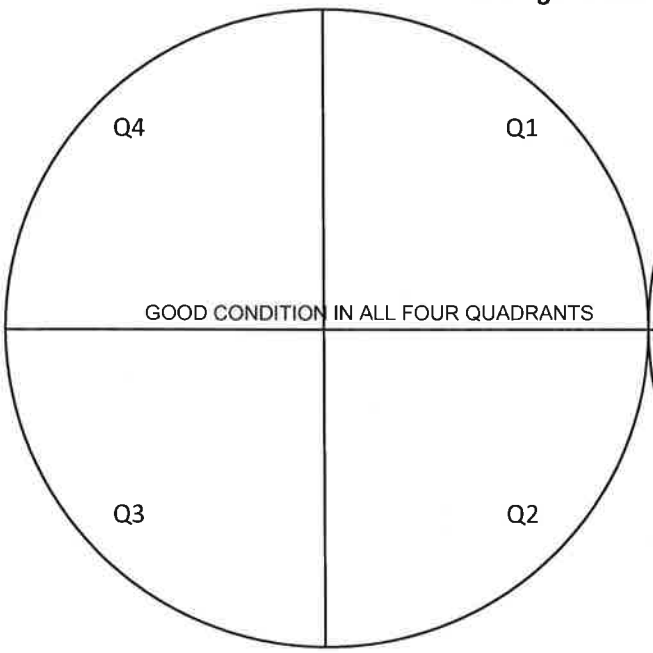
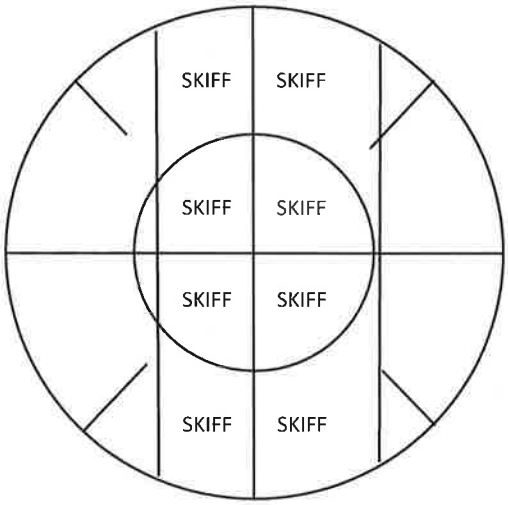
# Circular Tank Diagram / Information Worksheet

Job Number 52761 Utility Name MISSOULA WATER Tank Name LOWER LINCOLN HILL

| Quadrant 1 | Quadrant 2 | Quadrant 3 | Quadrant 4 |
|---|---|---|---|
| | GOOD CONDITION IN ALL FOUR QUADRANTS WITH LIGHT STAINING IN QUADRANTS ONE AND TWO | | |

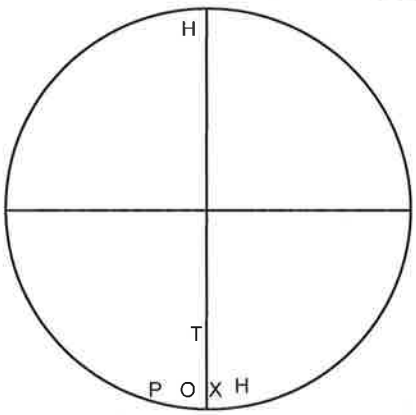
**ROOF** **Testing and Discrepancy Locations** **FLOOR**





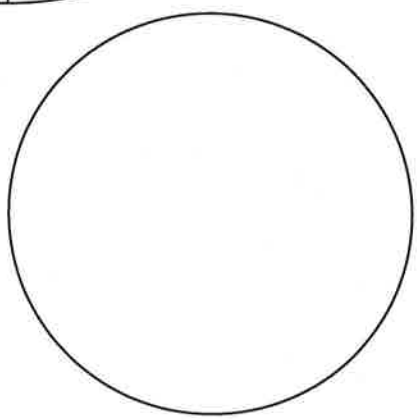

**Sediment Depth Measurements**

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken




**Plumbing & Structure location**

Plumbing and structure codes
O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry



**Column Placement**

Type of Column

Base Structure

Top Structure

Column Construction ------

**Avg. Depth** SKIFF **Cubic Yardage** **Sediment Type** SAND & GRAVEL

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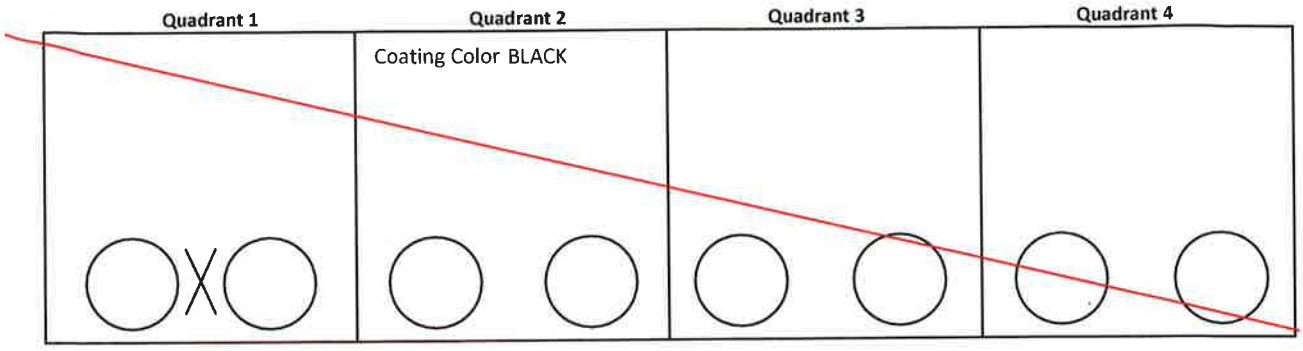
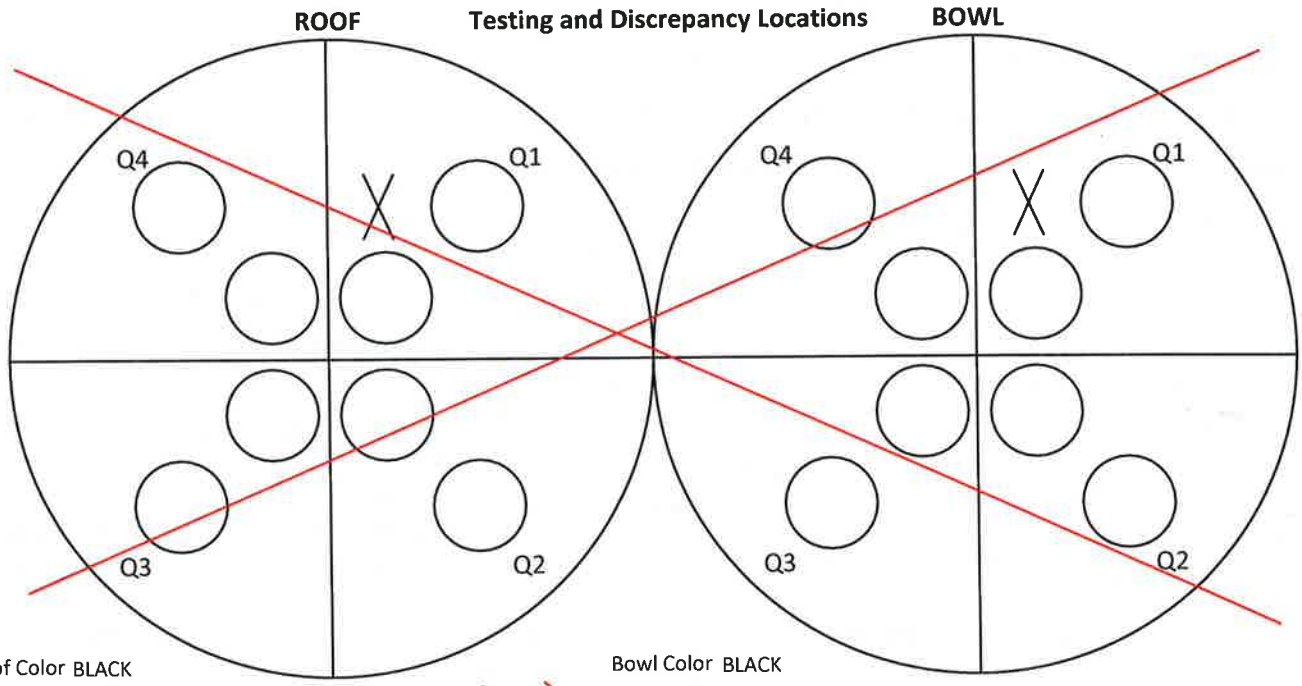
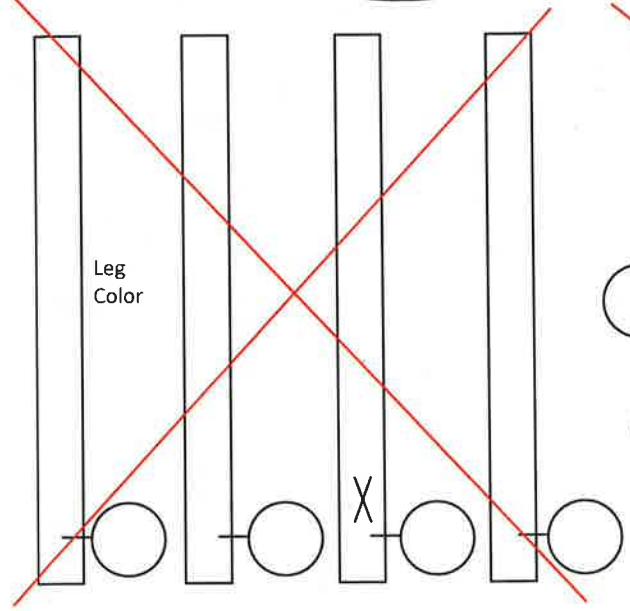
## Circular Tank Diagram / NDT ☐ DFT ☐ Coating Adhesion ☐ Presence of lead ☐

Job Number 52761 Utility Name MISSOULA WATER Tank Name LOWER LINCOLN HILL

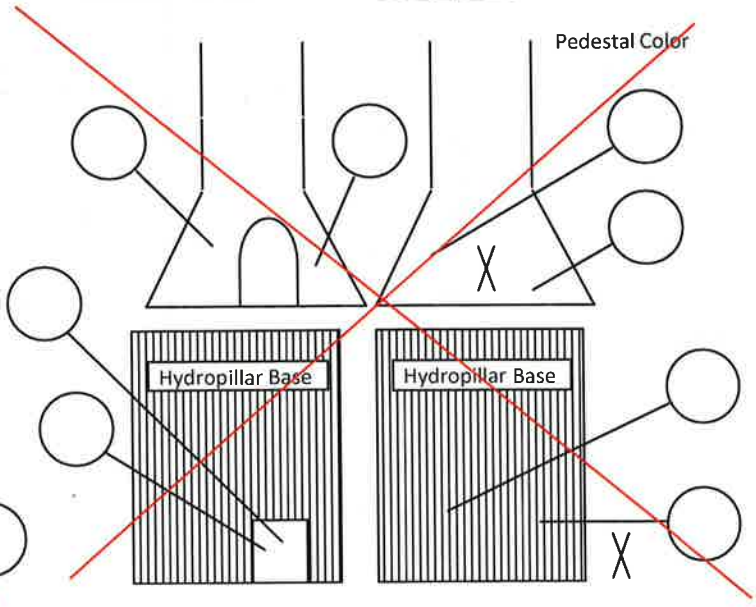



Roof Color BLACK




Bowl Color BLACK

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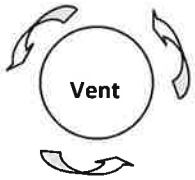
# Steel Potable Water Reservoir Security / Measurement Worksheet

Job Number 52761 Utility Name MISSOULA WATER Tank Name LOWER LINCOLN HILL

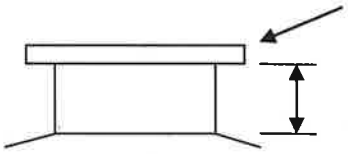
## Security

| | |
|---|---|
| Is the area surrounding the tank well lit? | Yes |
| Is the tank surrounded by a Security Fence? | Yes |
| Are the access gates locked? | Yes |
| Is the tank equipped with a Vandal Guard on the primary access ladder? | N/A |
| If so, is the Vandal Guard locked? | N/A |
| Are the vents equipped with security vent shrouds? | No |
| Are all of the hatches equipped with electronic monitoring devices? | Yes |
| Are the external plumbing components housed in a secure vault or out-building? | Yes |
| Does the surrounding geography of the tank obscure it from public view? | Yes |
| Does the exterior of the tank show signs of trespass? | No |

## Measurements

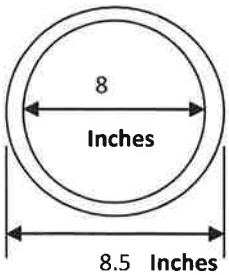



**Outside Circumference**
34.5 **Inches**



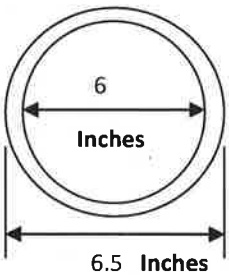

| | | |
|---|---|---|
| **Flange Metal Thickness** | N/A | **Inches** |
| **Roof to Screen or Flange** | 13 | **Inches** |
| **Flange** | ---- | |
| **Number of Bolt Holes** | N/A | **Inches** |
| **Size of Bolts** | N/A | **Inches** |

**Inlet**



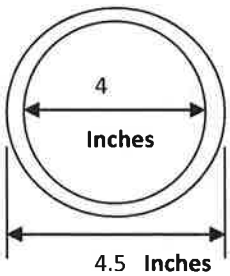

8.5 **Inches**

**Outlet**



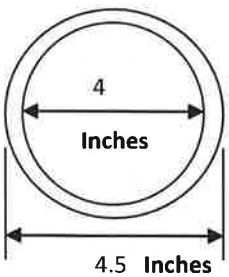

6.5 **Inches**

**Drain**



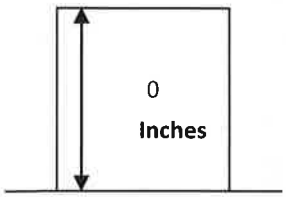

4.5 **Inches**

**Overflow**



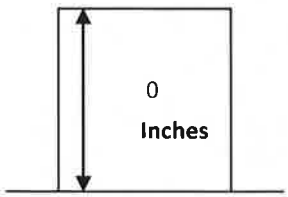

4.5 **Inches**

**Inlet Riser**




**Floor**

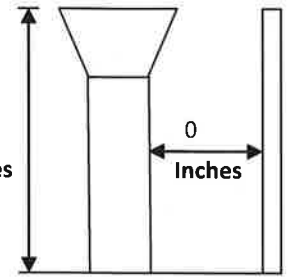
**Outlet Riser**




**Floor**

**Overflow** **Wall**

10'
**Feet/Inches**




**Floor**

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# Steel Potable Water Reservoir Immediate Needs Assessment

Job Number: 52761 | Utility: MISSOULA WATER | Tank: LOWER LINCOLN HILL

Inspector: A. JAMES | Dive Controller: S. SANCHEZ | Date: 10/21/2018

**1. Health and Safety Items**

- ☐ Safety Climb System Installation: NOT RECOMMENDED
- ☐ Vent Screen Repairs: NOT RECOMMENDED

**2. Testing Items**

- ☐ Dye Testing for Leak Evaluation: NOT RECOMMENDED
- ☐ Presence of Lead Test (Interior/Exterior): NOT RECOMMENDED

**3. Destructive Testing Items**

- ☐ % of Lead Test (Interior/Exterior) *(Coating samples are removed for laboratory analysis)* NOT RECOMMENDED
- ☐ Coating Adhesion Test (Interior/Exterior): NOT RECOMMENDED

*Specific written authorization required to perform destructive testing. Destructive tests include touch-up of coating system.*

**4. Repair Items**

- ☐ Epoxy Coating Repairs: NOT RECOMMENDED
- ☐ Temporary Leak Repairs: NOT RECOMMENDED
- ☐ Float Operated Level Indicator Repairs / Maintenance: NOT RECOMMENDED
- ☐ Hypalon Repairs: NOT RECOMMENDED

**5. Security Related Items** *(Critical security upgrade information is immediately available)*

- ☐ Tank vents are not equipped with a security vent shroud:
- ☐ Tank hatches are not equipped with a security hatch locking device:
- ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

## Reservoir Inspection Condition Supplemental

A. JAMES ( LOWER LINCOLN HILL) -UPON ENTERING THE RESERVOIR THE DIVER FOUND A LIGHT SKIFF OF SAND SEDIMENT IN THE FRONT AND A LITTLE IN THE BACK OF THE TANK. THE HATCH IS IN GOOD CONDITION WITH ON STAINING. THE UPPER, MID AND LOWER WALL HAS LIGHT STAINING IN ALL FOUR QUADRANTS. FLOOR HAS SOME LIGHT CONCENTRATION CELL CORROSION IN THE FRIST QUADRANT BUT NOTHING IN OTHER QUADRANTS. INLET AND OUTLET ARE IN GOOD CONDITION WITH LIGHT STAINING ON THEM. THIS RESERVOIR OVER ALL IS IN GOOD CONDITION.

As per AWWA M42, Liquid Engineering recommends a clean and inspect every 3 years.

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# Steel Potable Water Reservoir Inspection Report

Job Number: 52761 | Utility: MISSOULA WATER | Tank: UPPER FARVIEWS

Inspector: A. LEON | Dive Controller: S. SANCHEZ | Date: 10/20/2018

**AMERICAN WATER WORKS ASSOCIATION**
**ANSI/AWWA M42 / D101-53**

### SSPC Legend

| Grade | Description |
|---|---|
| 10 | No Rusting, or <0.01% of surface is rusted |
| 9 | Minor rusting, or <0.03% of surface is rusted |
| 8 | Isolated rust, <.01% of surface is rusted |
| 7 | Isolated rust, <.03% of surface is rusted |
| 6 | Extensive rusting, <1% of surface is rusted |
| 5 | Approximately 3% of the surface is rusted |
| 4 | Approximately 10% of the surface is rusted |
| 3 | Approximately 17% of the surface is rusted |
| 2 | Approximately 33% of the surface is rusted |
| 1 | Approximately 50% of the surface is rusted |
| 0 | Approximately 100% of the surface is rusted |

### NACE Legend

| Grade | Description |
|---|---|
| A | None |
| B | Uniform Surface Corrosion |
| C | Pitting |
| D | Concentration Cell Corrosion |
| E | Galvanic Corrosion |
| F | Stress Corrosion Cracking |
| G | Erosion Corrosion |
| H | Intergranular Corrosion |
| I | Dealloying |

### AWS Legend

| Grade | Description |
|---|---|
| L | Satisfactory |
| M | Spatter |
| N | Porosity |
| O | Convexity / Concavity |
| P | Cracks |
| Q | Inclusions |
| R | Incomplete Fusion |
| S | Incomplete Penetration |
| T | Undercut |
| U | Underfill |
| V | Overlap |
| W | Unable to evaluate |

## INTERIOR RESERVOIR ROOF

| | QUADRANT 1 | | | QUADRANT 2 | | | QUADRANT 3 | | | QUADRANT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
| Vents | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Roof Panels | 9 | B | N/A | 9 | B | N/A | 9 | B | N/A | 9 | B | N/A |
| Roof Support | 9 | B | N/A | 9 | B | N/A | 9 | B | N/A | 9 | B | N/A |
| ~~Roof Gussets~~ | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| ~~Painting Ring~~ | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Overall Coating Rating Good | Average Blister Diameter | Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☐

## INTERIOR RESERVOIR WALLS

| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ~~Wall to Roof weld~~ | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Lower Ring Panels | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A |
| Middle Ring Panels | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A |
| Upper Ring Panels | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A |
| Interior Ladder | 9 | B | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Overall Coating Rating Good | Average Blister Diameter | Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☐

## INTERIOR RESERVOIR FLOOR

| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ~~Perimeter Weld~~ | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Floor Panels | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A |

Overall Coating Rating Good | Average Blister Diameter | Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☐

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# Steel Potable Water Reservoir Inspection Report

Job Number: 52761 | Utility: MISSOULA WATER | Tank: UPPER FARVIEWS

Inspector: A. LEON | Dive Controller: S. SANCHEZ | Date: 10/20/2018

## INTERIOR RESERVOIR SUPPORT COLUMNS

| | QUADRANT 1 | | | QUADRANT 2 | | | QUADRANT 3 | | | QUADRANT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
| Column Structures | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A |
| Column Bases | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A |
| Column to Roof | 9 | B | N/A | 9 | B | N/A | 9 | B | N/A | 9 | B | N/A |

Overall Coating Rating Good | Average Blister Diameter | Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☐

## INTERIOR RESERVOIR PLUMBING COMPONENTS

| | QUADRANT 1 | | | QUADRANT 2 | | | QUADRANT 3 | | | QUADRANT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
| Inlet Plumbing | 9 | B | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Outlet Plumbing | 9 | B | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Manways | 9 | B | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Floor Drains | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Interior Overflow | 9 | B | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

## EXTERIOR RESERVOIR ROOF

| | QUADRANT 1 | | | QUADRANT 2 | | | QUADRANT 3 | | | QUADRANT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
| Vents | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Roof Panels | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A |
| Access Hatches | 10 | A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Overall Coating Rating Good | Average Blister Diameter | Average Pit Depth

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☑ Sags/Runs ☐

## EXTERIOR RESERVOIR WALLS

| | QUADRANT 1 | | | QUADRANT 2 | | | QUADRANT 3 | | | QUADRANT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS | SSPC | NACE | AWS |
| Wall to Roof Weld | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Lower Ring Panels | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A |
| Mid Ring Panels | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A |
| Upper Ring Panels | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A | 10 | A | N/A |
| Exterior Overflow | 10 | A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Overall Coating Rating Good | Average Blister Diameter N/A | Average Pit Depth N/A

Coating Deficiencies: Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Growth ☐ Pinholes ☐ Staining ☐ Sags/Runs ☐

## FOOTINGS / FOUNDATION

| | | | | |
|---|---|---|---|---|
| Footings / Foundations: | Satisfactory ☑ | Cracking ☐ | Spalling ☐ | Erosion/Exposed Aggregate ☐ |
| ~~Anchor Bolts:~~ | Satisfactory ☐ | Loose ☐ | Rusted Corroded ☐ | (If excessive) Diameter = |

## ~~TOWER SUPPORT STRUCTURES~~

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Tower Legs/Columns: | Satisfactory ☐ | Alignment | ---- | Settling | ---- | Rust /Corrosion | ---- |
| Riser Pipe: | Satisfactory ☐ | Alignment | ---- | Frost Casing | ---- | Rust /Corrosion | ---- |
| Rods & Turnbuckles: | Satisfactory ☐ | Turnbuckle Tension | ---- | Rod Tension | ---- | Cotter Pins/Rod Nuts | ---- |
| Leg shoes/Brackets: | Satisfactory ☐ | Coating | ---- | Rust/Corrosion | ---- | Pitting/Cracking | ---- |

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# Potable Water Reservoir Contamination, Health and Safety Report

Job Number: 52761 | Utility: MISSOULA WATER | Tank: UPPER FARVIEWS

Inspector: A. LEON | Dive Controller: S. SANCHEZ | Date: 10/20/2018

**Complies With: AWWA • OSHA • ANSI • NIOSH • NAVFAC • NFPAC**

## CONTAMINATION & HEALTH

| | | | | | |
|---|---|---|---|---|---|
| **Air Vents** | Type: MUSHROOM | | #: 1 | Screen Condition(s): Good | |
| **Hatches** | Type: Square | | #: 1 | Secured Properly: Yes | Properly Sealed: Yes |
| **Exterior Overflow** | Flapper: No | Screen: Yes | | Gasket: No | Condition: Good |
| ~~**Cathodic Covers**~~ | In- Place: ---- | | #: | Gasket: ---- | Properly Sealed: ---- |
| **Roof to Wall Joint** | Welded: No | Properly Sealed: Yes | | | |
| **Roof Integrity** | Holes: No | Cracking: No | Standing Water: No | | |
| **Wall Integrity** | Holes: No | Cracking: No | | | |
| **Manway Integrity** | Leaks: No | Condition: Good | | | |
| **Water Clarity** | General Appearance: CLEAR | | | Odor: NONE | |
| **Floating Surface Debris** | Type: NONE | | | Source: N/A | |
| ~~**Hypalon Floating Cover**~~ | Condition: ---- | Holes: ---- | Tears: ---- | | |
| **Telemetry Penetrations** | Properly Sealed: Yes | | | | |

## FACILITY SAFETY COMPLIANCE

**Exterior Ladder**

| | | | | | |
|---|---|---|---|---|---|
| **Overall Ladder** | Condition: Good | #: 1 | Offset Landing: No | Height: 16' | |
| **Vandal Guard** | Present: Yes | Vandal Guard Locked: Yes | | | |
| **Ladder Rails & Rungs** | Condition: Good | Missing/Damaged Rungs: No | | | |
| **Rung Spacing & Depth** | Spacing: 12 in. *(max 12")* | Toe Depth: 8.5 in. *(min 7")* | | | |
| **Rail Spacing & Size** | Width: 1.5 in. *(min 2")* | Thickness: 1.5 in. *(min 1/4")* | Rail to Rail: 17 | in.*(min 16")* | |
| **Safety Climb System** | Type: Cage | Condition: Good | | | |
| **Number & Locations** | Wall: 1 | Leg: | Roof: | Riser Pipe: | Other: |
| **Ladder Attachments** | WELD, GOOD CONDITION | | | | |

**Manways**

| | | | | |
|---|---|---|---|---|
| **Type and size** | Type: Round | #: 1 | Size: 33 | inches *(24" – 18'x22" min)* |
| **Support Structure** | Type: Bolted | Condition: Good | | |
| **Number & Locations** | Wall: 1 | Roof: | Riser Pipe: | Other: |

**Hatches**

| | | | | |
|---|---|---|---|---|
| **Hatch Type & Size** | Type: Square | #: 1 | Size: 24X24 | in. *(24" – 24"x15" min)* |
| **Hatch & Lid Lip Height** | Hatch: 4 in. *(min 4")* | Lid: 2 | in. *(min 2")* | |

~~**Balconies & Railing**~~

| | | | | | |
|---|---|---|---|---|---|
| **Deck / Walkways** | Condition: ---- | Width: | | | |
| **Hand Rails** | Condition: ---- | Height: | in. *(min 42")* | No. Rails: | *(min 2)* |
| **Toe Rail** | Condition: ---- | Height: | in. *(min 4")* | | |
| **Welds / Attachments** | Condition: ---- | | | | |

**Roof**

| | | | |
|---|---|---|---|
| **Safety Tie-Off Points** | Condition: Good | #: 5 | |
| **Antennas** | Type: ------- | #: ---- | |

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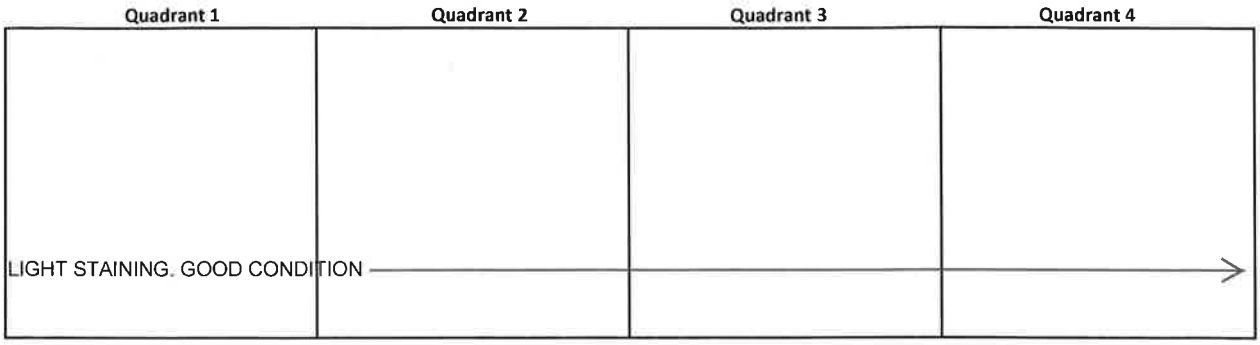
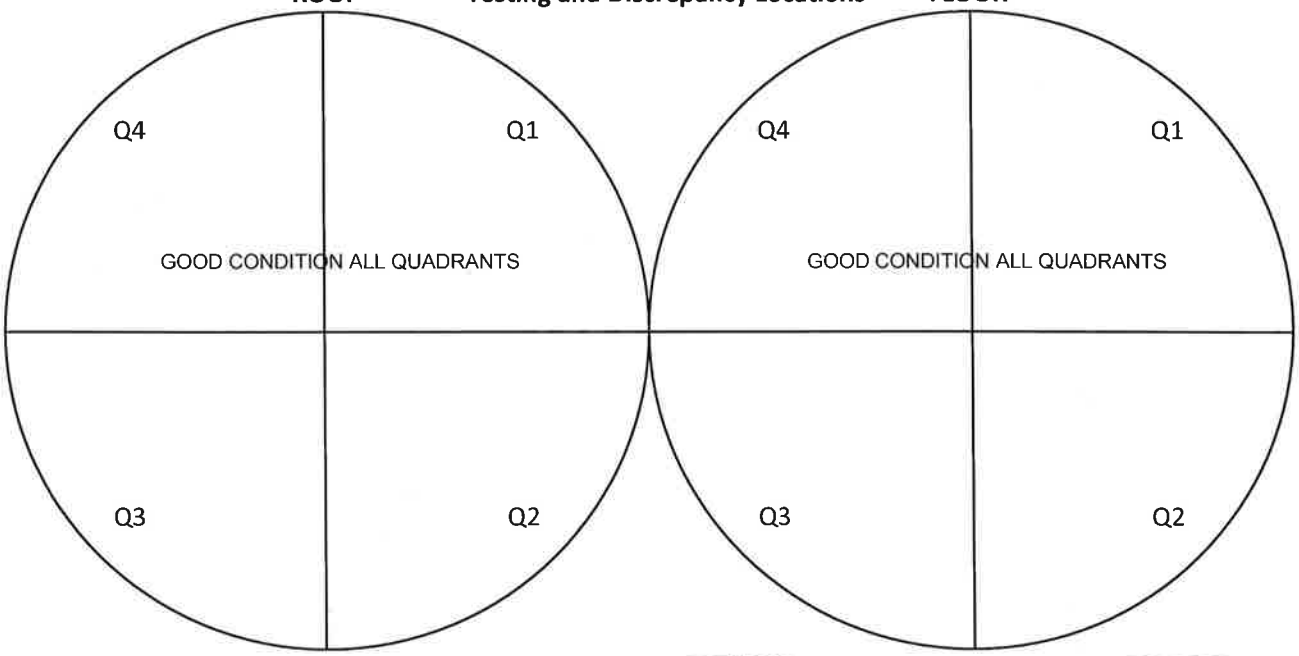
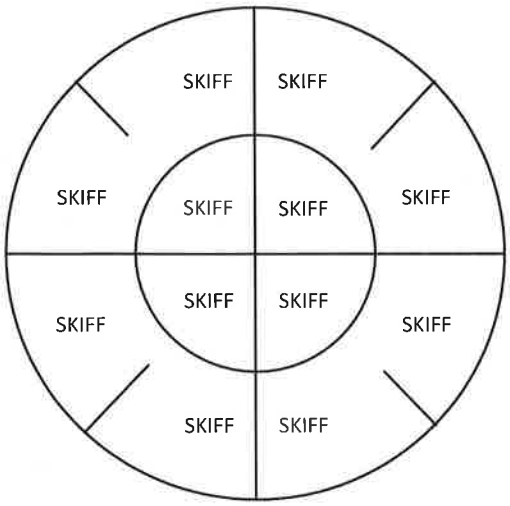
# Circular Tank Diagram / Information Worksheet

Job Number 52761 Utility Name MISSOULA WATER Tank Name UPPER FARVIEWS




**ROOF** **Testing and Discrepancy Locations** **FLOOR**

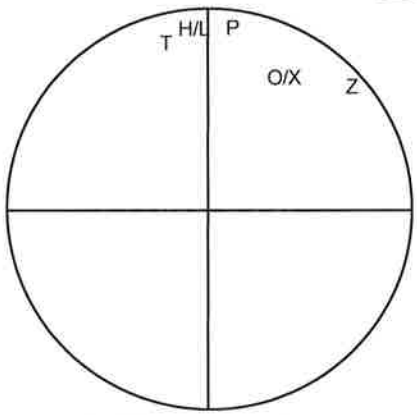



**Sediment Depth Measurements**

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

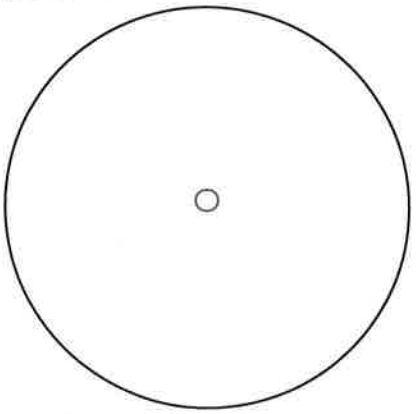
**Avg. Depth** SKIFF **Cubic Yardage** **Sediment Type** IRON




**Plumbing & Structure location**

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry



**Column Placement**

Type of Column

Base Structure

Top Structure

Column Construction Steel

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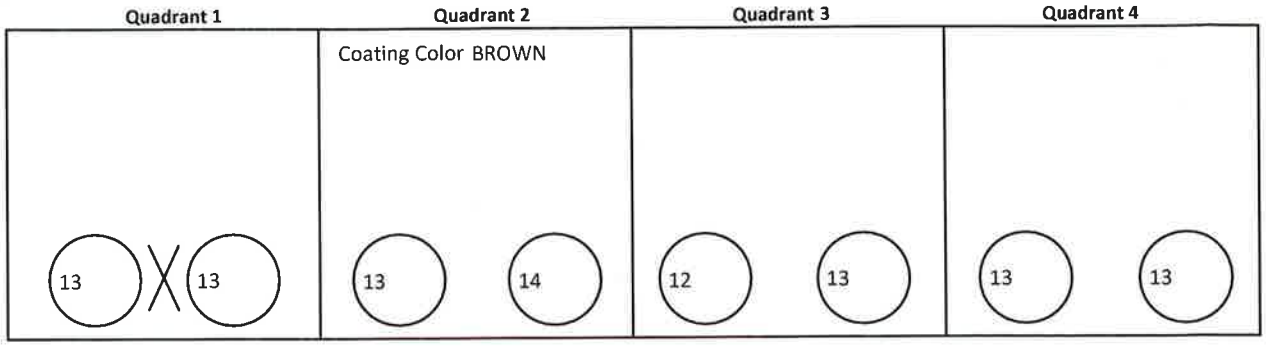
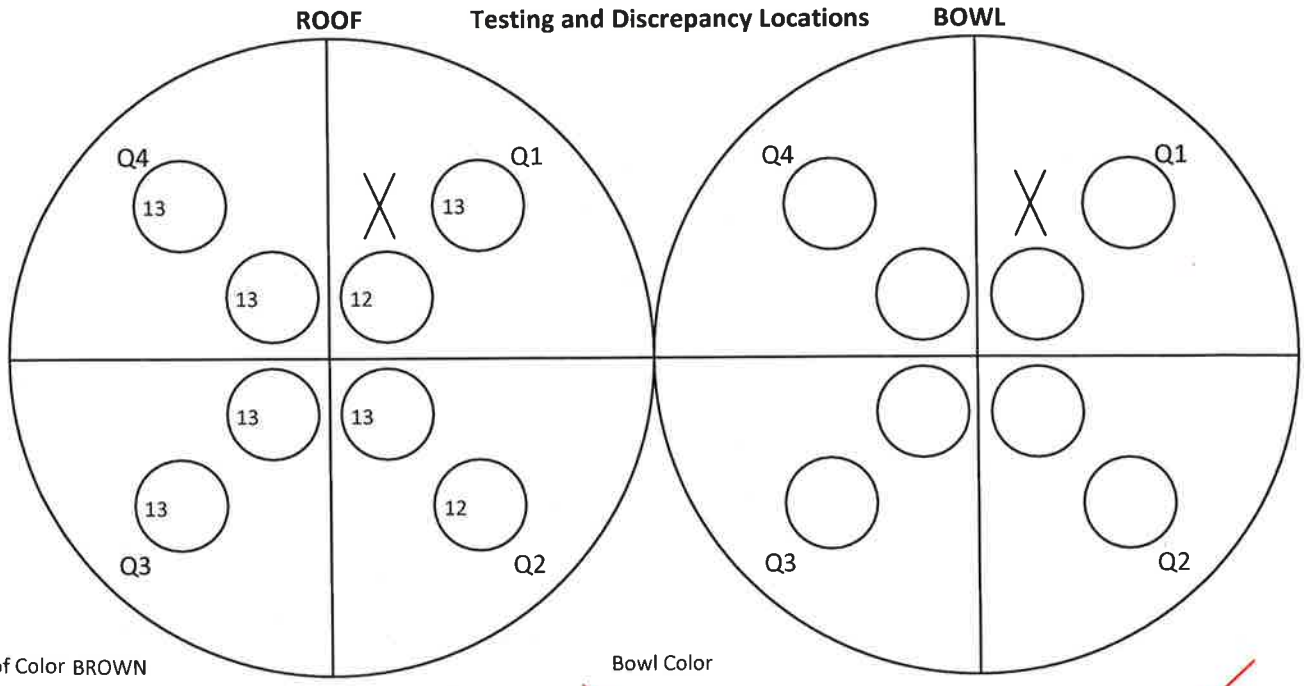
## Circular Tank Diagram / NDT ☐ DFT ☐ Coating Adhesion ☐ Presence of lead ☐

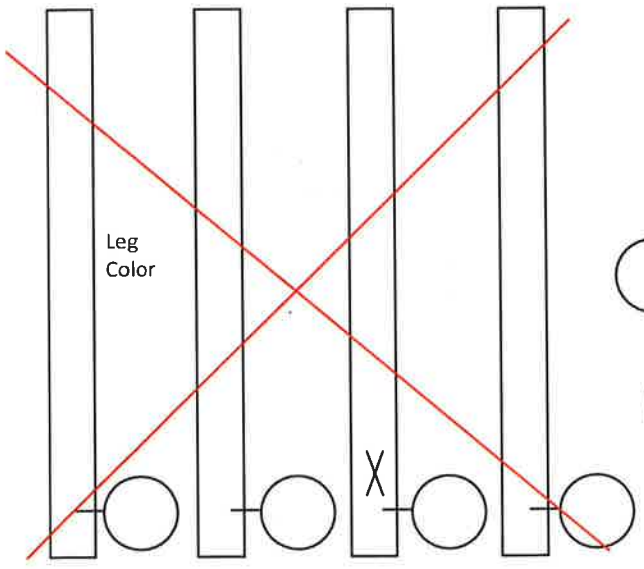
Job Number 52761 Utility Name MISSOULA WATER Tank Name UPPER FARVIEWS

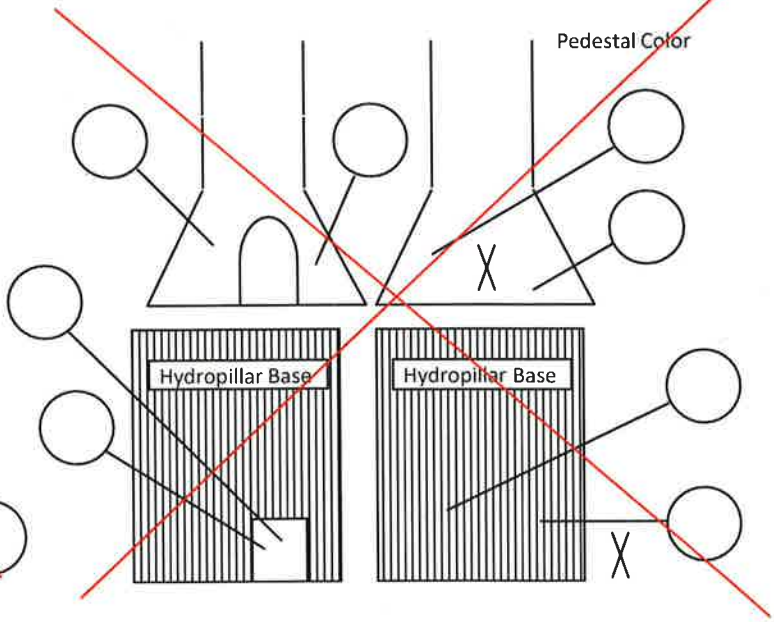



Roof Color BROWN

Bowl Color

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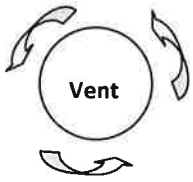
# Steel Potable Water Reservoir Security / Measurement Worksheet

Job Number 52761 Utility Name MISSOULA WATER Tank Name UPPER FARVIEWS

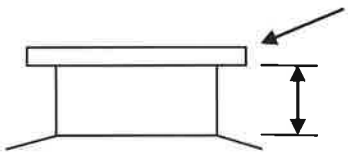
## Security

| | |
|---|---|
| Is the area surrounding the tank well lit? | Yes |
| Is the tank surrounded by a Security Fence? | Yes |
| Are the access gates locked? | Yes |
| Is the tank equipped with a Vandal Guard on the primary access ladder? | Yes |
| If so, is the Vandal Guard locked? | Yes |
| Are the vents equipped with security vent shrouds? | Yes |
| Are all of the hatches equipped with electronic monitoring devices? | Yes |
| Are the external plumbing components housed in a secure vault or out-building? | Yes |
| Does the surrounding geography of the tank obscure it from public view? | No |
| Does the exterior of the tank show signs of trespass? | No |

## Measurements

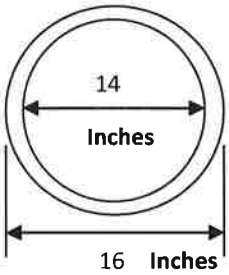



**Outside Circumference**
N/A **Inches**

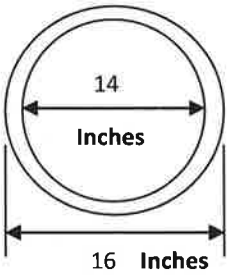



| | | |
|---|---|---|
| **Flange Metal Thickness** | N/A | **Inches** |
| **Roof to Screen or Flange** | N/A | **Inches** |
| **Flange** | ---- | |
| **Number of Bolt Holes** | N/A | **Inches** |
| **Size of Bolts** | N/A | **Inches** |

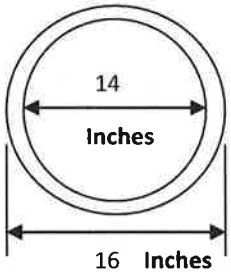
**Inlet**



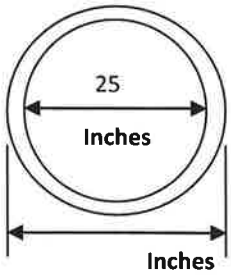

**Outlet**



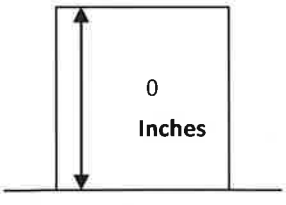

**Drain**



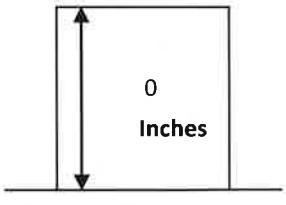

**Overflow**

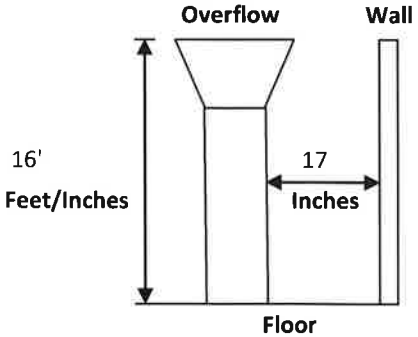



**Inlet Riser**




**Outlet Riser**

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# Steel Potable Water Reservoir Immediate Needs Assessment

Job Number: 52761 | Utility: MISSOULA WATER | Tank: UPPER FARVIEWS

Inspector: A. LEON | Dive Controller: S. SANCHEZ | Date: 10/20/2018

**1. Health and Safety Items**

- ☐ Safety Climb System Installation: NOT RECOMMENDED
- ☐ Vent Screen Repairs: NOT RECOMMENDED

**2. Testing Items**

- ☐ Dye Testing for Leak Evaluation: NOT RECOMMENDED
- ☐ Presence of Lead Test (Interior/Exterior): NOT RECOMMENDED

**3. Destructive Testing Items**

- ☐ % of Lead Test (Interior/Exterior) *(Coating samples are removed for laboratory analysis)* NOT RECOMMENDED
- ☐ Coating Adhesion Test (Interior/Exterior): NOT RECOMMENDED

*Specific written authorization required to perform destructive testing. Destructive tests include touch-up of coating system.*

**4. Repair Items**

- ☐ Epoxy Coating Repairs: NOT RECOMMENDED
- ☐ Temporary Leak Repairs: NOT RECOMMENDED
- ☐ Float Operated Level Indicator Repairs / Maintenance: NOT RECOMMENDED
- ☐ Hypalon Repairs: NOT RECOMMENDED

**5. Security Related Items** *(Critical security upgrade information is immediately available)*

- ☐ Tank vents are not equipped with a security vent shroud:
- ☐ Tank hatches are not equipped with a security hatch locking device:
- ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

## Reservoir Inspection Condition Supplemental

(A. LEON) -
Upon entering the reservoir, the diver found the roof and roof supports to be in good condition with minor uniform surface corrosion. The center column also appeared to be in good condition with no major discrepancies. The diver returned to the ladder and proceeded down to bottom. The ladder appeared to be in good condition with light corrosion. Upon reaching bottom, the diver found a skiff of iron sediment in all four quadrants. The floor beneath the sediment appeared to be in good condition with a light stain. The common inlet/outlet was found to be in the first quadrant at about the 1 o'clock position and appeared to have some light concentration cell corrosion, but was otherwise in good condition. The hardware securing the wall panels and floor panels also appeared to be in good condition. The walls did have a light stain, but no major discrepancies were found. In the center of the reservoir the column base appeared to be in good condition with light staining as well as some light sediment. The diver then returned to the ladder and surface. Once on surface the diver found the overflow structure which appeared to be in good condition with light staining as well as light uniform surface corrosion. Overall, this reservoir appears to be in good condition.

As per AWWA M42, Liquid Engineering recommends a clean and inspect every 3 years.

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# Appendix J

# Replacement Cost New Less Depreciation (RCNLD) Valuation, Appendix G: Inspection of Watermains

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# Appendix G: INSPECTION OF WATERMAINS

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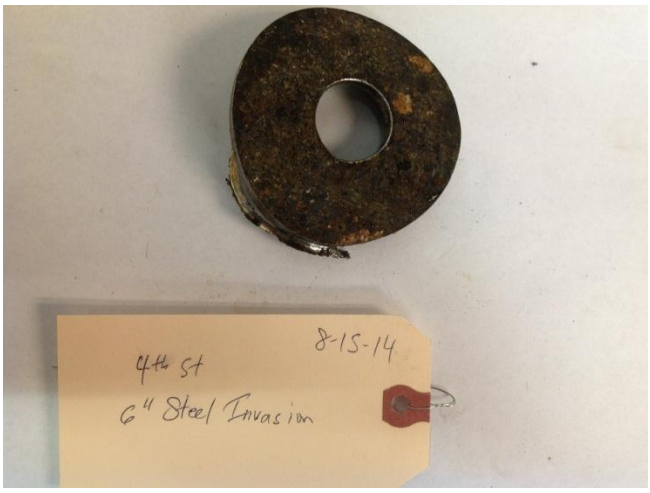
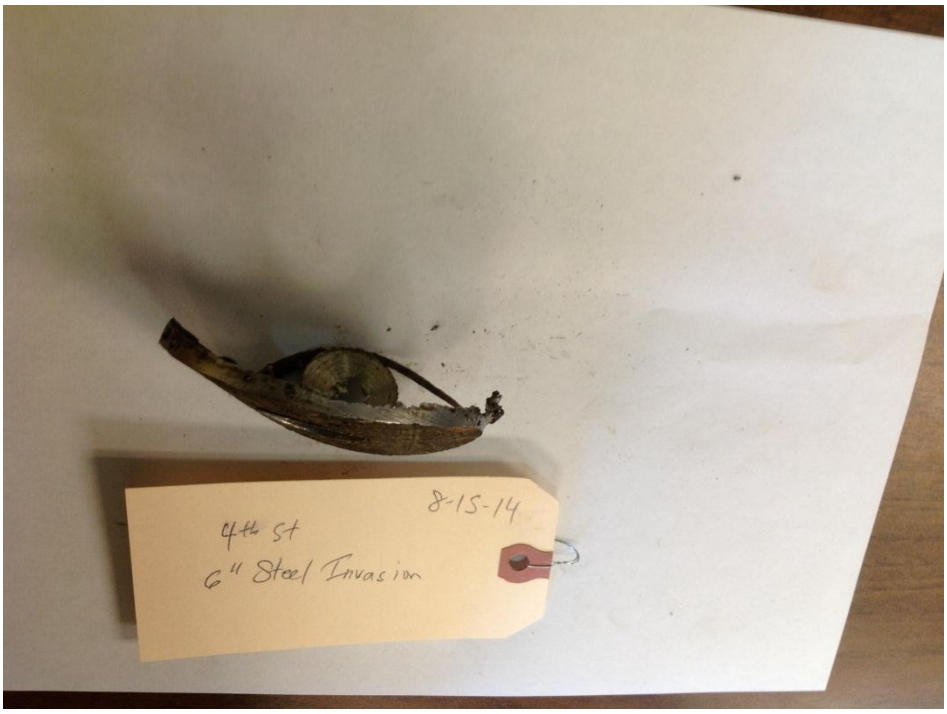



**Pipe ID:** M3886

**Pipe Sample:** 6" Steel Invasion

**Location:** 4th St at Ash

PIPE INSPECTION FORM

Utility - (Operating Unit) Maintain Water

Inspection by: Joseph Mantua Date: 8/15/14

Sample No: 11

1. Location: 4th St. at Ash

2. Type of Inspection (check appropriate data)
   - (X) Exposure, exterior condition
   - ( ) Cut, interior and exterior condition
   - (X) Coupon, interior and exterior condition
   - ( ) Other (describe) _____

3. Nominal Pipe Size: 6 inches _____ Tap Size

4. Depth of Cover: _____

5. Length of Cut: _____

6. Type of Excavation (check appropriate data)

| | | |
|---|---|---|
| ( ) Clay | (X) Loose Rock | ( ) Wet |
| (X) Sand or Gravel | ( ) Solid Rock | ( ) Damp |
| ( ) Shale | ( ) Fill Material | (X) Dry |
| ( ) Other (describe) 2" pavement on 2" 3/4" MINUS | | |

7. Pipe Material (check appropriate data)

| | | |
|---|---|---|
| ( ) Cast Iron | (X) Steel invasion | ( ) Lead |
| ( ) Ductile Iron | ( ) Galvanized Steel | ( ) Alloy |
| ( ) Asbestos-Cement | ( ) Wrought Iron | ( ) Plastic, PVC |
| ( ) Concrete Cylinder | ( ) Copper | ( ) Plastic, Polyethylene |
| ( ) Other (describe) _____ | | |

8. Pipe Coating (check appropriate data)

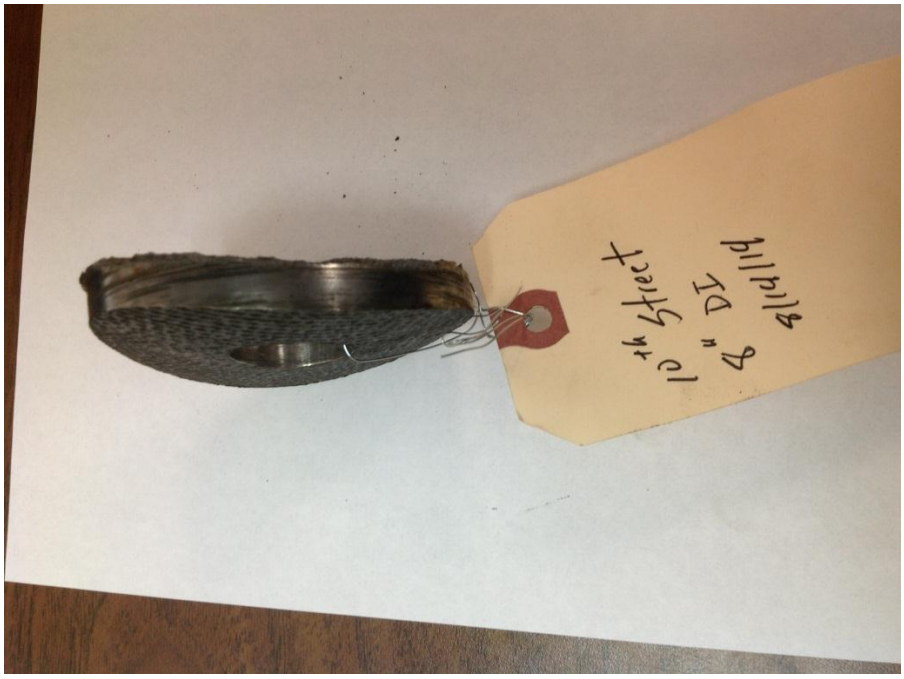
| **Exterior** | **Interior** |
|---|---|
| (X) Bituminous Coated | (X) Bituminous Coated |
| ( ) Not Coated | ( ) Cement Lined, P.S.C. |
| ( ) Poly Wrapped | ( ) Not Coated |
| ( ) Coated and Wrapped | ( ) Coating not Intact |
| ( ) Other (describe) _____ | |

9. Outside Diameter: 6.10 inches (horiz); _____ inches (vert); New _____ inches

10. Inside Diameter: _____inches (horiz); _____inches (vert); New_____inches
11. Wall Thickness: 0.138 inch New_____inch
12. Indicated Pipe Class: _____
13. Pipe Joint, if visible:
    Type: N/A
    Condition: _____
14. Pictures: _____
15. Work Order # _____(if sample was taken in conjuction with a capital project or maintenance activity)

Procedure: To the extent possible, please tag each sample taken and place in a plastic bag (size permitting) with a copy of inspection form. Then keep the samples in a secure location. Also take photos of the excavation of the pipe and the sampling process. Then maintain a file on each sample with the pictures and inspection form included.

pipe in poor conditon
when tapped with hammer pipe began
to spray




**Pipe ID:** M2055

**Pipe Sample:** 8” Ductile Iron

**Location:** 10th St

PIPE INSPECTION FORM

Utility - (Operating Unit) Mountain Water

Inspection by: Mantua Date: 8/14/14

Sample No: 7

1. Location: 10th St.

2. Type of Inspection (check appropriate data)

   [X] Exposure, exterior condition

   ( ) Cut, interior and exterior condition

   [X] Coupon, interior and exterior condition

   ( ) Other (describe) _____

3. Nominal Pipe Size: 8 inches 4" Tap Size

4. Depth of Cover: 80"

5. Length of Cut: N/A

6. Type of Excavation (check appropriate data)

| | | |
|---|---|---|
| ( ) Clay | ( ) Loose Rock | ( ) Wet |
| [X] Sand or Gravel | ( ) Solid Rock | ( ) Damp |
| ( ) Shale | ( ) Fill Material | [X] Dry |

   ( ) Other (describe) 2" pavement on top of 3" of 3/4" Minus

7. Pipe Material (check appropriate data)

| | | |
|---|---|---|
| ( ) Cast Iron | ( ) Steel | ( ) Lead |
| [X] Ductile Iron | ( ) Galvanized Steel | ( ) Alloy |
| ( ) Asbestos-Cement | ( ) Wrought Iron | ( ) Plastic, PVC |
| ( ) Concrete Cylinder | ( ) Copper | ( ) Plastic, Polyethylene |

   ( ) Other (describe) _____

8. Pipe Coating (check appropriate data)

| **Exterior** | **Interior** |
|---|---|
| ( ) Bituminous Coated | ( ) Bituminous Coated |
| ( ) Not Coated | [X] Cement Lined, P.S.C. |
| [X] Poly Wrapped | ( ) Not Coated |
| [X] Coated and Wrapped | ( ) Coating not Intact |

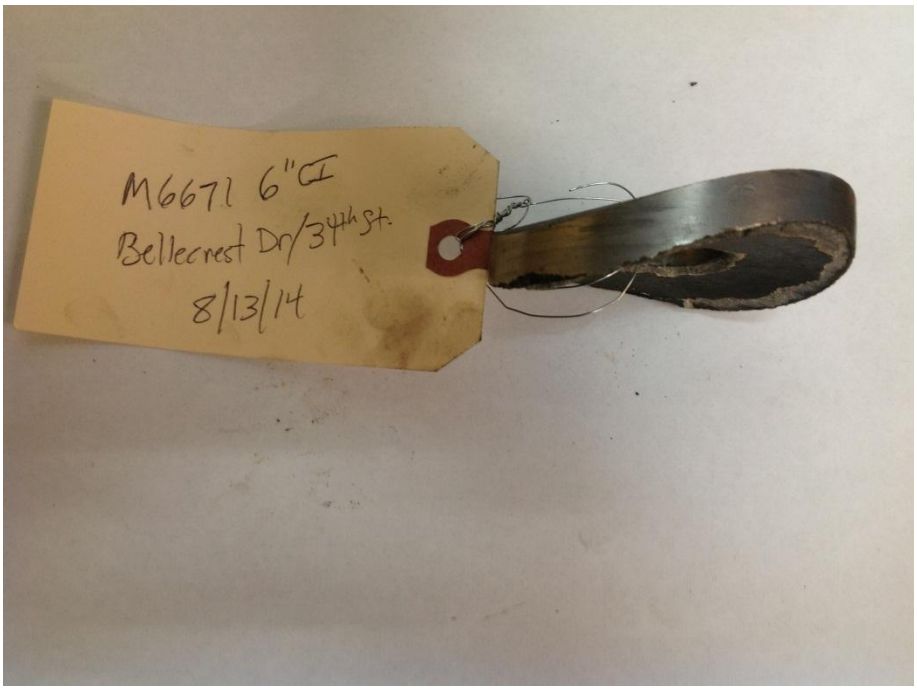
   ( ) Other (describe) _____

9. Outside Diameter: 9.05 inches (horiz); _____ inches (vert); New _____ inches

10. Inside Diameter: _____inches (horiz); _____inches (vert); New_____inches
11. Wall Thickness: 0.433 inch New_____inch
12. Indicated Pipe Class: _____
13. Pipe Joint, if visible:
    Type: N/A
    Condition: _____
14. Pictures: _____
15. Work Order # _____(if sample was taken in conjuction with a capital project or maintenance activity)

Procedure: To the extent possible, please tag each sample taken and place in a plastic bag (size permitting) with a copy of inspection form. Then keep the samples in a secure location. Also take photos of the excavation of the pipe and the sampling process. Then maintain a file on each sample with the pictures and inspection form included.

Pipe in excellent condition




**Pipe ID:** M6671

**Pipe Sample:** 6" Cast Iron

**Location:** Bellecrest Dr at 34th Street

PIPE INSPECTION FORM

Utility - (Operating Unit) Mountain Water

Inspection by: Joseph Mantua Date: 8/13/14

Sample No: 2

1. Location: Bellecrest Dr. @ 34th Street

2. Type of Inspection (check appropriate data)

(X) Exposure, exterior condition

( ) Cut, interior and exterior condition

( ) Coupon, interior and exterior condition

( ) Other (describe) _____

3. Nominal Pipe Size: 6 inches 4" Tap Size

4. Depth of Cover: 78"

5. Length of Cut: N/A

6. Type of Excavation (check appropriate data)

| | | |
|---|---|---|
| ( ) Clay | ( ) Loose Rock | ( ) Wet |
| (X) Sand or Gravel | ( ) Solid Rock | ( ) Damp |
| ( ) Shale | ( ) Fill Material | (X) Dry |

( ) Other (describe) 3" pavement on top of 3/4" minus

7. Pipe Material (check appropriate data)

| | | |
|---|---|---|
| (X) Cast Iron | ( ) Steel | ( ) Lead |
| ( ) Ductile Iron | ( ) Galvanized Steel | ( ) Alloy |
| ( ) Asbestos-Cement | ( ) Wrought Iron | ( ) Plastic, PVC |
| ( ) Concrete Cylinder | ( ) Copper | ( ) Plastic, Polyethylene |

( ) Other (describe) _____

8. Pipe Coating (check appropriate data)

| **Exterior** | **Interior** |
|---|---|
| (X) Bituminous Coated | ( ) Bituminous Coated |
| ( ) Not Coated | (X) Cement Lined, P.S.C. |
| ( ) Poly Wrapped | ( ) Not Coated |
| ( ) Coated and Wrapped | ( ) Coating not Intact |

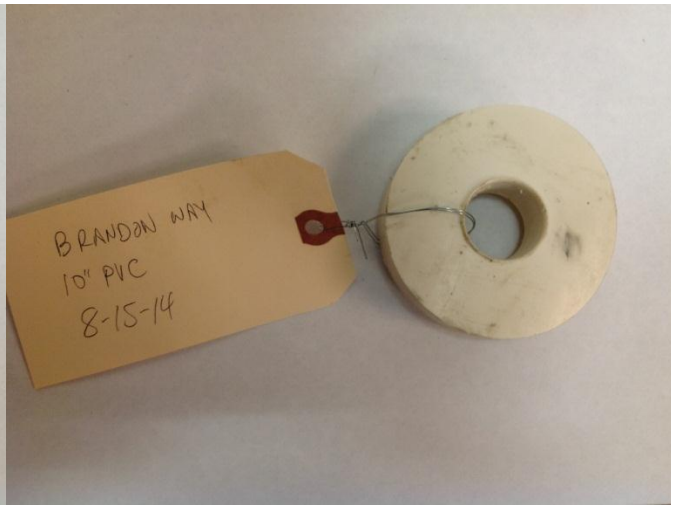
( ) Other (describe) _____

9. Outside Diameter: 6.90 inches (horiz); _____ inches (vert); New _____ inches

10. Inside Diameter: _____inches (horiz); _____inches (vert); New_____inches
11. Wall Thickness: 0.454 inch New_____inch
12. Indicated Pipe Class: _____
13. Pipe Joint, if visible:
    Type: N/A
    Condition: _____
14. Pictures: _____
15. Work Order # _____(if sample was taken in conjuction with a capital project or maintenance activity)

Procedure: To the extent possible, please tag each sample taken and place in a plastic bag (size permitting) with a copy of inspection form. Then keep the samples in a secure location. Also take photos of the excavation of the pipe and the sampling process. Then maintain a file on each sample with the pictures and inspection form included.

pipe in excellent condition



**Pipe ID:** M1127

**Pipe Sample:** 10" PVC

**Location:** Brandon Way at Miller Creek Rd

PIPE INSPECTION FORM

Utility - (Operating Unit) Mountain Water

Inspection by: Joseph Mantua Date: 8/15/14

Sample No: 12

1. Location: Brandon Way

2. Type of Inspection (check appropriate data)

(X) Exposure, exterior condition

( ) Cut, interior and exterior condition

(X) Coupon, interior and exterior condition

( ) Other (describe) _____

3. Nominal Pipe Size: 10" inches 4" Tap Size

4. Depth of Cover: 66"

5. Length of Cut: _____

6. Type of Excavation (check appropriate data)

| | | |
|---|---|---|
| ( ) Clay | ( ) Loose Rock | ( ) Wet |
| (X) Sand or Gravel | ( ) Solid Rock | ( ) Damp |
| ( ) Shale | ( ) Fill Material | (X) Dry |

( ) Other (describe) 2" pavement

7. Pipe Material (check appropriate data)

| | | |
|---|---|---|
| ( ) Cast Iron | ( ) Steel | ( ) Lead |
| ( ) Ductile Iron | ( ) Galvanized Steel | ( ) Alloy |
| ( ) Asbestos-Cement | ( ) Wrought Iron | (X) Plastic, PVC |
| ( ) Concrete Cylinder | ( ) Copper | ( ) Plastic, Polyethylene |

( ) Other (describe) _____

8. Pipe Coating (check appropriate data)

| **Exterior** | **Interior** |
|---|---|
| ( ) Bituminous Coated | ( ) Bituminous Coated |
| (X) Not Coated | ( ) Cement Lined, P.S.C. |
| ( ) Poly Wrapped | (X) Not Coated |
| ( ) Coated and Wrapped | ( ) Coating not Intact |

( ) Other (describe) _____

9. Outside Diameter: 11.15 inches (horiz); _____ inches (vert); New _____ inches

10. Inside Diameter: _____inches (horiz); _____inches (vert); New_____inches
11. Wall Thickness: 0.798 inch New_____inch
12. Indicated Pipe Class: _____
13. Pipe Joint, if visible:
    Type: N/A
    Condition: _____
14. Pictures: _____
15. Work Order # _____(if sample was taken in conjuction with a capital project or maintenance activity)

Procedure: To the extent possible, please tag each sample taken and place in a plastic bag (size permitting) with a copy of inspection form. Then keep the samples in a secure location. Also take photos of the excavation of the pipe and the sampling process. Then maintain a file on each sample with the pictures and inspection form included.

pipe in excellent condition

**Pipe ID:** M6556

**Pipe Sample:** 6” Cast Iron

**Location:** Burlington Ave W of Schilling

PIPE INSPECTION FORM

Utility - (Operating Unit) Mountain Water

Inspection by: Joseph Mantua Date: 8/14/14

Sample No: 8

1. Location: Burlington Ave at Schilling

2. Type of Inspection (check appropriate data)

(X) Exposure, exterior condition

( ) Cut, interior and exterior condition

(X) Coupon, interior and exterior condition

( ) Other (describe) _____

3. Nominal Pipe Size: 6 inches 4" Tap Size

4. Depth of Cover: 78"

5. Length of Cut: N/A

6. Type of Excavation (check appropriate data)

| | | |
|---|---|---|
| ( ) Clay | ( ) Loose Rock | ( ) Wet |
| (X) Sand or Gravel | ( ) Solid Rock | ( ) Damp |
| ( ) Shale | ( ) Fill Material | ( ) Dry |

( ) Other (describe) 2" asphalt pavement on top of 2" 3/4" minus

7. Pipe Material (check appropriate data)

| | | |
|---|---|---|
| (X) Cast Iron | ( ) Steel | ( ) Lead |
| ( ) Ductile Iron | ( ) Galvanized Steel | ( ) Alloy |
| ( ) Asbestos-Cement | ( ) Wrought Iron | ( ) Plastic, PVC |
| ( ) Concrete Cylinder | ( ) Copper | ( ) Plastic, Polyethylene |

( ) Other (describe) _____

8. Pipe Coating (check appropriate data)

| **Exterior** | **Interior** |
|---|---|
| (X) Bituminous Coated | ( ) Bituminous Coated |
| ( ) Not Coated | ( ) Cement Lined, P.S.C. |
| ( ) Poly Wrapped | ( ) Not Coated |
| ( ) Coated and Wrapped | ( ) Coating not Intact |

( ) Other (describe) No lining observed, no tuberculation noted

9. Outside Diameter: 6.95 inches (horiz); _____ inches (vert); New _____ inches

10. Inside Diameter: _____inches (horiz); _____inches (vert); New_____inches
11. Wall Thickness: 0.380 inch New_____inch
12. Indicated Pipe Class: _____
13. Pipe Joint, if visible:
    Type: N/A
    Condition: _____
14. Pictures: _____
15. Work Order # _____(if sample was taken in conjuction with a capital project or maintenance activity)

Procedure: To the extent possible, please tag each sample taken and place in a plastic bag (size permitting) with a copy of inspection form. Then keep the samples in a secure location. Also take photos of the excavation of the pipe and the sampling process. Then maintain a file on each sample with the pictures and inspection form included.

pipe in excellent condition

**Pipe ID:** M6538

**Pipe Sample:** 6” Cast Iron

**Location:** 1805-1816 Ernest Ave

PIPE INSPECTION FORM

Utility - (Operating Unit) Maintain Water

Inspection by: Joseph Mantua Date: 8/13/14

Sample No: 5

1. Location: Ernest Ave.

2. Type of Inspection (check appropriate data)
   - (X) Exposure, exterior condition
   - (X) Cut, interior and exterior condition
   - ( ) Coupon, interior and exterior condition
   - ( ) Other (describe) _____

3. Nominal Pipe Size: 6 inches N/A Tap Size

4. Depth of Cover: 78"

5. Length of Cut: 3'

6. Type of Excavation (check appropriate data)

| | | |
|---|---|---|
| ( ) Clay | (X) Loose Rock | ( ) Wet |
| (X) Sand or Gravel | ( ) Solid Rock | ( ) Damp |
| ( ) Shale | ( ) Fill Material | (X) Dry |
| ( ) Other (describe) 2" pavement | | |

7. Pipe Material (check appropriate data)

| | | |
|---|---|---|
| (X) Cast Iron | ( ) Steel | ( ) Lead |
| ( ) Ductile Iron | ( ) Galvanized Steel | ( ) Alloy |
| ( ) Asbestos-Cement | ( ) Wrought Iron | ( ) Plastic, PVC |
| ( ) Concrete Cylinder | ( ) Copper | ( ) Plastic, Polyethylene |
| ( ) Other (describe) _____ | | |

8. Pipe Coating (check appropriate data)

| **Exterior** | **Interior** |
|---|---|
| (X) Bituminous Coated | ( ) Bituminous Coated |
| ( ) Not Coated | (X) Cement Lined, P.S.C. |
| ( ) Poly Wrapped | ( ) Not Coated |
| ( ) Coated and Wrapped | ( ) Coating not Intact |
| ( ) Other (describe) _____ | |

9. Outside Diameter: 6.90 inches (horiz); _____ inches (vert); New _____ inches

10. Inside Diameter: _____inches (horiz); _____inches (vert); New_____inches
11. Wall Thickness: 0.442 inch New_____inch
12. Indicated Pipe Class: _____
13. Pipe Joint, if visible:
    Type: Mechanical Joint
    Condition: dry, excellent condition
14. Pictures: _____
15. Work Order # _____(if sample was taken in conjuction with a capital project or maintenance activity)

Procedure: To the extent possible, please tag each sample taken and place in a plastic bag (size permitting) with a copy of inspection form. Then keep the samples in a secure location. Also take photos of the excavation of the pipe and the sampling process. Then maintain a file on each sample with the pictures and inspection form included.

pipe in very good condition

**Pipe ID:** M2651

**Pipe Sample:** 6" Ductile Iron

**Location:** Joseph Court

PIPE INSPECTION FORM

Utility - (Operating Unit) Mountain Water

Inspection by: Joseph Mantua Date: 8/13/14

Sample No: 1

1. Location: Joseph Ct.

2. Type of Inspection (check appropriate data)
   - [X] Exposure, exterior condition
   - ( ) Cut, interior and exterior condition
   - [X] Coupon, interior and exterior condition
   - ( ) Other (describe) _____
3. Nominal Pipe Size: 6 inches 4" Tap Size
4. Depth of Cover: 76"
5. Length of Cut: N/A
6. Type of Excavation (check appropriate data)

| | | |
|---|---|---|
| ( ) Clay | ( ) Loose Rock | ( ) Wet |
| [X] Sand or Gravel | ( ) Solid Rock | ( ) Damp |
| ( ) Shale | ( ) Fill Material | [X] Dry |

   ( ) Other (describe) 2" pavement on top of 3/4" minus
7. Pipe Material (check appropriate data)

| | | |
|---|---|---|
| ( ) Cast Iron | ( ) Steel | ( ) Lead |
| [X] Ductile Iron | ( ) Galvanized Steel | ( ) Alloy |
| ( ) Asbestos-Cement | ( ) Wrought Iron | ( ) Plastic, PVC |
| ( ) Concrete Cylinder | ( ) Copper | ( ) Plastic, Polyethylene |

   ( ) Other (describe) _____
8. Pipe Coating (check appropriate data)

| **Exterior** | **Interior** |
|---|---|
| [X] Bituminous Coated | ( ) Bituminous Coated |
| ( ) Not Coated | [X] Cement Lined, P.S.C. |
| ( ) Poly Wrapped | ( ) Not Coated |
| ( ) Coated and Wrapped | ( ) Coating not Intact |

   ( ) Other (describe) _____
9. Outside Diameter: 6.90 inches (horiz); _____ inches (vert); New _____ inches

10. Inside Diameter: _____inches (horiz); _____inches (vert); New_____inches
11. Wall Thickness: 0.335 inch New_____inch
12. Indicated Pipe Class: _____
13. Pipe Joint, if visible:
    Type: Bell and Spigot
    Condition: Very good
14. Pictures: _____
15. Work Order # _____(if sample was taken in conjuction with a capital project or maintenance activity)

Procedure: To the extent possible, please tag each sample taken and place in a plastic bag (size permitting) with a copy of inspection form. Then keep the samples in a secure location. Also take photos of the excavation of the pipe and the sampling process. Then maintain a file on each sample with the pictures and inspection form included.

pipe in excellent condition

**Pipe ID:** M6411

**Pipe Sample:** 6” Steel

**Location:** Palmer St W of Dickens

PIPE INSPECTION FORM

Utility - (Operating Unit) Mountain Water

Inspection by: Joseph Mantua Date: 8/13/14

Sample No: 6

1. Location: Palmer St. at Dickens

2. Type of Inspection (check appropriate data)
   - [X] Exposure, exterior condition
   - [X] Cut, interior and exterior condition
   - ( ) Coupon, interior and exterior condition
   - ( ) Other (describe) _____

3. Nominal Pipe Size: 6 inches N/A Tap Size

4. Depth of Cover: 78"

5. Length of Cut: 16.5"

6. Type of Excavation (check appropriate data)

| | | |
|---|---|---|
| ( ) Clay | [X] Loose Rock | ( ) Wet |
| [X] Sand or Gravel | ( ) Solid Rock | ( ) Damp |
| ( ) Shale | ( ) Fill Material | [X] Dry |
| ( ) Other (describe) 2" pavement | | |

7. Pipe Material (check appropriate data)

| | | |
|---|---|---|
| ( ) Cast Iron | [X] Steel | ( ) Lead |
| ( ) Ductile Iron | ( ) Galvanized Steel | ( ) Alloy |
| ( ) Asbestos-Cement | ( ) Wrought Iron | ( ) Plastic, PVC |
| ( ) Concrete Cylinder | ( ) Copper | ( ) Plastic, Polyethylene |
| ( ) Other (describe) _____ | | |

8. Pipe Coating (check appropriate data)

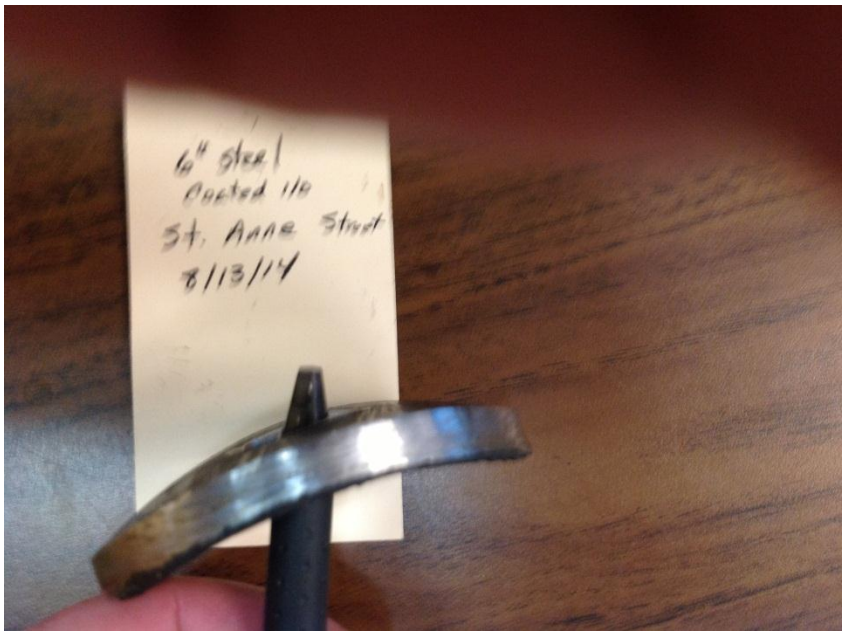
| **Exterior** | **Interior** |
|---|---|
| ( ) Bituminous Coated | [X] Bituminous Coated |
| ( ) Not Coated | ( ) Cement Lined, P.S.C. |
| ( ) Poly Wrapped | ( ) Not Coated |
| [X] Coated and Wrapped | ( ) Coating not Intact |
| ( ) Other (describe) _____ | |

9. Outside Diameter: 6.65 inches (horiz); _____ inches (vert); New _____ inches

10. Inside Diameter: ✓ inches (horiz); _____ inches (vert); New_____ inches
11. Wall Thickness: 0.479 inch New_____ inch
12. Indicated Pipe Class: _____
13. Pipe Joint, if visible:
    Type: N/A
    Condition: _____
14. Pictures: _____
15. Work Order # _____ (if sample was taken in conjuction with a capital project or maintenance activity)

Procedure: To the extent possible, please tag each sample taken and place in a plastic bag (size permitting) with a copy of inspection form. Then keep the samples in a secure location. Also take photos of the excavation of the pipe and the sampling process. Then maintain a file on each sample with the pictures and inspection form included.

pipe in very good condition




**Pipe ID:** M2418

**Pipe Sample:** 6" Steel Coated

**Location:** Stanley Ave at St. Anne

PIPE INSPECTION FORM

Utility - (Operating Unit) Mountain Water

Inspection by: Joseph Mantua Date: 8/13/14

Sample No: 3

1. Location: Stanley Ave. @ St. Anne

2. Type of Inspection (check appropriate data)
   - [X] Exposure, exterior condition
   - ( ) Cut, interior and exterior condition
   - [X] Coupon, interior and exterior condition
   - ( ) Other (describe) _____

3. Nominal Pipe Size: 6 inches 4" Tap Size

4. Depth of Cover: 65"

5. Length of Cut: N/A

6. Type of Excavation (check appropriate data)

| | | |
|---|---|---|
| ( ) Clay | ( ) Loose Rock | ( ) Wet |
| [X] Sand or Gravel | ( ) Solid Rock | ( ) Damp |
| ( ) Shale | ( ) Fill Material | [X] Dry |
| ( ) Other (describe) Baffalo grass | | |

7. Pipe Material (check appropriate data)

| | | |
|---|---|---|
| ( ) Cast Iron | [X] Steel | ( ) Lead |
| ( ) Ductile Iron | ( ) Galvanized Steel | ( ) Alloy |
| ( ) Asbestos-Cement | ( ) Wrought Iron | ( ) Plastic, PVC |
| ( ) Concrete Cylinder | ( ) Copper | ( ) Plastic, Polyethylene |
| ( ) Other (describe) | | |

8. Pipe Coating (check appropriate data)

| **Exterior** | **Interior** |
|---|---|
| ( ) Bituminous Coated | ( ) Bituminous Coated |
| ( ) Not Coated | ( ) Cement Lined, P.S.C. |
| ( ) Poly Wrapped | ( ) Not Coated |
| [X] Coated and Wrapped | ( ) Coating not Intact |
| ( ) Other (describe) asphaltic | |

9. Outside Diameter: 6.62 inches (horiz); _____ inches (vert); New _____ inches

10. Inside Diameter: ✓ inches (horiz); _____ inches (vert); New_____ inches
11. Wall Thickness: 0.329 inch New_____ inch
12. Indicated Pipe Class: _____
13. Pipe Joint, if visible:
    Type: N/A
    Condition: _____
14. Pictures: _____
15. Work Order # _____(if sample was taken in conjuction with a capital project or maintenance activity)

Procedure: To the extent possible, please tag each sample taken and place in a plastic bag (size permitting) with a copy of inspection form. Then keep the samples in a secure location. Also take photos of the excavation of the pipe and the sampling process. Then maintain a file on each sample with the pictures and inspection form included.

pipe in excellent condition

**Pipe ID:** M4625

**Pipe Sample:** 6” Cast Iron

**Location:** Strand Ave at Schilling

PIPE INSPECTION FORM

Utility - (Operating Unit) Mountain Water

Inspection by: Joseph Mantua Date: 8/14/14

Sample No: 10

1. Location: Strand Ave at Schilling

2. Type of Inspection (check appropriate data)
   - (X) Exposure, exterior condition
   - ( ) Cut, interior and exterior condition
   - (X) Coupon, interior and exterior condition
   - ( ) Other (describe) _____

3. Nominal Pipe Size: 6 inches 4" Tap Size

4. Depth of Cover: 80"

5. Length of Cut: N/A

6. Type of Excavation (check appropriate data)

| | | |
|---|---|---|
| ( ) Clay | (X) Loose Rock | ( ) Wet |
| (X) Sand or Gravel | ( ) Solid Rock | (X) Damp |
| ( ) Shale | ( ) Fill Material | ( ) Dry |

   ( ) Other (describe) 2" pavement on 2" 3/4" mixes

7. Pipe Material (check appropriate data)

| | | |
|---|---|---|
| (X) Cast Iron | ( ) Steel | ( ) Lead |
| ( ) Ductile Iron | ( ) Galvanized Steel | ( ) Alloy |
| ( ) Asbestos-Cement | ( ) Wrought Iron | ( ) Plastic, PVC |
| ( ) Concrete Cylinder | ( ) Copper | ( ) Plastic, Polyethylene |

   ( ) Other (describe) _____

8. Pipe Coating (check appropriate data)

| **Exterior** | **Interior** |
|---|---|
| (X) Bituminous Coated | ( ) Bituminous Coated |
| ( ) Not Coated | ( ) Cement Lined, P.S.C. |
| ( ) Poly Wrapped | (X) Not Coated |
| ( ) Coated and Wrapped | ( ) Coating not Intact |

   ( ) Other (describe) no presence of tuberculation noted

9. Outside Diameter: 6.89 inches (horiz); _____ inches (vert); New _____ inches

10. Inside Diameter: _____inches (horiz); _____inches (vert); New_____inches

11. Wall Thickness: 0.395 inch New_____inch

12. Indicated Pipe Class: _____

13. Pipe Joint, if visible:

    Type: Mechanical Joint

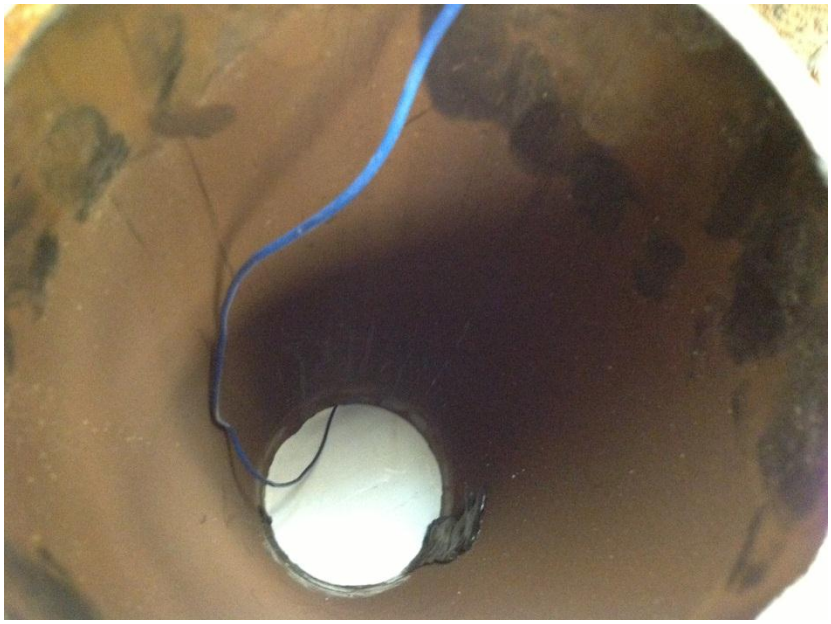
    Condition: Dry, very good condition

14. Pictures: _____

15. Work Order # _____(if sample was taken in conjuction with a capital project or maintenance activity)

Procedure: To the extent possible, please tag each sample taken and place in a plastic bag (size permitting) with a copy of inspection form. Then keep the samples in a secure location. Also take photos of the excavation of the pipe and the sampling process. Then maintain a file on each sample with the pictures and inspection form included.

pipe in excellent condition



**Pipe ID:** M1042

**Pipe Sample:** 6” Steel

**Location:** Vista Rd W of 23rd

PIPE INSPECTION FORM

Utility - (Operating Unit) Mountain Water

Inspection by: Joseph Mantua Date: 8/14/14

Sample No: 9

1. Location: Vista Rd at 23rd

2. Type of Inspection (check appropriate data)
   - (X) Exposure, exterior condition
   - (X) Cut, interior and exterior condition
   - (X) Coupon, interior and exterior condition
   - ( ) Other (describe) _____

3. Nominal Pipe Size: 6 inches 4" Tap Size

4. Depth of Cover: 74"

5. Length of Cut: 21"

6. Type of Excavation (check appropriate data)

| | | |
|---|---|---|
| ( ) Clay | (X) Loose Rock | ( ) Wet |
| (X) Sand or Gravel | ( ) Solid Rock | ( ) Damp |
| ( ) Shale | ( ) Fill Material | (X) Dry |

( ) Other (describe) _____

7. Pipe Material (check appropriate data)

| | | |
|---|---|---|
| ( ) Cast Iron | (X) Steel | ( ) Lead |
| ( ) Ductile Iron | ( ) Galvanized Steel | ( ) Alloy |
| ( ) Asbestos-Cement | ( ) Wrought Iron | ( ) Plastic, PVC |
| ( ) Concrete Cylinder | ( ) Copper | ( ) Plastic, Polyethylene |

( ) Other (describe) _____

8. Pipe Coating (check appropriate data)

| **Exterior** | **Interior** |
|---|---|
| ( ) Bituminous Coated | (X) Bituminous Coated |
| ( ) Not Coated | ( ) Cement Lined, P.S.C. |
| ( ) Poly Wrapped | ( ) Not Coated |
| (X) Coated and Wrapped | ( ) Coating not Intact |

( ) Other (describe) _____

9. Outside Diameter: 6.05 inches (horiz); _____ inches (vert); New _____ inches

10. Inside Diameter: _____inches (horiz); _____inches (vert); New_____inches
11. Wall Thickness: 0.345 inch New_____inch
12. Indicated Pipe Class: _____
13. Pipe Joint, if visible:
    Type: N/A
    Condition: _____
14. Pictures: _____
15. Work Order # _____(if sample was taken in conjuction with a capital project or maintenance activity)

Procedure: To the extent possible, please tag each sample taken and place in a plastic bag (size permitting) with a copy of inspection form. Then keep the samples in a secure location. Also take photos of the excavation of the pipe and the sampling process. Then maintain a file on each sample with the pictures and inspection form included.

pipe in very good condition

**Pipe ID:** M2274

**Pipe Sample:** 6” Asbestos Cement

**Location:** Highland Park

PIPE INSPECTION FORM

Utility - (Operating Unit) Mountain Water

Inspection by: Doseph Mantua Date: 8/13/14

Sample No: 4

1. Location: Highland Park @ Ben Hogan

2. Type of Inspection (check appropriate data)
   - [X] Exposure, exterior condition
   - [X] Cut, interior and exterior condition
   - ( ) Coupon, interior and exterior condition
   - ( ) Other (describe) _____
3. Nominal Pipe Size: 6 inches N/A Tap Size
4. Depth of Cover: 72"
5. Length of Cut: 2'
6. Type of Excavation (check appropriate data)

| | | |
|---|---|---|
| ( ) Clay | ( ) Loose Rock | ( ) Wet |
| (X) Sand or Gravel | ( ) Solid Rock | (X) Damp |
| ( ) Shale | ( ) Fill Material | ( ) Dry |

   ( ) Other (describe) 4" pavement
7. Pipe Material (check appropriate data)

| | | |
|---|---|---|
| ( ) Cast Iron | ( ) Steel | ( ) Lead |
| ( ) Ductile Iron | ( ) Galvanized Steel | ( ) Alloy |
| [X] Asbestos-Cement | ( ) Wrought Iron | ( ) Plastic, PVC |
| ( ) Concrete Cylinder | ( ) Copper | ( ) Plastic, Polyethylene |

   ( ) Other (describe) _____
8. Pipe Coating (check appropriate data)

| **Exterior** | **Interior** |
|---|---|
| ( ) Bituminous Coated | ( ) Bituminous Coated |
| [X] Not Coated | ( ) Cement Lined, P.S.C. |
| ( ) Poly Wrapped | (X) Not Coated |
| ( ) Coated and Wrapped | ( ) Coating not Intact |

   ( ) Other (describe) _____
9. Outside Diameter: 7.27 inches (horiz); _____inches (vert); New_____inches

10. Inside Diameter: _____inches (horiz); _____inches (vert); New_____inches
11. Wall Thickness: 0.69 inch New_____inch
12. Indicated Pipe Class: _____
13. Pipe Joint, if visible:
    Type: Coupling - tight, dry, appears in good condition
    Condition: _____
14. Pictures: _____
15. Work Order # _____(if sample was taken in conjuction with a capital project or maintenance activity)

Procedure: To the extent possible, please tag each sample taken and place in a plastic bag (size permitting) with a copy of inspection form. Then keep the samples in a secure location. Also take photos of the excavation of the pipe and the sampling process. Then maintain a file on each sample with the pictures and inspection form included.

pipe in good condition

# Appendix K

# Replacement Cost New Less Depreciation (RCNLD) Valuation, Appendix H: Soil Testing

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# Appendix H: SOIL TESTING

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TETRA TECH

2525 Palmer St, Ste 2
Missoula, MT 59808

PH: (406) 543.3045
Fax: (406) 543.3088

# TECHNICAL REPORT

**REPORT TO:** Mr. Joseph Conner
Baker, Donelson, Bearman, Caldwell & Berkowitz, P.C.
1800 Republic Grove Center
653 Chestnut Street
Chattanooga, TN 37450-1800

**DATE:** October 6, 2014
**JOB NO.:** 114-570827
**PAGE:** 1 **OF** 4

**PROJECT:** Re: Laboratory Test Results
Missoula, Montana

Tetra Tech Inc. (Tetra Tech) has completed the following laboratory analysis of the submitted samples. On August 12, 13, 14, and 15 of 2014, samples of soil and rock were obtained by Mountain Water Company (Mountain Water) and submitted through chain of custody to Tetra Tech's Missoula laboratory. The samples were retrieved by Tetra Tech at "on-site" locations. Individual samples were assigned "Laboratory ID Numbers" by Tetra Tech and these numbers are referenced as "Lab ID" numbers in tables 1 and 2 of this report. A listing of sample numbers and corresponding sample locations, dates, and sample times appears below.

| Laboratory ID Number | Location of Sampling | Depth of Sampling | Date of Sampling | Time of Sampling |
|---|---|---|---|---|
| 820-1 | 908 Palmer Street | At pipe depth | 8-13-14 | 1600 |
| 820-2 | 1816 Earnest Avenue | At pipe depth | 8-13-14 | 1530 |
| 820-3 | Gharrett Street | At pipe depth | 8-15-14 | 1045 |
| 820-4 | 4th Street | At pipe depth | 8-15-14 | 1015 |
| 820-5 | 2215 Strand Avenue | At pipe depth | 8-14-14 | 1345 |
| 820-6 | W. Vista Drive | At pipe depth | 8-14-14 | 1140 |
| 820-7 | 10th Street | At pipe depth | 8-14-14 | 1000 |
| 820-8 | Burlington Avenue | At pipe depth | 8-14-14 | 1040 |
| 820-9 | 34th Street and Bellecrest Drive | At pipe depth | 8-13-14 | 0945 |
| 820-10 | St. Ann Street | At pipe depth | 8-12-14 | 1100 |
| 820-11 | Highland Park Drive and Ben Hogan Drive | At pipe depth | 8-13-14 | 1035 |
| 820-12 | Joseph Court | At pipe depth | 8-12-14 | 1430 |

## TESTING METHODOLOGY

The samples as received were split into appropriate size for the prescribed battery of tests. The samples were scheduled for the following tests as described by the following procedures or methods:

- *ASTM G 51:* Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing,
- *ASTM G 187:* Standard Test Method for Measurement of Soil Resistivity Using the Two-Electrode Soil Box Method,
- *ASTM G 200:* Standard Test Method for Measurement of Oxidation-Reduction Potential (ORP) of Soil

AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC & OURSELVES, ALL REPORTS ARE SUBMITTED AS CONFIDENTIAL PROPERTY OF OUR CLIENTS & AUTHORIZATION FOR PUBLICATION OF STATEMENTS. CONCLUSIONS/EXTRACTS FROM OR REGARDING OUR REPORTS ARE RESERVED PENDING OUR WRITTEN APPROVAL. SAMPLES WILL BE DISPOSED OF AFTER TESTING IS COMPLETED UNLESS OTHER ARRANGEMENTS ARE AGREED TO IN WRITING.

- *ASTM D2216:* Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
- *Sodium Azide:* Sodium Azide reactivity testing was completed as described in a method (attached) produced by the Ductile Iron Pipe Research Association (DIPRA). Each sample was split to an approximately 50 gram sample size for testing. The samples were placed in single-use, non-reactive containers. A solution of Sodium Azide was introduced into the container and the sample was observed for a minimum of 10 minutes. The reagent / soil reaction was recorded as **trace** (a reaction, not vigorous, where Nitrogen gas bubbles are observed), **negative** (no noted Nitrogen gas bubbles are observed) or **positive** (a vigorous reaction with abundant Nitrogen gas bubbles observed). "Vigorous" reactivity was further defined in the literature as being similar to carbonated beverage frothing on exposure to air.
- *Total Soluble Chlorides:* The analysis method used to determine the chlorides is the United States Environmental Protection Agency (USEPA) Method 300.0; the preparation of the soil was completed using section 11.7 of the method. The extract was prepared at a 10:1 ratio of water to soil (by mass). Soluble chloride tests were completed by an external vendor (Pace Analytical).

## TEST DATA

**Table -1 Data Summary**

| Lab ID | | 820-1 | 820-2 | 820-3 | 820-4 | 820-5 | 820-6 | 820-7 | 820-8 | 820-9 | 820-10 | 820-11 | 820-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Soil Moisture (%) | | 8.3 | 8.3 | 5.3 | 3.2 | 4.7 | 3.1 | 5.1 | 1.4 | 12.7 | 8.9 | 17.8 | 13.0 |
| Soil pH | | 7.19 | 7.84 | 7.42 | 7.50 | 7.07 | 7.11 | 7.13 | 6.66 | 7.55 | 6.86 | 7.66 | 7.71 |
| Sodium Azide (Reactivity) | | Trace | Trace | Trace | Trace | Trace | Neg | Trace | Neg | Trace | Trace | Neg | Trace |
| Soluble Chlorides | | * | * | * | * | * | * | * | * | * | * | * | * |
| Soil Resistivity (Ω) | | 16,200 | 16,500 | 12,500 | 7,900 | 35,500 | 7,400 | 4,100 | 8,500 | 13,500 | 7,400 | 5,600 | 4,950 |
| Soil ORP (mV) | Read 1 | +233.2 | +171.7 | +180.3 | +182.4 | +198.9 | +185.3 | +188.3 | +164.5 | +170.5 | +193.6 | +247.2 | +229.4 |
| | Read 2 | +230.1 | +186.7 | +186.6 | +186.0 | +175.6 | +183.4 | +246.3 | +175.8 | +184.4 | +223.4 | +231.1 | +186.4 |
| | Read 3 | +239.5 | +176.7 | +189.7 | +191.5 | +183.3 | +171.1 | +175.4 | +157.2 | +172.0 | +221.7 | +239.0 | +195.0 |
| | Average ORP | +234.3 | +178.4 | +185.5 | +186.6 | +185.9 | +179.9 | +203.3 | +165.8 | +175.6 | +212.9 | +239.1 | +203.6 |

*Test data for soluble chlorides was not available at the time of this report. The soluble chlorides value is not part of the AWWA score calculation.

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## AWWA EVALUATION SCORING

The data presented in Table-1 may be used to evaluate the soil environment in which the pipe will serve. The American Water Works Association (AWWA) C105/A21.5-10 states that "If the sum (Total AWWA Evaluation Score) is equal to 10 or more, the soil is corrosive to ductile-iron pipe, and protection against exterior corrosion should be provided." The table below (Table- 2) uses the soil-test evaluations scale (attached) to arrive at an AWWA score for each of the test samples.

The moisture score, presented in the table below, was derived from the in-situ values obtained from the ASTM D 2216 test result for each sample. Generally, the soil samples appeared to have "good drainage" (visually classified as sandy gravel, gravelly sand, sand gravel and cobble and silty sand gravel and cobble). However, some moisture was present therefore the soil could be considered "generally moist", depending on the definition used. As presented in the AWWA literature, the possible scoring value for moisture may range from 0 to 2; a score of 1 was used in Tetra Tech's analysis below. While the definition of certain terms may be open for discussion, the Tetra Tech assigned value of 1 (if disputed) can only change the overall score by 1; a change of this value will not shift any individual score above or below the critical score of 10.

The pH scores presented in the Table-2 are reflective of the AWWA scoring criteria. An asterisk appears next to a pH score value that was dependent upon consideration of other score values (presented). Values for pH in the range of 6.5 to 7.5 are scored a "3" value if the Redox Potential (ORP) was < +100 mV **and** sulfides were present. For the individual samples below, all ORP values were greater than +100 mV; therefore a 0 score was assigned (even if trace sulfides were present).

Soil Resistivity values greater than 3,000 Ohms received a score of 0 according to the AWWA literature. The soil resistivities recorded for all 12 samples were equal or greater than 4,100 Ohms; the corresponding "0" score appears for all tested samples in the table below.

Soil Oxidation Potential (ORP) was determined by averaging the results of three properly conducted trials. The average value was used as the determining value to score each of the samples. No individual trial produced an ORP value less than +100 mV. All samples received an ORP score value of 0.

**Table -2 AWWA Soil-Test Evaluation**

| Lab ID | 820-1 | 820-2 | 820-3 | 820-4 | 820-5 | 820-6 | 820-7 | 820-8 | 820-9 | 820-10 | 820-11 | 820-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Moisture Score | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| pH Score | 0* | 0 | 0* | 0* | 0* | 0 | 0* | 0 | 0 | 0* | 0 | 0 |
| Sodium Azide Reactivity (Sulfides) Score | 2 | 2 | 2 | 2 | 2 | 0 | 2 | 0 | 2 | 2 | 0 | 2 |
| Soil ORP Score | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Soil Resistivity Score | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total AWWA Evaluation Score | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 1 | 3 | 3 | 1 | 3 |

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## CLOSURE

All test samples were scored via the AWWA procedure for evaluation of corrosive soil environments for pipe. The AWWA score for each sample was calculated to be "3" or less, based on the literature. A score of 10 or greater is considered in the AWWA literature as the point where additional considerations should be taken into account for protection of ductile iron pipe. Score values for other types of pipe were not considered in the literature and the score values in Table -2 should not be used to evaluate such pipe or pipe/soil combinations.

Tetra Tech has completed the above analysis of individual samples received from Mountain Water. Tetra Tech's laboratory followed the procedures as outlined in the stated test methods wherever possible; any noted deviations from the identified methods are discussed in the body of this report. All sample locations, sample selection, sampling methods and sampling procedures were determined by Mountain Water.

We appreciate the opportunity to provide this service for your project. If you have additional needs for testing or if there are any questions regarding this report please contact me at our Missoula office at (406) 543-3045.

Sincerely,

Tetra Tech Inc.

Reviewed By: _____
Michael Connolly
Missoula CME Lab Manager

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## Sulfides

In anaerobic conditions, bacteria utilize sulfates as a source of oxygen in their metabolic activity. As a by product of the metabolism of sulfates, sulfides are produced. The presence of sulfides, therefore, is one indicator of the presence of sulfate reducing anaerobic bacteria.

A field test used by DIPRA involves the use of a 3% solution of sodium azide in a 0.1 N iodine solution. Soil that contains sulfides will, in the presence of the above solution, react in a catalytic way to produce nitrogen gas. The gas is evidenced by a bubbling reaction and may be classified as a positive result (vigorous bubbling) or a trace (slight bubbling). A negative result – no bubbling – is an indicator that sulfides are not present.

The sodium azide solution is made by placing 15 grams of sodium azide and 100 ml of Lugol's iodine solution into 400 ml of distilled water.

## Recipe for the Sodium Azide Solution

**Ingredients:**

Sodium azide powder – practical
Lugol's iodine solution – concentrated
Distilled water

**Directions:**

In a 500 ml graduated cylinder:

1. Place 300 ml of distilled water;
2. Add 15 grams of sodium azide powder. Stir until dissolved.
3. Add 100 ml of Lugol's iodine solution. Stir.
4. Add distilled water to 500 ml. Stir.

DIPRA purchases sodium azide in a 500 gm bottle and Lugol's iodine solution in a 500 ml bottle from Andwin Scientific: 800.297.1220.

# APPENDIX A

## Notes on Procedures for Soil Survey Tests and Observations and Their Interpretation to Determine Whether Polyethylene Encasement Should Be Used

*This appendix is for information only and is not a part of ANSI/AWWA C105/A21.5.*

In the appraisal of soil and other conditions that affect the corrosion rate of ductile-iron pipe,* many factors must always be considered. They are outlined here. A method of evaluating and interpreting each factor and a method of weighing each factor to determine whether polyethylene encasement should be used are subsequently described.

These methods should be employed only by qualified personnel who are experienced in soil analysis and evaluation of conditions potentially corrosive to ductile-iron pipe. Factors such as moisture content, soil temperature, location of soil sample with respect to pipe, time between removal of soil sample and testing, and other factors can significantly affect the soil-test evaluation. For example, certain soil environments are considered to be potentially corrosive to ductile-iron pipe and, therefore, do not require evaluation to determine the need for corrosion protection. These environments include, but are not limited to, coal, cinders, muck, peat, mine wastes, and landfill areas high in foreign materials. Existing installations and the potential for stray direct-current corrosion should also be a part of the evaluation.

## SECTION A.1: SOIL SURVEY TESTS AND OBSERVATIONS

Factors to consider when determining the need for polyethylene encasement of pipe are outlined below. A discussion of each point follows the outline.

1. Earth resistivity (see A.1.1).
   a. Four-pin
   b. Single-probe
   c. Saturated-sample (soil-box)

* NOTE: The information contained in appendix A is also applicable to gray-iron pipe. Although gray-iron pipe is no longer produced in the United States, many miles of this product remain in service.

2. pH (see A.1.2).
3. Oxidation-reduction (redox) potential (see A.1.3).
4. Sulfides (see A.1.4).
   a. Azide (qualitative)
5. Moisture content (relative) (see A.1.5).
   a. Prevalence
6. Soil description (see A.1.6).
   a. Particle size
   b. Uniformity
   c. Type
   d. Color
7. Potential stray direct current (see A.1.7).
   a. Nearby cathodic-protection-utilizing rectifiers
   b. Railroads (electric)
   c. Industrial equipment, including welding equipment
   d. Mine transportation equipment
8. Experience with existing installations in the area (see A.1.8).

A.1.1 *Earth resistivity.* There are three methods for determining earth resistivity: four-pin, single-probe, and soil-box. In the field, a four-pin determination should be made with pins spaced at approximate pipe depth. This method yields an average of resistivity from the surface to a depth equal to pin spacing. However, results are sometimes difficult to interpret where dry topsoil is underlain with wetter soils and where soil types vary with depth. The Wenner configuration is used with a soil-resistance meter, which is available with varying ranges of resistance. For all-around use, a meter with a capacity of up to $10^4$ ohms is suggested, because it permits both field and laboratory testing of most soils.

Because of this difficulty in interpretation, the same meter may be used with a single probe that yields resistivity at the point of the probe. A boring is made into the subsoil allowing the probe to be pushed into the soil at the desired depth.

Because the soil may not typically be wet, a sample should be removed for saturated resistivity determination. This may be accomplished with a laboratory unit that permits the introduction of water to saturation, therefore simulating saturated field conditions. The unit is used in conjunction with a soil-resistance meter.

The interpretation of the results of resistivity measurements is extremely important. A determination based on a four-pin reading with dry topsoil averaged with wetter subsoil would probably be inaccurate. Only by determining the resistivity

in soil at pipe depth can an accurate interpretation be made. Also, the local situation should be determined concerning groundwater table, the presence of shallow groundwater, and the approximate percentage of time the soil is likely to be water saturated.

With ductile-iron pipe, corrosion protection provided by products of corrosion is enhanced if there are dry periods during each year. Dry periods seem to permit hardening, or toughening, of the corrosion scale or products, which become impervious and serve as better insulators.

In making field determinations of resistivity, temperature is important. Resistivity increases as the temperature decreases. As the water in the soil approaches freezing, resistivity increases greatly and, therefore, is not reliable. Field determinations under frozen soil conditions should be avoided. Reliable results under these conditions can be obtained only by the collection of suitable subsoil samples for analysis in laboratory conditions at a proper temperature.

*Interpretation of resistivity data.* Because of the wide variance in results obtained using the methods described, it is difficult to interpret any single reading without knowing which method was used to obtain the reading. The interpretation should be based on the lowest reading obtained, with consideration to other conditions, such as typical moisture content of the soil. Because of the lack of exact correlation between experiences and resistivity, it is necessary to assign ranges of resistivity rather than specific numbers. Table A.1 shows the points assigned to various ranges of resistivity. These points, when considered along with points assigned to other soil characteristics (also shown in Table A.1), are significant.

A.1.2 *pH.* In the pH range of 0.0 to 4.0, soils indicate acid conditions that are often associated with high rates of corrosion. In the pH range of 6.5 to 7.5, soil conditions are optimum for sulfate reduction. In the pH range of 8.5 to 14.0, soils are generally high in dissolved salts, yielding a low soil resistivity.

In testing pH, a combination pH electrode is pushed into the soil sample, and a direct reading is made, following suitable temperature setting on the instrument. Normal procedures are followed for standardization.

A.1.3 *Oxidation-reduction (redox) potential.* The redox potential of a soil is significant, because the most common sulfate-reducing bacteria can live only in anaerobic conditions. A redox potential greater than +100 mV demonstrates that the soil is sufficiently aerated, preventing sulfate reducers from forming. Potentials of 0 to +100 mV may or may not indicate anaerobic conditions; however, a negative redox potential definitely indicates the anaerobic conditions in which

**Table A.1 Soil-test evaluation**

| Soil Characteristics Based on Samples Taken Down to Pipe Depth | | |
|---|---|---|
| Resistivity—ohm-cm (based on water-saturated soil box): | | Points* |
| | <1,500 | 10 |
| | ≥1,500–1,800 | 8 |
| | >1,800–2,100 | 5 |
| | >2,100–2,500 | 2 |
| | >2,500–3,000 | 1 |
| | >3,000 | 0 |
| pH: | | |
| | 0–2 | 5 |
| | 2–4 | 3 |
| | 4–6.5 | 0 |
| | 6.5–7.5 | 0† |
| | 7.5–8.5 | 0 |
| | >8.5 | 3 |
| Redox potential: | | |
| | > +100 mV | 0 |
| | +50 to +100 mV | 3.5 |
| | 0 to +50 mV | 4 |
| | Negative | 5 |
| Sulfides: | | |
| | Positive | 3.5 |
| | Trace | 2 |
| | Negative | 0 |
| Moisture: | | |
| | Poor drainage, continuously wet | 2 |
| | Fair drainage, generally moist | 1 |
| | Good drainage, generally dry | 0 |

*Ten points or greater indicates that soil is corrosive to ductile-iron pipe; protection is needed. Refer to paragraph A.3 for a description of Uniquely Severe Environments and additional considerations.

†If sulfides are present and low (<100 mv) or negative redox-potential results are obtained, add three points for this range.

sulfate reducers thrive. The redox test is performed using a pH/mV meter with a combination ORP electrode inserted into the soil sample. It should be noted that soil samples removed from a boring or excavation can undergo a change in redox potential when exposed to air. These samples should be tested immediately after the excavation. Heavy clays, muck, and organic soils are often anaerobic. For this reason, these soils should be regarded as potentially corrosive.

A.1.4 *Sulfides.* A positive sulfide reaction reveals a potential problem caused by sulfate-reducing bacteria. The sodium azide–iodine qualitative test is used to identify sulfides. In this determination, a solution of 3 percent sodium azide in a 0.1*N* iodine solution is introduced into a test tube containing a sample of the soil. Sulfides catalyze the reaction between sodium azide and iodine, resulting in nitrogen. If strong bubbling or foaming results, sulfides are present, as are sulfate-reducing bacteria. If very slight bubbling is noted, sulfides are probably present in small concentration, and the result is noted as a trace.

A.1.5 *Moisture content.* Because prevailing moisture content is extremely important to soil corrosion, this condition must be determined. It is not necessary that the specific moisture content of a soil sample be determined, because the content probably varies throughout the year. However, local authorities should observe the soil moisture conditions many times during the year. (Although mentioned in item 1, Earth resistivity, this variability factor is reiterated to emphasize the importance of notation.)

A.1.6 *Soil description.* In each investigation, soil types should be completely described. The description should include color and physical characteristics, such as particle size, plasticity, friability, and uniformity. Observation and testing will reveal whether the soil is high in organic content; this should be noted. In a given area, corrosivity may often be reflected in certain types and colors of soil. This information is valuable for future investigations or for determining suspect soils.

Soil uniformity is important because of the possible development of local corrosion cells caused by the difference in potential, such as different soil types contacting the pipe. The same is true for uniformity of aeration. If one segment of soil contains more oxygen than a neighboring segment, a corrosion cell can develop from the difference in potential. This cell is known as a differential aeration cell.

There are several basic types of soils that should be noted in the soil description: sand, loam, silt, clay, and muck. In addition, unusual soils, such as peat or soils high in foreign material, should be noted.

A.1.7 *Potential stray direct current.* Soil surveys should consider the possibility of stray direct current that might interfere with the ductile-iron-pipe installation. The widespread use of rectifiers and ground beds for cathodic protection of underground structures has increased the potential of stray direct current. The proximity of these cathodic protection systems should be noted. Among other potential sources of stray direct current are electric railways, industrial equipment (including welding equipment), and mine-transportation equipment.

Normally, the amount of stray current influence from cathodic protection systems on an electrically discontinuous ductile-iron pipeline will be negligible. It is not detrimental to the expected life of the system, unless the pipeline comes close to an impressed-current, cathodic-protection anode bed where the current density is high. When a ductile-iron pipeline is exposed to a high-density stray current environment, the pipeline should be rerouted or the anode bed relocated. If neither of these options is feasible, the ductile-iron pipe in this area should be electrically bonded together, electrically isolated from adjacent pipe, polyethylene encased, and appropriate test leads and "current drain" installed.

A.1.8 *Experience with existing installations.* The best information on soil corrosivity with respect to ductile-iron pipe results from experience with this material in the area under investigation. Every effort should be made to acquire this data by questioning local officials and, if possible, by observing existing installations.

## SECTION A.2: SOIL-TEST EVALUATION

When the soil-test procedures described in this standard are employed, the following tests are used in evaluating corrosivity of the soil: resistivity, pH, redox potential, sulfides, and moisture. For each of these tests, results are categorized according to their contribution to corrosivity. Point values are assigned, based on experience with ductile-iron pipe (see Table A.1). When results of these five tests/observations are available, the assigned points are totaled. If the sum is equal to 10 or more, the soil is corrosive to ductile-iron pipe, and protection against exterior corrosion should be provided. This system of evaluation is limited to soil corrosion and does not include consideration of stray direct current.

A.2.1 *General.* These notes address only ductile-iron pipe, the soil environment in which the pipe will serve, and the methods of determining a need for polyethylene encasement.

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# Appendix L

# Water Rights and the Dams in the Rattlesnake Wilderness

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WGMGROUP
Community Values. Inspired Futures.

1111 East Broadway
Missoula, MT 59802
406.728.4611
www.wgmgroup.com

# MEMORANDUM

**DATE:** March 1, 2018

**TO:** Missoula Water

**CC:** John Wilson, Ryan Sudbury, Logan McInnis, Dennis Bowman, Ross Mollenhauer, Elizabeth Erickson

**FROM:** Kyle Mace, WGM Group, Inc.

**RE:** Water Rights and the Dams in the Rattlesnake Wilderness

---

The Water Rights Group at WGM has worked on the Missoula Water system water rights for many years and has been involved with the multiple change and permit applications that have been filed, including the application that allowed the City's Rattlesnake Creek direct flow water rights to be exercised by pumping from groundwater wells in the valley.

Based on this past experience, WGM Group was asked to review the September 1, 2017 letter from Patrick Byorth at Trout Unlimited (TU) regarding Missoula Water's Rattlesnake Creek water rights and the dams in the Rattlesnake Wilderness area. The following is a discussion of items we feel should be considered as the City decides how to proceed with determining the best course of action regarding those dams.

Please consider this a preliminary treatment of these topics. At our meeting in November, we concluded that more research into the historical operation of the dams would be conducted. Information gathered as a result of further research may alter the recommendations presented here. For the sake of brevity, we will skip any background explanation of the Rattlesnake water rights as the TU letter provides a solid synopsis of the facts.

The TU letter addresses the issue of abandonment of the water rights for the Rattlesnake wilderness dams, further referred to as the Storage Rights. There are two aspects of abandonment that specifically need to be considered;

- Non-use of the Storage Rights with the current infrastructure in place
- Non-use after the mainstem dam and intake works are removed.

Arguably, the wilderness dams have not been operated in their historical capacity for a number of years. This has the implications for abandonment of the Storage Rights. Although, as TU points out, there are certain protections for municipal water rights that likely work in the City's favor.

The planned removal of the mainstem dam and intake changes the dynamic of the abandonment discussion because that is an overt act to remove the historical means of diversion. While this is a legal issue that we cannot specifically address, it appears this action could be perceived differently than the non-use.

Abandonment has two conditions, *non-use* and *intent* to abandon. As TU describes, municipalities may have some protection under the non-use portion. However, it is unclear if that protection extends to actions that could be perceived as intent to abandon, such as removal of the means of diversion.

In addition to abandonment, another major consideration is priority. Downstream hydropower, Avista Corp (currently being sold to Hydro One, a Canadian company), has major power-generation water rights on the Clark Fork River that pre-date several of the City's well water rights (though not the Rattlesnake Creek rights). The priority issue is two-pronged:

- Avista's seniority puts it in a position to potentially make call on the City's water rights that are junior to Avista's
- Avista's large, senior rights strictly limit the legal availability of water for new uses anywhere in the Clark Fork and Flathead River Basins. As Missoula grows, it will be difficult to obtain new water right permits for that growth.

In light of the potential priority challenges, it may behoove the City to prioritize protection of its most senior water rights such as those associated with the wilderness dams. There are at least three major components to consider;

- taking action to protect the Storage Rights with an Application to Change
- rehabilitation or removal of the wilderness dams
- removal of the mainstem dam and intake works

As TU explains, filing an Application to Change the Storage Rights would address the concerns referenced above, preventing an abandonment charge, protecting the City from call from downstream users, and protecting volume for future use. There are a number of options, two of which were suggested by TU;

- Change the Storage Rights to Instream Flow
- Change the Storage Rights to Mitigation

and a third option not specifically suggested by TU;

- Change the Storage Rights to add valley wells as points of diversion.

Arguably, some combination of the above could also be employed.

The TU memo explores five different options for action;

- Remove the mainstem and the wilderness dams, change the Storage Rights to instream flow
- Remove the mainstem dam and maintain the wilderness dams, change the Storage Rights to instream flow and mitigation
- Partially remove the mainstem dam, leaving the intake structure in place
- Renovate and retain all of the dams
- No action

TU indicates a preference for the first option. We have some concerns about this possible solution that should be considered.

While on paper, the Storage Rights list year-round periods of diversion and use, it is questionable if this is accurate. It is likely that the historical practice was to store water during periods of high-flows then release it during low-flows in the late summer and early fall when natural flows in the creek are diminished. If/when the City files an Application to Change with the Dept of Natural Resources and Conservation (DNRC), the question of historical use practices will be raised.

Without the wilderness dams in place as control structures, it would not be possible to exercise the water rights during low-flow periods. The water that was historically stored in the spring for use later in the season would flow down the creek with the spring run-off when there is already plenty of water available for the fishery. Without the dams, the City would not be physically able to put the water in the creek during the same times as it was historically present, during low flows when it is needed by the fish. A proposed change to increase instream flows under these conditions may not be considered a beneficial use. Further discussions with the DNRC could provide perspective on this concern.

Changing the Storage Rights to mitigation could enable a new permitted use of water in this basin, but it could face similar difficulties if the wilderness dams are removed. The timing of depletions and return flows under the change scenario would not match the historical depletions and return flows. One option that could facilitate a change to mitigation, would be to develop an aquifer recharge plan that would involve diversion of water from Rattlesnake Creek at a different location and retention of that water in an infiltration gallery or similar structure in order to mimic the historical depletion and return flow regimes.

The third water right Change option would be to add the wells as points of diversion for the Storage Rights as was done with the Rattlesnake Creek direct flow rights. This option is more feasible now than it was back in 2002-2003 because of the 2005 statute and the *City of Helena v Community of Rimini* Supreme Court ruling as discussed in the TU letter. This type of Change may face the same concerns as a mitigation Change due to modifications of the pattern of depletion and return flows relative to the historical use.

It is worth explaining briefly how it is determined if/when the senior Rattlesnake Creek rights are being exercised versus when the junior well water rights are being exercised.

The conditions of the Rattlesnake Creek Change Authorization state that the City is exercising its senior Rattlesnake Creek rights when water measured at the historical point of diversion in Rattlesnake Creek, the mainstem dam and intake, is available in the amounts described under the Rattlesnake Creek direct flow claims. When the amount of water available in the creek drops below that physical diversion threshold,

then the City is exercising its junior water rights from the wells. The same would hold true for the Storage Rights.

One final consideration is based on the discussion we have had regarding the condition of the wilderness dams. It is our understanding that some of the dams are in much worse shape than others. One course of action could be to remove the dams that are in the worst condition and make plans to repair those that are in better condition. The amount of volume that can be protected may also be a factor in this decision-making process.

Given the above discussion, WGM Group believes a variation on TU's second option should be considered, specifically;

- Remove the mainstem dam and intake infrastructure
- Rehabilitate the wilderness dams that are deemed to be in better condition
- Remove the wilderness dam or dams that are in the worst condition
- Change the Storage Rights to add the valley wells as points of diversion

The benefits of this option include *de facto* instream flow for Rattlesnake Creek including the ability to release water to supplement creek flows when it is needed the most, during low-flow conditions. If this option is pursued, it would be useful to install a stream gauge in the creek at the site of the mainstem dam in order to record streamflow so it is possible to report when the senior rights are being exercised.

Assuming the volumes of the Storage Rights and the estimated cost to repair the infrastructure contained in the TU letter are in the ballpark, $3 million for over 2,500 ac-ft of water could be considered a reasonable cost. At those rates, it equates to about $1,200 per ac-ft. This could be compared to the cost of bringing the Maloney Ranch water rights on line. More information would need to be gathered about those costs to make an accurate comparison.

In summary, there are obviously a number of factors to consider in regard to the wilderness dams and the associated Storage Rights. In addition to the questions of abandonment of the water rights, the downstream hydropower rights have the potential to play a major factor in the future of the City's ability to use water. As we look into the future, it should be noted that the ability to store water under the historical priority dates of the Storage rights provides protections that cannot be gained in any other way. We would like to emphasize the concern that if the wilderness dams are removed, it is likely they could never be replaced.

# Appendix M

# Rattlesnake Dams - Project Information Sheets

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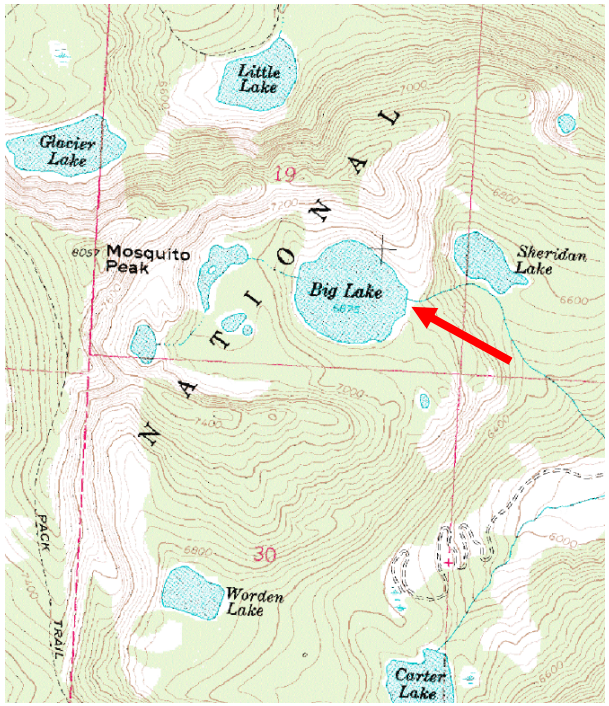
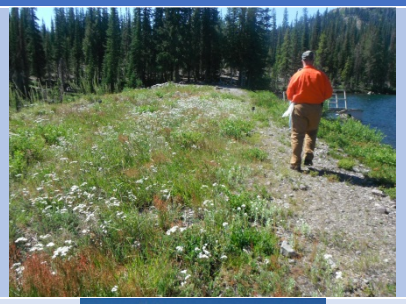
| Project Information | |
|---|---|
| **Name:** | Big Lake Dam |
| **Location:** | Missoula County, SE ¼ Sec. 19, T15N, R18W, Lat. 47°02'18", Long. 113°55'42" |
| **Hazard Classification:** | Significant (failure would cause environmental damage) |
| **Type of Dam:** | Earthen embankment with rock timber crib core |
| **Construction History:** | Built 1915; spillway enlarged 2010 |
| **Storage Capacity:** | Normal Storage 143 acre-feet; Max Storage 621 acre-feet |
| **Water Rights:** | Priority Date: August 30, 1919; Max Flow Rate: 5.22 cfs; Max Volume: 623 acre-feet |

**Location Map**




**Photo**

| Summary of Existing Conditions | | |
|---|---|---|
| **Embankment, Crest:** | Very wide crest (~30 ft); sinkholes have surfaced in the past. Nine piezometers are in place on the crest and monitored annually. Recommend monitoring at least semi-annually. |  |
| **Embankment, Downstream Slope:** | Rock-lined surface, very steep; stable but has erosion from past overtopping. | |
| **Embankment, Upstream Slope:** | Good condition, lined with riprap. Note damaged south valve access tower and walkway, referred to in Low-Level Outlet, South. | |

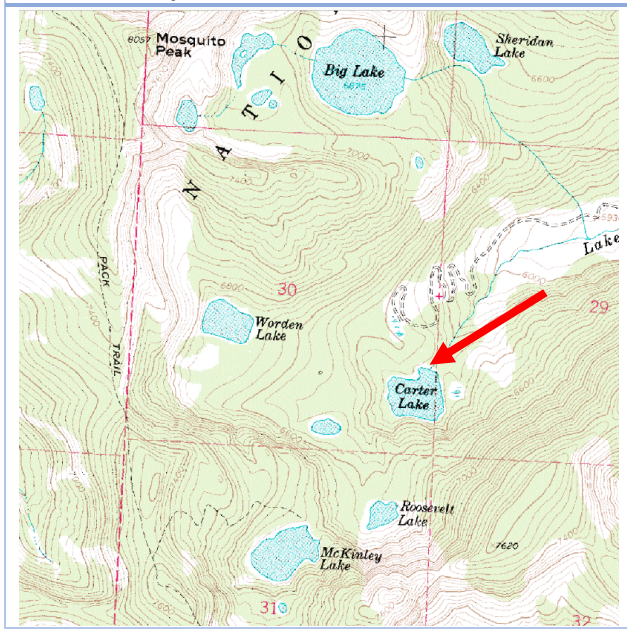
| | | | |
|---|---|---|---|
| **Emergency Spillway** | Enlarged in 2010. Lined with riprap, good condition, meets USFS standards. | | |
| **Low-Level Outlet, South:** | 12-inch diameter corrugated metal pipe (CMP) with steel pipe extension on the end; inspection video shows corrosion holes in both pipes. Control valve on upstream end seals well. Access tower and walkway to valve control susceptible to ice damage. | | |
| **Low-Level Outlet, North:** | 12-inch diameter CMP; new section on end added when spillway was enlarged in 2010; old section has heavy corrosion. Control valve on upstream end is open; unsure if operable. | | |

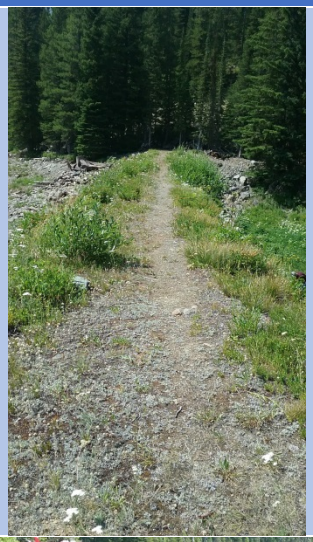
| | | | |
|---|---|---|---|
| **Seepage:** | Foundation seepage evident in downstream toe of dam. Two seepage flow weirs and two piezometers are in place in the downstream toe and are monitored annually. Recommend monitoring at least semi-annually. No seepage from embankment slope. | | |

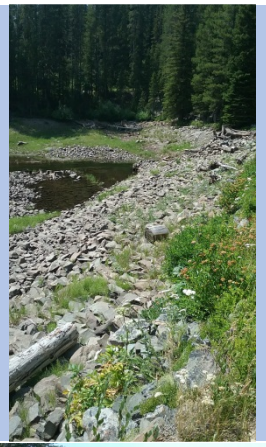
**Summary of Repairs Needed to Meet Forest Service Standards:**

1. **Conduct a geotechnical investigation and analysis.**
2. **Stabilize the downstream slope by repairing erosion and buttressing with additional fill material.**
3. **Repair the sinkhole on crest of dam.**
4. **Minimize seepage through dam with a geosynthetic liner on the upstream slope.**
5. **Slip-line both outlets with high-density polyethylene (HDPE) pipe. Replace the north outlet gate valve. Extend the south outlet to accommodate new toe berm.**
6. **Repair the south valve access tower and walkway.**

| Project Information | |
|---|---|
| **Name:** | Carter Lake Dam |
| **Location:** | Missoula County, SE ¼ Sec. 30, T15N, R18W, Lat. 47°01'36", Long. 113°54'42" |
| **Hazard Classification:** | Low (failure would cause minor damage) |
| **Type of Dam:** | Earthen embankment with rock timber crib core |
| **Construction History:** | Built 1921 |
| **Storage Capacity:** | Normal Storage 161 acre-feet; Max Storage 161 acre-feet |
| **Water Rights:** | Priority Date: November 6, 1923; Max Flow Rate: 1.43 CFS; Max Volume: 170 acre-feet |

| Location Map | Photo |
|---|---|
|  | |

| Summary of Existing Conditions | | |
|---|---|---|
| **Embankment, Crest:** | Narrow crest (~5 ft). Some erosion from past overtopping. |  |
| **Embankment, Downstream Slope:** | Rock-lined surface; very steep; stable; vegetation needs to be removed. If crest is widened, fill would be placed on downstream side. | |

| | | | |
|---|---|---|---|
| **Embankment, Upstream Slope:** | Good condition, lined with riprap. For seepage control, line upstream slope with impermeable liner. | |  |
| **Emergency Spillway** | Overall good condition and has updated log-corduroy structure. Needs annual maintenance to remove logs and fix scour hole at end of log corduroy structure. Meets USFS standards but has continual maintenance issues and needs repair. | | |

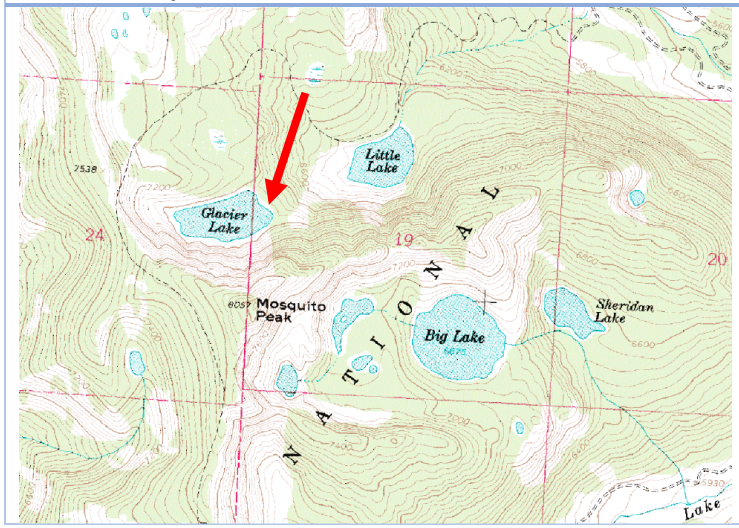
| | | |
|---|---|---|
| **Low-Level Outlet:** | Corrugated metal pipe (CMP); inspection video shows extensive corrosion. Valve access tower is damaged and needs to be replaced. | |
| **Seepage:** | Foundation seepage significant in downstream toe of dam during high reservoir levels. No seepage from embankment slope. | |

**Summary of Repairs Needed to Meet Forest Service Standards:**

1. **Conduct a geotechnical investigation and analysis.**
2. **Fully replace the low-level outlet, valve, and valve access structure.**
3. **Widen the crest and stabilize the downstream slope by buttressing with additional fill material.**
4. **Minimize seepage through dam with a geosynthetic liner on the upstream slope.**
5. **Repair and stabilize the spillway.**
6. **Monitor dam for seepage after liner installation and install piezometers on embankment and downstream toe if needed.**

| Project Information | |
|---|---|
| **Name:** | Glacier Lake Dam |
| **Location:** | Missoula County, NW ¼ Sec. 19, T15N, R18W, Lat. 47° 02' 42", Long. 113° 56' 6" |
| **Hazard Classification:** | Significant (failure would cause significant environmental damage) |
| **Type of Dam:** | Earthen embankment with rock timber crib core |
| **Construction History:** | Built 1911 |
| **Storage Capacity:** | Normal Storage 210 acre-feet; Max Storage 240 acre-feet |
| **Water Rights:** | Priority Date: August 30, 1919; Max Flow Rate: 1.76 CFS; Max Volume: 212 acre-feet |

**Location Map**




**Photo**

| Summary of Existing Conditions | | |
|---|---|---|
| **Embankment, Crest:** | Good condition. Vegetation needs trimming. | |
| **Embankment, Downstream Slope:** | Rock-lined vegetative surface; vegetation needs trimming; small slough 50 feet to the right of the outlet. | |
| **Embankment, Upstream Slope:** | Good condition, lined with riprap; vegetation needs trimming. | |
| **Emergency Spillway** | Has a headcut that is being monitored. Meets USFS standards. | |

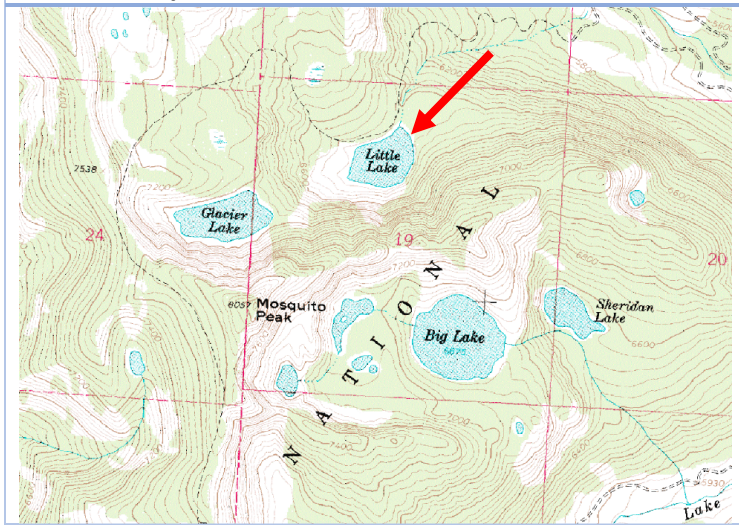
| | | |
|---|---|---|
| **Low-Level Outlet:** | Corrugated metal pipe (CMP); inspection video shows extensive corrosion. Recommend slip-line repair. Outlet valve access timber structure is deteriorated and needs repair. | |
| **Seepage:** | No seepage is evident because reservoir is kept low, but seepage has been observed in the past during full pool. | |

**Summary of Repairs Needed to Meet Forest Service Standards:**

1. **Conduct a geotechnical investigation and analysis.**
2. **Slip-line the outlet pipe with a high-density polyethylene (HDPE) pipe.**
3. **Repair the valve access timber structure.**
4. **Repair the spillway and install enhanced erosion control measures.**
5. **Monitor dam for seepage after liner installation and install piezometers on embankment and downstream toe if needed.**

| Project Information | |
|---|---|
| **Name:** | Little Lake Dam |
| **Location:** | Missoula County, NW ¼ Sec. 19, T15N, R18W, Lat. 47° 2' 54", Long. 113° 55' 24" |
| **Hazard Classification:** | Significant (failure would cause significant environmental damage) |
| **Type of Dam:** | Earthen embankment with rock timber crib core |
| **Construction History:** | Built 1912 |
| **Storage Capacity:** | Normal Storage 125 acre-feet; Max Storage 298 acre-feet |
| **Water Rights:** | Priority Date: August 30, 1919; Max Flow Rate: 2.5 CFS; Max Volume: 300 acre-feet |

**Location Map**




**Photo**

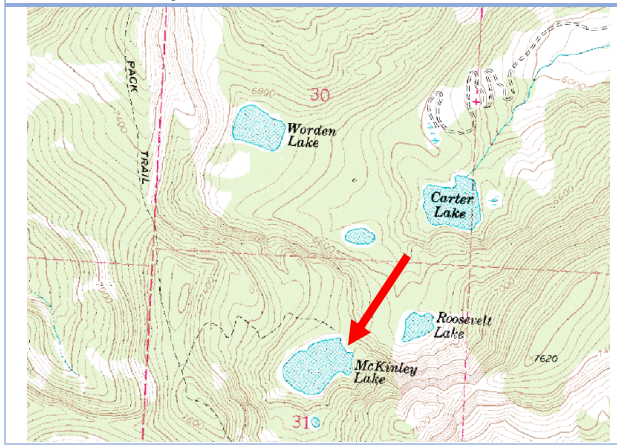
| Summary of Existing Conditions | | |
|---|---|---|
| **Embankment, Crest:** | Very narrow (~3 feet in places). Does not meet minimum FS criteria (12 feet). Repair is to add more material on downstream side and widen crest. | |
| **Embankment, Downstream Slope:** | Toe berm installed for stability during sink-hole emergency repair in 1996. Slope is steep above toe berm and has minor sloughing in places. Vegetation needs trimming. Likely repair is to add more to embankment and toe berm to make stable. | |
| **Embankment, Upstream Slope:** | Mostly in good condition, but 1996 sink hole is still evident and has not been repaired. Reservoir is kept low to prevent water from entering the sink hole. Vegetation needs to be trimmed. Likely repair is to line with impermeable liner. | |

| | | |
|---|---|---|
| **Emergency Spillway** | Excavated to low elevation during 1996 sinkhole emergency repair. Generally in good condition. Debris removal and repair of erosion along spillway side slopes are constant maintenance items. | |
| **Low-Level Outlet:** | Video inspected in 2014. Pipe is smooth-walled steel and is rusted; corroded at up-stream end of pipe. Large bulge near the downstream end. Control valve is on the downstream side so outlet pipe is pressurized. Recommend slip lining. | |
| **Seepage:** | No seepage is evident because reservoir is kept low. Sink hole in 1996 is evidence that embankment repair is needed. | |

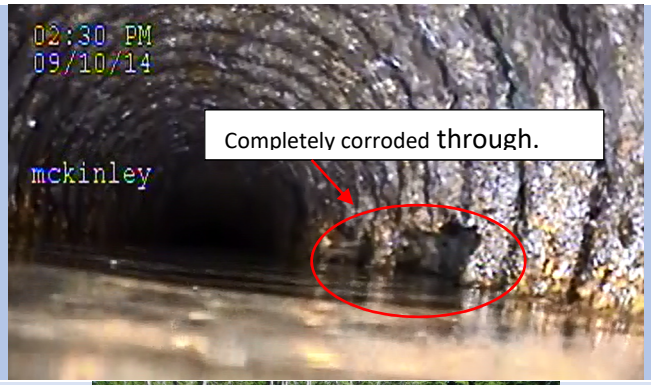
**Summary of Repairs Needed to Meet Forest Service Standards:**

1. **Conduct a geotechnical investigation and analysis.**
2. **Slip-line the outlet pipe with a high-density polyethylene (HDPE) pipe.**
3. **Minimize seepage through dam with a geosynthetic liner on the upstream slope.**
4. **Widen the crest and stabilize the downstream slope by buttressing with additional fill material.**
5. **Monitor dam for seepage after liner installation and install piezometers on embankment and downstream toe if needed.**

| Project Information | |
|---|---|
| **Name:** | McKinley Lake Dam |
| **Location:** | Missoula County, NW ¼ Sec. 31, T15N, R18W, Lat. 47° 1' 0", Long. 113° 55' 12" |
| **Hazard Classification:** | Significant (failure would cause significant environmental damage) |
| **Type of Dam:** | Earthen embankment. Core material unknown. |
| **Construction History:** | Built 1923 |
| **Storage Capacity:** | Normal Storage 152 acre-feet; Max Storage 168 acre-feet |
| **Water Rights:** | Priority Date: August 13, 1923; Max Flow Rate: 1.64 CFS; Max Volume: 195 acre-feet |

| Location Map | Photo |
|---|---|
|  | |

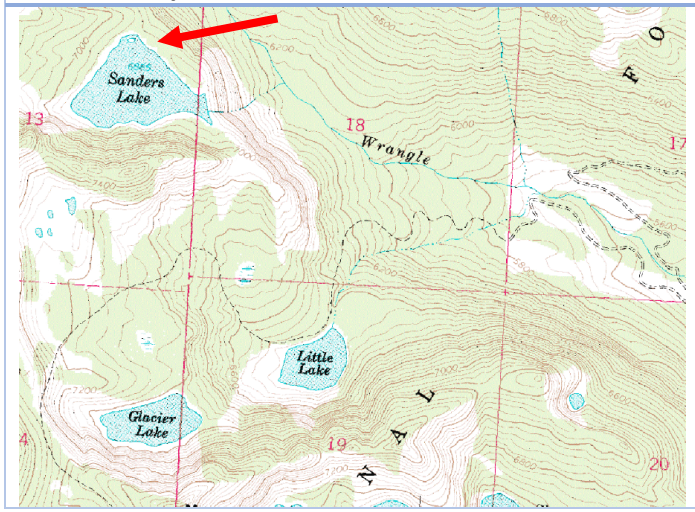
| Summary of Existing Conditions | | | |
|---|---|---|---|
| **Embankment, Crest:** | Crest is wide enough to meet FS criteria but it slopes to the upstream side near the outlet. Woody vegetation needs trimming. | | |
| **Embankment, Downstream Slope:** | The downstream slope on both the left and right sides is very steep with a cover of stacked rock, but no signs of instability. | | |
| **Embankment, Upstream Slope:** | Left side is steep, some erosion. No signs of instability. | | |
| **Emergency Spillway** | Severe erosion on downstream side, affecting hillside downstream of channel. Headcut progress is being monitored. At the location pictured (left) the channel has eroded down approximately 4 feet over 4 years. | | |

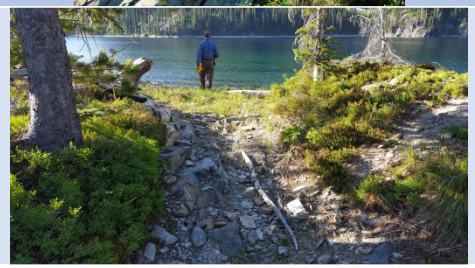
| | | |
|---|---|---|
| **Low-Level Outlet:** | Video inspected in 2014. Pipe is corrugated metal (CMP) with a 6-foot section of PVC on the downstream end. Pipe is highly corroded with many large holes. Recommend full replacement. Control valve is on the upstream side but protective metal tower continually gets damaged by ice so is no longer used. |  |
| **Seepage:** | No seepage in the downstream embankment, but high pool levels result in significant downstream toe seepage. | |

**Summary of Repairs Needed to Meet Forest Service Standards:**

1. **Conduct a geotechnical investigation and analysis.**
2. **Fully replace the outlet pipe and repair the inlet control tower.**
3. **Add additional fill on the crest and on the upstream slope near the outlet.**
4. **Minimize seepage through dam with a geosynthetic liner on the upstream slope.**
5. **Install erosion control measures on the existing spillway or re-route the spillway to prevent further erosion of the hillside.**
6. **Monitor dam for seepage after liner installation and install piezometers on embankment and downstream toe if needed.**

| Project Information | |
|---|---|
| **Name:** | Sanders Lake North Dam |
| **Location:** | Missoula County, NW ¼ Sec. 31, T15N, R18W, Lat. 47° 3' 30", Long. 113° 56' 0" |
| **Hazard Classification:** | Significant (failure would cause significant environmental damage) |
| **Type of Dam:** | Earthen embankment with rock timber crib core |
| **Construction History:** | Built 1913 |
| **Storage Capacity:** | Normal Storage 325 acre-feet; Max Storage 897 acre-feet |
| **Water Rights:** | Priority Date: August 30, 1919; Max Flow Rate: 7.54 CFS; Max Volume: 905 acre-feet |

| Location Map | Photo |
|---|---|
|  | |

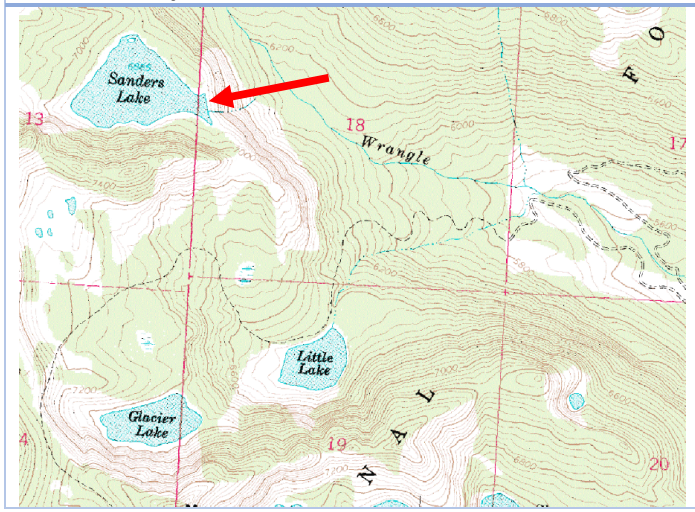
| Summary of Existing Conditions | | |
|---|---|---|
| **Embankment, Crest:** | Crest is in good condition but has evidence of rodents. Vegetation needs trimming. | |
| **Embankment, Downstream Slope:** | Steep, but in good condition with no signs of instability. Rodents are evident. Vegetation needs trimming. | |
| **Embankment, Upstream Slope:** | Slope and riprap are in good condition. | |
| **Emergency Spillway** | Good condition. Meets FS criteria. |  |

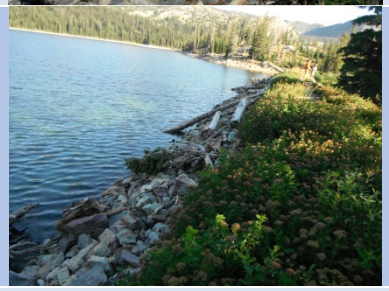
| | | |
|---|---|---|
| **Low-Level Outlet:** | Video inspected in 2014. Pipe is corrugated metal (CMP) and is corroded with several cracks near the upstream end. Recommend slip-lining. Control valve is hard to access on the reservoir side and is left open. | |
| **Seepage:** | Significant seepage in the downstream toe when reservoir level is high. Monitoring weir in toe area needs repair. | |

**Summary of Repairs Needed to Meet Forest Service Standards:**

1. **Conduct a geotechnical investigation and analysis.**
2. **Slip-line the outlet pipe with a high-density polyethylene (HDPE) pipe.**
3. **Minimize seepage through dam with a geosynthetic liner on the upstream slope.**
4. **Stabilize the downstream slope by buttressing with additional fill material.**
5. **Monitor dam for seepage after liner installation and install piezometers on embankment and downstream toe if needed.**

| Project Information | |
|---|---|
| **Name:** | Sanders Lake South Dam |
| **Location:** | Missoula County, NW ¼ Sec. 18, T15N, R18W, Lat. 47° 3' 30", Long. 113° 56' 0" |
| **Hazard Classification:** | Significant (failure would cause significant environmental damage) |
| **Type of Dam:** | Earthen embankment with rock timber crib core |
| **Construction History:** | Built 1915 |
| **Storage Capacity:** | Normal Storage 325 acre-feet; Max Storage 897 acre-feet |
| **Water Rights:** | Priority Date: August 30, 1919; Max Flow Rate: 7.54 CFS; Max Volume: 905 acre-feet |

| Location Map | Photo |
|---|---|
|  | |

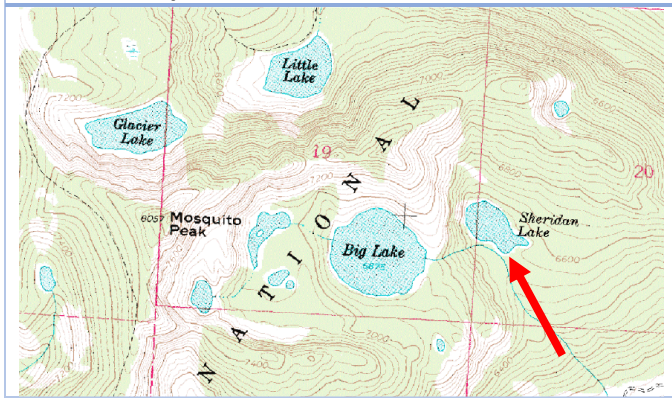
| Summary of Existing Conditions | | |
|---|---|---|
| **Embankment, Crest:** | Crest is in good condition but is narrow in places (~5 feet). Does not meet FS criteria. Vegetation needs trimming. | |
| **Embankment, Downstream Slope:** | Steep, rock lined. A bulge in the rock-lined slope is just above and to the left of the outlet. Rock had fallen from the slope. | |
| **Embankment, Upstream Slope:** | Slope and riprap are in fair condition with some wave erosion visible. Woody debris needs to be removed. |  |
| **Emergency Spillway** | See Sanders Lake North Dam. | |

| | | |
|---|---|---|
| **Low-Level Outlet:** | Video inspected in 2014. Pipe is corrugated metal (CMP) with a 5-foot PVC pipe extension on the downstream end. CMP is corroded with one hole near the upstream end. Recommend slip-lining. Control valve is left open. Valve access timber structure is gone due to ice damage. Needs to be replaced. | |
| **Seepage:** | No seepage evident. | |

**Summary of Repairs Needed to Meet Forest Service Standards:**

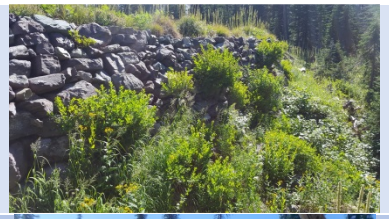
1. **Conduct a geotechnical investigation and analysis.**
2. **Slip-line the outlet pipe with a high-density polyethylene (HDPE) pipe.**
3. **Minimize seepage through dam with a geosynthetic liner on the upstream slope.**
4. **Widen the crest and stabilize the downstream slope by buttressing with additional fill material.**
5. **Monitor dam for seepage after liner installation and install piezometers on embankment and downstream toe if needed.**

| Project Information | |
|---|---|
| **Name:** | Sheridan Lake East Dam |
| **Location:** | Missoula County, SW ¼ Sec. 20, T15N, R18W, Lat. 47° 2' 30", Long. 113° 54' 42" |
| **Hazard Classification:** | Significant (failure would cause significant environmental damage) |
| **Type of Dam:** | Earthen embankment with rock timber crib core |
| **Construction History:** | Built 1915 |
| **Storage Capacity:** | Normal Storage 115 acre-feet; Max Storage 130 acre-feet |
| **Water Rights:** | Priority Date: August 30, 1919; Max Flow Rate: 431 GPM; Max Volume: 115 acre-feet |

| Location Map | Photo |
|---|---|
|  | |



| Summary of Existing Conditions | | | |
|---|---|---|---|
| **Embankment, Crest:** | In good condition. Vegetation needs trimming. Two piezometers near outlet. | | |

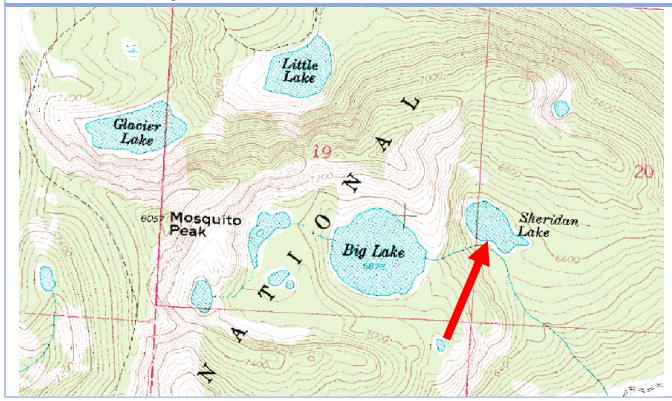
| | | |
|---|---|---|
| **Embankment, Downstream Slope:** | Steep, rock-lined. Seepage evident with high water levels, but reservoir has been kept low. |  |
| **Embankment, Upstream Slope:** | Riprap in good condition. Vegetation needs trimming. | |
| **Emergency Spillway** | Good condition. Meets FS criteria, but only for existing dams; will need enlargement when other repairs are made. Annual maintenance needed to remove logs. | |
| **Low-Level Outlet:** | Very corroded corrugated metal pipe (CMP). Many large holes. Requires full replacement. Valve access timber structure is damaged and needs repair. | |

| | | | | |
|---|---|---|---|---|
| **Seepage:** | None evident with low reservoir level, but significant seepage through embankment and downstream toe with high water levels. Monitoring weir in right downstream toe. Liner of upstream slope recommended to eliminate or reduce seepage. | | | |

**Summary of Repairs Needed to Meet Forest Service Standards:**

1. **Conduct a geotechnical investigation and analysis.**
2. **Stabilize the downstream slope by buttressing with additional fill material.**
3. **Fully replace the outlet pipe.**
4. **Minimize seepage through dam with a geosynthetic liner on the upstream slope.**
5. **Repair the outlet valve access timber structure.**
6. **Enlarge the spillway and provide for erosion protection.**
7. **Monitor dam for seepage after liner installation and install piezometers on embankment and downstream toe if needed.**

| Project Information | |
|---|---|
| **Name:** | Sheridan Lake West Dam |
| **Location:** | Missoula County, SW ¼ Sec. 20, T15N, R18W, Lat. 47° 2' 30", Long. 113° 54' 49" |
| **Hazard Classification:** | Significant (failure would cause significant environmental damage) |
| **Type of Dam:** | Earthen embankment with rock timber crib core |
| **Construction History:** | Built 1915 |
| **Storage Capacity:** | Normal Storage 115 acre-feet; Max Storage 130 acre-feet |
| **Water Rights:** | Priority Date: August 30, 1919; Max Flow Rate: 431 GPM; Max Volume: 115 acre-feet |

| Location Map | Photo |
|---|---|
|  | |



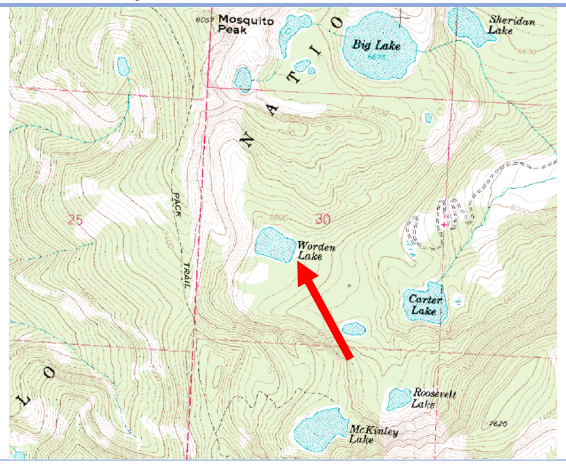
| Summary of Existing Conditions | | | |
|---|---|---|---|
| **Embankment, Crest:** | In good condition. Vegetation needs trimming. | | |

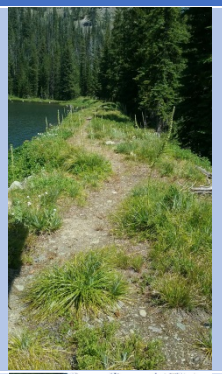
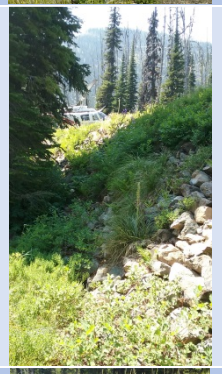
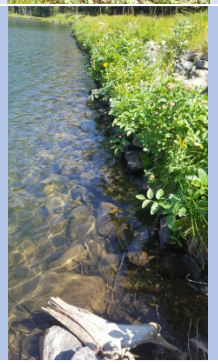
| | | |
|---|---|---|
| **Embankment, Downstream Slope:** | Steep, rock-lined. Good condition. | |
| **Embankment, Upstream Slope:** | Riprap in good condition. | |
| **Emergency Spillway** | See Sheridan Lake East Dam. | |
| **Low-Level Outlet:** | No outlet. | |
| **Seepage:** | Seepage evident in downstream toe area, even with low reservoir level. Possible source is nearby creek, which is outflow from Big Lake. | |

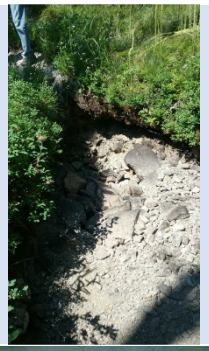
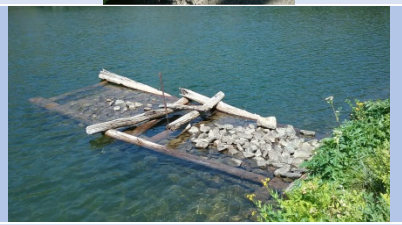
**Summary of Repairs Needed to Meet Forest Service Standards:**

1. **Conduct a geotechnical investigation and analysis.**
2. **Widen the crest and stabilize the downstream slope by buttressing with additional fill material.**
3. **Minimize seepage through dam with a geosynthetic liner on the upstream slope.**
4. **Monitor dam for seepage after liner installation and install piezometers on embankment and downstream toe if needed.**

| Project Information | |
|---|---|
| **Name:** | Worden Lake Dam |
| **Location:** | Missoula County, SW ¼ Sec. 30, T15N, R18W, Lat. 47° 1' 42", Long. 113° 55' 36" |
| **Hazard Classification:** | Significant (failure would cause significant environmental damage) |
| **Type of Dam:** | Earthen embankment. Core material unknown. |
| **Construction History:** | Built 1921 |
| **Storage Capacity:** | Normal Storage 43 acre-feet; Max Storage 70 acre-feet |
| **Water Rights:** | Priority Date: September 8, 1923; Max Flow Rate: 398 GPM; Max Volume: 104 acre-feet |

| Location Map | Photo |
|---|---|
|  | |

| Summary of Existing Conditions | | | |
|---|---|---|---|
| **Embankment, Crest:** | In good condition. Vegetation needs trimming. One piezometer near outlet that is monitored. | |  |
| **Embankment, Downstream Slope:** | Steep, rock-lined. No signs of instability or seepage. | |  |
| **Embankment, Upstream Slope:** | Riprap in good condition. Vegetation needs trimming. | |  |

| | | |
|---|---|---|
| **Emergency Spillway** | There is a headcut approximately 200 feet downstream from the reservoir that is being monitored. Meets FS criteria but only as an existing spillway; it would have to be enlarged with any other repair on the dam. Annual maintenance needed to remove logs. |  |
| **Low-Level Outlet:** | Outlet video not available. However, it is of the same vintage as other dams and likely needs repair/replacement. For this document, assume slip-line repair. Valve access timber structure is damaged and needs repair. |  |
| **Seepage:** | None evident. Small puddle at outlet but no flowing seepage observed. | |

**Summary of Repairs Needed to Meet Forest Service Standards:**

1. **Conduct a geotechnical investigation and analysis.**
2. **Slip-line the outlet pipe with a high-density polyethylene (HDPE) pipe.**
3. **Minimize seepage through dam with a geosynthetic liner on the upstream slope.**
4. **Stabilize the downstream slope by buttressing with additional fill material.**
5. **Enlarge the spillway and provide for enhanced erosion control.**
6. **Repair the outlet valve access timber structure.**
7. **Monitor dam for seepage after liner installation and install piezometers on embankment and downstream toe if needed.**

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# Appendix N

# Special Use Permit

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A-6943

Authorization ID: **MIS331**
Contact Name: **CITY OF MISSOULA**
Expiration Date: **12/31/2036**
Use Codes: **922, 753**

FS-2700-4 (V.01/2014)
OMB 0596-0082

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE SPECIAL USE PERMIT
Authority:
FEDERAL LAND POLICY AND MGMT ACT, AS AMENDED October 21, 1976

CITY OF MISSOULA of 435 RYMAN MISSOULA, MT 59802 (hereinafter "the holder") is authorized to use and occupy National Forest System lands in the LOLO NATIONAL FOREST of the National Forest System, subject to the terms and conditions of this special use permit (the permit).

This permit covers **22 flooded acres and 3.14 miles of road** as described in the Legal Descriptions and Maps in Exhibit B, for the purposes of **1) Operating and Maintaining five (5) existing dams and associated flood areas to impound and store waters, and (2) Maintaining and using existing roads and trails for access to the water storage sites.**

TERMS AND CONDITIONS

I. GENERAL TERMS

A. AUTHORITY. This permit is issued pursuant to FLPMA and 36 CFR Part 251, Subpart B, as amended, and is subject to their provisions.

B. AUTHORIZED OFFICER. The authorized officer is the Forest Supervisor or a subordinate officer with delegated authority.

C. TERM. This permit shall expire at midnight on **12/31/2036**, approximately 20 years from the date of issuance.

D. RENEWAL. This permit is not renewable. Prior to expiration of this permit, the holder may apply for a new permit that would renew the use and occupancy authorized by this permit. Applications for a new permit must be submitted at least 6 months prior to expiration of this permit. Renewal of the use and occupancy authorized by this permit shall be at the sole discretion of the authorized officer. At a minimum, before renewing the use and occupancy authorized by this permit, the authorized officer shall require that (1) the use and occupancy to be authorized by the new permit is consistent with the standards and guidelines in the applicable land management plan; (2) the type of use and occupancy to be authorized by the new permit is the same as the type of use and occupancy authorized by this permit; and (3) the holder is in compliance with all the terms of this permit. The authorized officer may prescribe new terms and conditions when a new permit is issued.

E. AMENDMENT. This permit may be amended in whole or in part by the Forest Service when, at the discretion of the authorized officer, such action is deemed necessary or desirable to incorporate new terms that may be required by law, regulation, directive, the applicable forest land and resource management plan, or projects and activities implementing a land management plan pursuant to 36 CFR Part 215.

F. COMPLIANCE WITH LAWS, REGULATIONS, AND OTHER LEGAL REQUIREMENTS. In exercising the rights and privileges granted by this permit, the holder shall comply with all present and future federal laws and regulations and all present and future state, county, and municipal laws, regulations, and other legal requirements that apply to the permit area, to the extent they do not conflict with federal law, regulation, or policy. The Forest Service assumes no responsibility for enforcing laws, regulations, and other legal requirements that fall under the jurisdiction of other governmental entities.

G. NON-EXCLUSIVE USE. The use or occupancy authorized by this permit is not exclusive. The Forest Service reserves the right of access to the permit area, including a continuing right of physical entry to the permit area for inspection, monitoring, or any other purpose consistent with any right or obligation of the United States under any law or regulation. The Forest Service reserves the right to allow others to use the permit area in any way that is not inconsistent with the holder's rights and privileges under this permit, after consultation with all parties involved. Except for any restrictions that the holder and the authorized officer agree are necessary to protect the installation and operation of authorized temporary improvements, the lands and waters covered by this permit shall remain open to the public for all lawful purposes.

H. ASSIGNABILITY. This permit is not assignable or transferable.

I. TRANSFER OF TITLE TO THE IMPROVEMENTS.

1. Notification of Transfer. The holder shall notify the authorized officer when a transfer of title to all or part of the authorized improvements is contemplated.

2. Transfer of Title. Any transfer of title to the improvements covered by this permit shall result in termination of the permit. The party who acquires title to the improvements must submit an application for a permit. The Forest Service is not obligated to issue a new permit to the party who acquires title to the improvements. The authorized officer shall determine that the applicant meets requirements under applicable federal regulations.

II.IMPROVEMENTS

A. LIMITATIONS ON USE. Nothing in this permit gives or implies permission to build or maintain any structure or facility or to conduct any activity, unless specifically authorized by this permit. Any use not specifically authorized by this permit must be proposed in accordance with 36 CFR 251.54. Approval of such a proposal through issuance of a new permit or permit amendment is at the sole discretion of the authorized officer.

B. PLANS. All plans for development, layout, construction, reconstruction, or alteration of improvements in the permit area, as well as revisions to those plans must be prepared by a professional engineer, architect, landscape architect, or other qualified professional based on federal employment standards acceptable to the authorized officer. These plans and plan revisions must have written approval from the authorized officer before they are implemented. The authorized officer may require the holder to furnish as-built plans, maps, or surveys upon completion of the work.

C. CONSTRUCTION. Any construction authorized by this permit shall commence by Not Applicable (N/A) and shall be completed by N/A.

III. OPERATIONS.

A. PERIOD OF USE. Use or occupancy of the permit area shall be exercised at least 365 days each year.

B. CONDITION OF OPERATIONS. The holder shall maintain the authorized improvements and permit area to standards of repair, orderliness, neatness, sanitation, and safety acceptable to the authorized officer and consistent with other provisions of this permit. Standards are subject to periodic change by the authorized officer when deemed necessary to meet statutory, regulatory, or policy requirements or to protect national forest resources. The holder shall comply with inspection requirements deemed appropriate by the authorized officer.

C. OPERATING PLAN. The **holder shall prepare and annually revise by June 1 an Operating and Maintenance Plan**. The operating plan shall be prepared in consultation with the authorized officer or the authorized officer's designated representative and shall cover all operations authorized by this permit. The operating plan shall outline steps the holder will take to protect public health and safety and the environment and shall include sufficient detail and standards to enable the Forest Service to monitor the holder's operations for compliance with the terms and conditions of this permit. The operating plan shall be submitted by the holder and approved by the authorized officer or the authorized officer's designated representative prior to commencement of operations and shall be attached to this permit as an appendix. The authorized officer may require an annual meeting with the holder to discuss the terms and conditions of the permit or operating plan, annual use reports, or other concerns either party may have.

D. INSPECTION BY THE FOREST SERVICE. The Forest Service shall monitor the holder's operations and reserves the right to inspect the permit area and transmission facilities at any time for compliance with the terms of this permit. The holder's obligations under this permit are not contingent upon any duty of the Forest Service to inspect the permit area or transmission facilities. A failure by the Forest Service or other governmental officials to inspect is not a justification for noncompliance with any of the terms and conditions of this permit.

IV. RIGHTS AND LIABILITIES

A. LEGAL EFFECT OF THE PERMIT. This permit, which is revocable and terminable, is not a contract or a lease, but rather a federal license. The benefits and requirements conferred by this authorization are reviewable solely under the procedures set forth in 36 CFR 251, Subpart C and 5 U.S.C. 704. This permit

does not constitute a contract for purposes of the Contract Disputes Act, 41 U.S.C. 601. The permit is not real property, does not convey any interest in real property, and may not be used as collateral for a loan.

B. VALID OUTSTANDING RIGHTS. This permit is subject to all valid outstanding rights. Valid outstanding rights include those derived under mining and mineral leasing laws of the United States. The United States is not liable to the holder for the exercise of any such right.

C. ABSENCE OF THIRD-PARTY BENEFICIARY RIGHTS. The parties to this permit do not intend to confer any rights on any third party as a beneficiary under this permit.

D. SERVICES NOT PROVIDED. This permit does not provide for the furnishing of road or trail maintenance, water, fire protection, search and rescue, or any other such service by a government agency, utility, association, or individual.

E. RISK OF LOSS. The holder assumes all risk of loss associated with use or occupancy of the permit area, including but not limited to theft, vandalism, fire and any fire-fighting activities (including prescribed burns), avalanches, rising waters, winds, falling limbs or trees, and other forces of nature. If authorized temporary improvements in the permit area are destroyed or substantially damaged, the authorized officer shall conduct an analysis to determine whether the improvements can be safely occupied in the future and whether rebuilding should be allowed. If rebuilding is not allowed, the permit shall terminate.

F. DAMAGE TO UNITED STATES PROPERTY. The holder has an affirmative duty to protect from damage the land, property, and other interests of the United States. Damage includes but is not limited to fire suppression costs, damage to government-owned improvements covered by this permit, and all costs and damages associated with or resulting from the release or threatened release of a hazardous material occurring during or as a result of activities of the holder or the holder's heirs, assigns, agents, employees, contractors, or lessees on, or related to, the lands, property, and other interests covered by this permit. For purposes of clause IV.F and section V, "hazardous material" shall mean (a) any hazardous substance under section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. § 9601(14); (b) any pollutant or contaminant under section 101(33) of CERCLA, 42 U.S.C. § 9601(33); (c) any petroleum product or its derivative, including fuel oil, and waste oils; and (d) any hazardous substance, extremely hazardous substance, toxic substance, hazardous waste, ignitable, reactive or corrosive materials, pollutant, contaminant, element, compound, mixture, solution or substance that may pose a present or potential hazard to human health or the environment under any applicable environmental laws.

1. The holder shall avoid damaging or contaminating the environment, including but not limited to the soil, vegetation (such as trees, shrubs, and grass), surface water, and groundwater, during the holder's use or occupancy of the permit area. If the environment or any government property covered by this permit becomes damaged during the holder's use or occupancy of the permit area, the holder shall immediately repair the damage or replace the damaged items to the satisfaction of the authorized officer and at no expense to the United States.

2. The holder shall be liable for all injury, loss, or damage, including fire suppression, prevention and control of the spread of invasive species, or other costs in connection with rehabilitation or restoration of natural resources associated with the use or occupancy authorized by this permit. Compensation shall include but not be limited to the value of resources damaged or destroyed, the costs of restoration, cleanup, or other mitigation, fire suppression or other types of abatement costs, and all administrative, legal (including attorney's fees), and other costs. Such costs may be deducted from a performance bond required under clause IV.I.

3. The holder shall be liable for damage caused by use of the holder or the holder's heirs, assigns, agents, employees, contractors, or lessees to all roads and trails of the United States to the same extent as provided under clause IV.F.1, except that liability shall not include reasonable and ordinary wear and tear.

G. HEALTH, SAFETY, AND ENVIRONMENTAL PROTECTION. The holder shall promptly abate as completely as possible and in compliance with all applicable laws and regulations any activity or condition arising out of or relating to the authorized use or occupancy that causes or threatens to cause a hazard to public health or the safety of the holder's employees or agents or harm to the environment (including areas of vegetation or timber, fish or other wildlife populations, their habitats, or any other natural resources). The holder shall prevent impacts to the environment and cultural resources by implementing actions identified in the operating plan to prevent establishment and spread of invasive species. The holder shall immediately notify the authorized officer of all serious accidents that occur in connection with such activities. The responsibility to protect the health and safety of all persons affected by the use or occupancy authorized by this permit is solely that of the holder. The Forest Service has no duty under the terms of this permit to inspect the permit area or operations and activities of the holder for hazardous conditions or compliance with health and safety standards.

H. INDEMNIFICATION OF THE UNITED STATES. The holder shall indemnify, defend, and hold harmless the United States for any costs, damages, claims, liabilities, and judgments arising from past, present, and future acts or omissions of the holder in connection with the use or occupancy authorized by this permit. This indemnification provision includes but is not limited to acts and omissions of the holder or the holder's heirs, assigns, agents, employees, contractors, or lessees in connection with the use or occupancy authorized by this permit which result in (1) violations of any laws and regulations which are now or which may in the future become applicable, and including but not limited to those environmental laws listed in clause V.A of this permit; (2) judgments, claims, demands, penalties, or fees assessed against the United States; (3) costs, expenses, and damages incurred by the United States; or (4) the release or threatened release of any solid waste, hazardous waste, hazardous materials, pollutant, contaminant, oil in any form, or petroleum product into the environment. The authorized officer may prescribe terms that allow the holder to replace, repair, restore, or otherwise undertake necessary curative actions to mitigate damages in addition to or as an alternative to monetary indemnification.

I. BONDING. The authorized officer may require the holder to furnish a surety bond or other security for any of the obligations imposed by the terms and conditions of this permit or any applicable law, regulation, or order.

J. STRICT LIABILITY. The holder shall be strictly liable (liable without proof of negligence) to the United States for $1 million per occurrence for any injury, loss, or damage arising in tort under this permit. Liability in tort for injury, loss, or damage to the United States exceeding the prescribed amount of strict liability in tort shall be determined under the law of negligence.

K. INSURANCE. The holder shall furnish proof of insurance, such as a certificate of insurance, to the authorized officer prior to issuance of this permit and each year thereafter that this permit is in effect. The Forest Service reserves the right to review and approve the insurance policy prior to issuance. The holder shall send an authenticated copy of any insurance policy obtained pursuant to this clause to the authorized officer immediately upon issuance of the policy. Any insurance policies obtained by the holder pursuant to this clause shall name the United States as an additional insured, and the additional insured provision shall provide for insurance coverage for the United States as required under this clause. Such policies also shall specify that the insurance company shall give 30 days prior written notice to the authorized officer of cancellation of or any modification to the policies. The certificate of insurance, the authenticated copy of the insurance policy, and written notice of cancellation or modification of insurance policies should be sent to Missoula Ranger District, Attn: Lands Special Uses, 24 Fort Missoula Road, Missoula, MT 59804. Minimum amounts of coverage and other insurance requirements are subject to change at the sole discretion of the authorized officer on the anniversary date of this permit.

1. The holder shall have in force liability insurance covering losses, including those associated with strict liability, or associated with the use or occupancy authorized by this permit arising from personal injury or death and third-party property damage in the minimum amount of $1 million as a combined single limit per occurrence.

2. Depending on the holder's operations, the Forest Service may require the holder to demonstrate the availability of funds to address any release or threatened release of hazardous materials that may occur in connection with the holder's use or occupancy. Any requirements imposed would be established on a case-by-case basis by the authorized officer based on the degree of environmental risk from the holder's operations. The storage and use of normal maintenance supplies in nominal amounts generally would not trigger financial assurance requirements.

V. RESOURCE PROTECTION

A. COMPLIANCE WITH ENVIRONMENTAL LAWS. The holder shall in connection with the use or occupancy authorized by this permit comply with all applicable federal, state, and local environmental laws and regulations, including but not limited to those established pursuant to the Resource Conservation and Recovery Act, as amended, 42 U.S.C. 6901 et seq., the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1251 et seq., the Oil Pollution Act, as amended, 33 U.S.C. 2701 et seq., the Clean Air Act, as amended, 42 U.S.C. 7401 et seq., CERCLA, as amended, 42 U.S.C. 9601 et seq., the Toxic Substances Control Act, as amended, 15 U.S.C. 2601 et seq., the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, 7 U.S.C. 136 et seq., and the Safe Drinking Water Act, as amended, 42 U.S.C. 300f et seq.

B. VANDALISM. The holder shall take reasonable measures to prevent and discourage vandalism and disorderly conduct and when necessary shall contact the appropriate law enforcement officer.

C. PESTICIDE USE. Pesticides may not be used outside of buildings to control undesirable woody and herbaceous vegetation (including aquatic plants), insects, rodents, fish, and other pests and weeds without prior written approval from the authorized officer. A request for approval of planned uses of pesticides shall be submitted annually by the holder on the due date established by the authorized officer. The report shall cover a 12-month period of planned use beginning 3 months after the reporting date. Information essential for review shall be provided in the form specified. Exceptions to this schedule may be allowed, subject to emergency request and approval, only when unexpected outbreaks of pests or weeds require control measures that were not anticipated at the time an annual report was submitted. Only those materials registered by the U.S. Environmental Protection Agency for the specific purpose planned shall be considered for use on National Forest System lands. Label instructions and all applicable laws and regulations shall be strictly followed in the application of pesticides and disposal of excess materials and containers.

D. ARCHAEOLOGICAL-PALEONTOLOGICAL DISCOVERIES. The holder shall immediately notify the authorized officer of all antiquities or other objects of historic or scientific interest, including but not limited to historic or prehistoric ruins, fossils, or artifacts discovered in connection with the use and occupancy authorized by this permit. The holder shall leave these discoveries intact and in place until directed otherwise by the authorized officer. Protective and mitigative measures specified by the authorized officer shall be the responsibility of the holder.

E. NATIVE AMERICAN GRAVES PROTECTION AND REPATRIATION. In accordance with 25 U.S.C. 3002(d) and 43 CFR 10.4, if the holder inadvertently discovers human remains, funerary objects, sacred objects, or objects of cultural patrimony on National Forest System lands, the holder shall immediately cease work in the area of the discovery and shall make a reasonable effort to protect and secure the items. The holder shall immediately notify the authorized officer by telephone of the discovery and shall follow up with written confirmation of the discovery. The activity that resulted in the inadvertent discovery may not resume until 30 days after the authorized officer certifies receipt of the written confirmation, if resumption of the activity is otherwise lawful, or at any time if a binding written agreement has been executed between the Forest Service and the affiliated Indian tribes that adopts a recovery plan for the human remains and objects.

F. PROTECTION OF HABITAT OF THREATENED, ENDANGERED, AND SENSITIVE SPECIES. The location of sites within the permit area needing special measures for protection of plants or animals listed as threatened or endangered under the Endangered Species Act (ESA) of 1973, 16 U.S.C. 1531 et seq., as amended, or identified as sensitive or otherwise requiring special protection by the Regional Forester under Forest Service Manual (FSM) 2670, pursuant to consultation conducted under section 7 of the ESA, may be shown on the ground or on a separate map. The map shall be attached to this permit as an appendix. The holder shall take any protective and mitigative measures specified by the authorized officer. If protective and mitigative measures prove inadequate, if other sites within the permit area containing threatened, endangered, or sensitive species or species otherwise requiring special

protection are discovered, or if new species are listed as threatened or endangered under the ESA or identified as sensitive or otherwise requiring special protection by the Regional Forester under the FSM, the authorized officer may specify additional protective and mitigative measures. Discovery of these sites by the holder or the Forest Service shall be promptly reported to the other party.

G. CONSENT TO STORE HAZARDOUS MATERIALS. The holder shall not store any hazardous materials at the site without prior written approval from the authorized officer. This approval shall not be unreasonably withheld. If the authorized officer provides approval, this permit shall include, or in the case of approval provided after this permit is issued, shall be amended to include specific terms addressing the storage of hazardous materials, including the specific type of materials to be stored, the volume, the type of storage, and a spill plan. Such terms shall be proposed by the holder and are subject to approval by the authorized officer.

H. CLEANUP AND REMEDIATION

1. The holder shall immediately notify all appropriate response authorities, including the National Response Center and the authorized officer or the authorized officer's designated representative, of any oil discharge or of the release of a hazardous material in the permit area in an amount greater than or equal to its reportable quantity, in accordance with 33 CFR Part 153, Subpart B, and 40 CFR Part 302. For the purposes of this requirement, "oil" is as defined by section 311(a)(1) of the Clean Water Act, 33 U.S.C. 1321(a)(1). The holder shall immediately notify the authorized officer or the authorized officer's designated representative of any release or threatened release of any hazardous material in or near the permit area which may be harmful to public health or welfare or which may adversely affect natural resources on federal lands.

2. Except with respect to any federally permitted release as that term is defined under Section 101(10) of CERCLA, 42 U.S.C. 9601(10), the holder shall clean up or otherwise remediate any release, threat of release, or discharge of hazardous materials that occurs either in the permit area or in connection with the holder's activities in the permit area, regardless of whether those activities are authorized under this permit. The holder shall perform cleanup or remediation immediately upon discovery of the release, threat of release, or discharge of hazardous materials. The holder shall perform the cleanup or remediation to the satisfaction of the authorized officer and at no expense to the United States. Upon revocation or termination of this permit, the holder shall deliver the site to the Forest Service free and clear of contamination.

I. CERTIFICATION UPON REVOCATION OR TERMINATION. If the holder uses or stores hazardous materials at the site, upon revocation or termination of this permit the holder shall provide the Forest Service with a report certified by a professional or professionals acceptable to the Forest Service that the permit area is uncontaminated by the presence of hazardous materials and that there has not been a release or discharge of hazardous materials upon the permit area, into surface water at or near the permit area, or into groundwater below the permit area during the term of the permit. This certification requirement may be waived by the authorized officer when the Forest Service determines that the risks

posed by the hazardous material are minimal. If a release or discharge has occurred, the professional or professionals shall document and certify that the release or discharge has been fully remediated and that the permit area is in compliance with all federal, state, and local laws and regulations.

VI. LAND USE FEE AND ACCOUNTING ISSUES

A. LAND USE FEES. The use or occupancy authorized by this permit is exempt from a land use fee or the **land use fee has been waived in full** pursuant to 36 CFR 251.57 and Forest Service Handbook 2709.11, Chapter 30.

B. MODIFICATION OF THE LAND USE FEE. The land use fee may be revised whenever necessary to reflect the market value of the authorized use or occupancy or when the fee system used to calculate the land use fee is modified or replaced.

C. FEE PAYMENT ISSUES.

1. Crediting of Payments. Payments shall be credited on the date received by the deposit facility, except that if a payment is received on a non-workday, the payment shall not be credited until the next workday.

2. Disputed Fees. Fees are due and payable by the due date. Disputed fees must be paid in full. Adjustments will be made if dictated by an administrative appeal decision, a court decision, or settlement terms.

3. Late Payments

(a) Interest. Pursuant to 31 U.S.C. 3717 et seq., interest shall be charged on any fee amount not paid within 30 days from the date it became due. The rate of interest assessed shall be the higher of the Prompt Payment Act rate or the rate of the current value of funds to the Treasury (i.e., the Treasury tax and loan account rate), as prescribed and published annually or quarterly by the Secretary of the Treasury in the Federal Register and the Treasury Fiscal Requirements Manual Bulletins. Interest on the principal shall accrue from the date the fee amount is due.

(b) Administrative Costs. If the account becomes delinquent, administrative costs to cover processing and handling the delinquency shall be assessed.

(c) Penalties. A penalty of 6% per annum shall be assessed on the total amount that is more than 90 days delinquent and shall accrue from the same date on which interest charges begin to accrue.

(d) Termination for Nonpayment. This permit shall terminate without the necessity of prior notice and opportunity to comply when any permit fee payment is 90 calendar days from the due date in arrears. The holder shall remain responsible for the delinquent fees.

4. Administrative Offset and Credit Reporting. Delinquent fees and other charges associated with the permit shall be subject to all rights and remedies afforded the United States pursuant to 31 U.S.C. 3711 et seq. and common law. Delinquencies are subject to any or all of the following:

(a) Administrative offset of payments due the holder from the Forest Service.

(b) If in excess of 60 days, referral to the Department of the Treasury for appropriate collection action as provided by 31 U.S.C. 3711(g)(1).

(c) Offset by the Secretary of the Treasury of any amount due the holder, as provided by 31 U.S.C. 3720 et seq.

(d) Disclosure to consumer or commercial credit reporting agencies.

VII. REVOCATION, SUSPENSION, AND TERMINATION

A. REVOCATION AND SUSPENSION. The authorized officer may revoke or suspend this permit in whole or in part:

1. For noncompliance with federal, state, or local law.

2. For noncompliance with the terms of this permit.

3. For abandonment or other failure of the holder to exercise the privileges granted.

4. With the consent of the holder.

5. For specific and compelling reasons in the public interest.

Prior to revocation or suspension, other than immediate suspension under clause VII.B, the authorized officer shall give the holder written notice of the grounds for revocation or suspension. In the case of revocation or suspension based on clause VII.A.1, 2, or 3, the authorized officer shall give the holder a reasonable time, typically not to exceed 90 days, to cure any noncompliance.

B. IMMEDIATE SUSPENSION. The authorized officer may immediately suspend this permit in whole or in part when necessary to protect public health or safety or the environment. The suspension decision shall be in writing. The holder may request an on-site review with the authorized officer's supervisor of the adverse conditions prompting the suspension. The authorized officer's supervisor shall grant this request within 48 hours. Following the on-site review, the authorized officer's supervisor shall promptly affirm, modify, or cancel the suspension.

C. APPEALS AND REMEDIES. Written decisions by the authorized officer relating to administration of this

permit are subject to administrative appeal pursuant to 36 CFR Part 214 as amended. Revocation or suspension of this permit shall not give rise to any claim for damages by the holder against the Forest Service.

D. TERMINATION. This permit shall terminate when by its terms a fixed or agreed upon condition, event, or time occurs without any action by the authorized officer. Examples include but are not limited to expiration of the permit by its terms on a specified date and termination upon change of control of the business entity. Termination of this permit shall not require notice, a decision document, or any environmental analysis or other documentation. Termination of this permit is not subject to administrative appeal and shall not give rise to any claim for damages by the holder against the Forest Service.

E. RIGHTS AND RESPONSIBILITIES UPON REVOCATION OR TERMINATION WITHOUT RENEWAL. Upon revocation or termination of this permit without renewal of the authorized use, the holder shall remove all structures and improvements, except those owned by the United States, within a reasonable period prescribed by the authorized officer and shall restore the site to the satisfaction of the authorized officer. If the holder fails to remove all structures and improvements within the prescribed period, they shall become the property of the United States and may be sold, destroyed, or otherwise disposed of without any liability to the United States. However, the holder shall remain liable for all costs associated with their removal, including costs of sale and impoundment, cleanup, and restoration of the site.

VIII. MISCELLANEOUS PROVISIONS

A. MEMBERS OF CONGRESS. No member of or delegate to Congress or resident commissioner shall benefit from this permit either directly or indirectly, except to the extent the authorized use provides a general benefit to a corporation.

B. CURRENT ADDRESSES. The holder and the Forest Service shall keep each other informed of current mailing addresses, including those necessary for billing and payment of land use fees.

C. SUPERSEDED PERMIT. This permit supersedes a special use permit designated MOUNTAIN WATER COMPANY, MIS36, dated 11/12/2002.

D. SUPERIOR CLAUSES. If there is a conflict between any of the preceding printed clauses and any of the following clauses, the preceding printed clauses shall control.

E. Continuous Minimum Flow (R1-D3). The holder shall assure that the discharge from the project area is a continuous, minimum flow pursuant to state water rights, as measured immediately below the point of proposed diversion. No diversion of water will be permitted contrary to state water rights. To maintain channel competence, the holder shall release flows during the peak runoff period with accordance with the release schedule pursuant to state water rights.

F. Noxious Weed/Exotic Plant Prevention and Control (R1-D4). The holder shall be responsible for the prevention and control of noxious weeds and/or exotic plants of concern on the area authorized by this

authorization and shall provide prevention and control measures prescribed by the Forest Service. Noxious weeds/exotic plants of concern are defined as those species recognized by Missoula County Weed District and Lolo National Forest in which the authorized use is located.

The holder shall also be responsible for prevention and control of noxious weed/exotic plant infestations which are not within the authorized area, but which are determined by the Forest Service to have originated with the authorized area.

When determined to be necessary by the authorized officer, the holder shall develop a site-specific plan for noxious weed/exotic plant prevention and control. Such plan shall be subject to Forest Service approval. Upon Forest service approval, the noxious weed/exotic plant prevention and control plan shall become a part of this authorization, and its provisions shall be enforceable under the terms of this authorization.

G. Reservoir and Dam Operation and Maintenance Plan (R1-X1). The holder shall prepare and revise annually as needed by May 1 an Operation and Maintenance Plan to be submitted to the District Ranger for approval. The plan shall consist of at least the following sections:

1. Water storage and releases, including dates and/or criteria for filling and release. Storage limitations, if any, will be clearly stated.
2. Procedures for flood conditions.
3. Inspection and safety requirements.
4. Erosion prevention in reservoir area and spillway channel.
5. Trash and debris removal.
6. Maintenance requirements based on latest inspection report.
7. Date of plan or revision and holder's and District Ranger's signatures.

Provisions of the approved plan and revisions shall become a part of this authorization.

H. Grizzly Bear Protection (R1-X10). This special-use authorization includes land which is part of the habitat of the grizzly bear. Therefore, in compliance with Forest Service responsibilities under the Endangered Species Act of 1973, 16 U.S.C. 1531, the following conditions apply to this special-use authorization:

1. The authorized officer may order an immediate temporary suspension of all human activities permitted by this authorization and, if needed, suspend or revoke the special-use authorization when, in his/her judgment, such action is necessary in order to prevent confrontation or conflict between humans and grizzly bears. The holder shall immediately comply with such order. The United States shall not be liable for any consequences from such a suspension or revocation. Such suspension or revocation may be appealed to the next higher level as provided in 36 CFR Parts 200 to 299.

2. The holder, his/her agents, employees, contractors and subcontractors will comply with the requirements of the attached Grizzly Bear Management and Protection Plan dated in the

conduct of any and all activities authorized. The authorized officer may review and revise the plan as needed.

3. The holder assumes full responsibility and shall hold the United States harmless from any and all claims by him/her or by third parties for any damages to life or property arising from the activities authorized by this special-use authorization and encounters with grizzly bears, or from suspension, revocation, or termination of activities authorized by this special-use authorization.

4. Intentional or negligent acts by the holder, his/her agents, employees, contractors and subcontractors that result in injury or death of a grizzly bear will be cause for suspension or revocation of this authorization in whole or in part.

5. Failure to comply with provisions 1, 2 or 3 may result in suspension or revocation of this authorization in whole or in part, and may cause criminal action to be taken against the holder under provisions of the Endangered Species Act of 1973, as amended, or other applicable authority.

I. Forest Service Representative (R1-X16). The District Ranger, Missoula Ranger District, Telephone No. 329-3814, is responsible for administering this special-use authorization. The holder should contact the District Ranger regarding any questions concerning the occupancy and use authorized and the provisions of this authorization.

J. Information from Holders (R1-X17). As a condition of this authorization, the holder is responsible for providing the authorized officer with any information in possession necessary for determining annual rental fees, ownership, or other matters concerning the administration of the authorized use by the Forest Service.

Regarding the submission of such information, the holder understands that it is a crime for any person to knowingly and willfully make false, fictitious, or fraudulent statements to matters under the jurisdiction of the United States Government (Title 18, U.S.C. Section 1001).

K. B-36. DAM SAFETY (Includes B-37 language)

1. The holder shall comply with all State standards and regulations pertaining to dam safety in the State of Montana. Unless stated otherwise in a memorandum of understanding (MOU) or equivalent instrument between the State of Montana and the Forest Service, the Forest Service has a role in enforcing applicable State of Montana dam safety regulations within the permit area. Applicable MOUs regarding safety of the improvements authorized by this permit shall apply.

2. Definitions. The following definitions apply to this clause:

Canal. A linear water conveyance structure of varying capacity that is usually lined and that is constructed to specified engineering standards.

Dam. Any artificial barrier, including appurtenant works, that impounds or diverts water, either temporarily or long term, but not including a facility that is 6 feet or less in height or that impounds no more than 15 acre feet of water, unless the facility poses a significant hazard to occupied facilities, structures, recreation areas, or travel routes downstream.

Dam Failure. The catastrophic breakdown or breach of a dam characterized by the sudden, rapid, and uncontrolled release of water.

Emergency Action Plan. A document that identifies potential emergency conditions at a dam and specifies preplanned actions to be followed to minimize property damage and loss of life should a dam failure occur, including:

a. Actions the owner of the dam must take to moderate or alleviate problems at the dam;

b. Procedures and information regarding issuance of early warning and notification of an emergency to responsible emergency management authorities; and

c. Inundation maps displaying critical areas for action by responsible emergency management authorities in case of an emergency (see FEMA Publication 64).

Hazard Assessment Classification. A system that categorizes dams according to the severity of consequences resulting from their failure or misoperation and that in no way reflects on their current condition (for example, their safety, structural integrity, or flood routing capacity).

a. Low. A classification that includes dams whose failure, malfunction, or misoperation would result in no loss of human life and minor damages limited to undeveloped or agricultural lands and for which significant improvements are not planned in the foreseeable future.

b. **Significant**. A classification that includes dams whose failure, malfunction, or misoperation would result in no probable loss of human life but could cause economic loss, disruption of lifeline facilities, or other significant impacts and dams whose failure would result in non-recoverable damage.

c. High. A classification that includes dams whose failure, malfunction, or misoperation would likely result in loss of human life.

3. Construction, Inspection, Certification, and Project Files. The holder shall ensure that any construction, rehabilitation, or modification of the authorized dam shall be inspected by a qualified engineer. At a minimum, the qualified engineer shall maintain a daily inspection diary, descriptions of design changes, and records of construction material and foundation tests for any construction, rehabilitation, or modification of the dam. Upon completion of the construction, rehabilitation, modification, the holder shall provide to the Authorized Officer

written certification from the qualified engineer that the work was performed in accordance with the approved plans and specifications. No water shall be impounded without prior written approval from the Authorized Officer. The holder shall maintain in a project file for the term of this permit all design notes, as-built drawings, and documentation produced by the qualified engineer and shall make the project file available to the Forest Service, other inspection personnel, and other Federal agencies authorized to review Forest Service activities.

4. Operating and Maintenance Plan. This clause supplements the standard operating plan clause in the permit. ~~The operating plan for a new dam shall be prepared during the design phase.~~ At a minimum, the operating and maintenance plan shall specify required operating procedures; routine maintenance; record-keeping for operation and maintenance; and those responsible for implementing the operating plan. When an operation and maintenance inspection of the dam is conducted, the operating and maintenance plan shall be reviewed and amended as needed by those responsible for implementing the operating plan and the qualified engineer performing the inspection.

5. Inspection and Maintenance. The holder shall have operation and maintenance (O&M) inspections of the dam and appurtenant structures conducted in accordance with the following table.

**DAM INSPECTIONS**

| Hazard Assessment Classification | Inspection Type | Inspection Frequency | Level of Expertise Required |
|---|---|---|---|
| LOW | O&M | 10 years | Qualified Engineer |
| | Hazard Assessment | 10 years* | Qualified Engineer |
| | Special | ** | Qualified Engineer |
| | | | |
| **SIGNIFICANT** | **O&M** | **5 years** | **Qualified Engineer** |
| | **Hazard Assessment** | **5 years*** | **Qualified Engineer** |
| | Special | ** | Qualified Engineer |
| | | | |
| HIGH | O&M | 1 year | Qualified Engineer*** |
| | Safety | 5 year | Qualified Engineer |
| | Special | ** | Qualified Engineer |

* Perform hazard assessments more frequently if increased downstream development is observed.

** A special inspection must be performed by a qualified engineer.

*** A qualified engineer must review and approve in writing the annual O&M inspection reports for dams with a high hazard assessment classification. At a minimum, the annual on-site inspection must be completed by someone familiar with the operation of the dam.

O&M inspections shall be reviewed by a qualified engineer. Special inspections shall be performed by a qualified engineer immediately after any dam has experienced an unusual event, such as a large flood, a first filling, an earthquake, or an act of terrorism. All

O&M inspections shall be documented in a report. Two copies of each inspection report shall be provided to the Authorized Officer within 30 days of the date of inspection.

Repairs or operational changes recommended by the inspecting or reviewing engineer shall be made by the holder within 1 year from the date of inspection, unless a longer period is approved by the Authorized Officer in writing or a shorter period is deemed required by the Authorized Officer for reasons of public safety. Upon request by the Authorized Officer, the holder shall provide a plan outlining the methods and schedule for performing the repairs or operational changes and shall notify the Authorized Officer when they are completed. The Authorized Officer shall specify a completion date for the corrective work.

6. Forest Service Inspection. The holder shall allow inspection of the authorized dam and appurtenant structures at any time by the Authorized Officer or their representative. A copy of inspection reports prepared by the Forest Service shall be provided to the holder. Inspections performed by the Forest Service do not relieve the holder from any liability for the dam or of the responsibility of ensuring that inspections are conducted in accordance with paragraph 6 of this clause. Failure of the Forest Service to inspect shall not constitute a violation of any duty of the United States or a defense to noncompliance with any terms and conditions of this permit and shall not relieve the holder of any liability for damages in the event of a dam failure.

7. Safety Evaluations. Beginning in 2017 and every 5 years thereafter, the holder shall have a dam safety evaluation performed by a professional engineer certified in the State in which the authorized dam is located to verify the safety and integrity of the dam and appurtenant structures. At a minimum, the dam safety evaluation shall include a detailed field inspection of the dam and appurtenant structures and a review of all pertinent documents, such as investigation, design, construction, instrumentation, operation, maintenance, and inspection records. The dam safety evaluation shall be based on current accepted design criteria and practices. The holder shall provide 2 copies of the dam safety evaluation report, stamped with the professional engineer's seal, to the Authorized Officer and Regional Engineer. Based on this report, the Authorized Officer may require the holder to perform additional evaluations pursuant to standards deemed appropriate by the Authorized Officer and may require rehabilitation or modification of the dam, as necessary or appropriate, within a reasonable period.

8. Forest Service's Right to Abate Emergencies. When the Authorized Officer determines that there is a danger of a failure for any reason of the authorized dam, the Forest Service has the right to take any actions deemed necessary to prevent or abate a dam failure, including lowering the level of impounded water by utilizing existing structures or by artificially breaching the dam. The United States shall not be liable to the holder for any loss or damage, including damage to the dam or loss of value of impounded water, associated with actions taken by the Forest Service under this clause. The holder shall indemnify, defend, and hold harmless the United States for all costs, including legal and court costs, associated with the Forest Service's exercise of its rights under this clause, other than costs attributed to the negligence of the United States or its officers, agents, or employees. Failure of the Forest Service to exercise its rights under this clause shall not constitute a violation of any duty of the United States or a defense to noncompliance with any terms and conditions of this permit and shall not relieve the holder of any liability for damages in the event of a dam failure.

9. Liability. The holder and the holder's successors, agents, and assigns shall have sole responsibility for the safety of the authorized dam and appurtenant structures and any associated liability.

10. Any condition of the authorized improvements that adversely affects or that could adversely affect operation of the authorized dam, safety of the dam or the public, or the surrounding lands and resources shall, upon written notice from the Authorized Officer, be corrected or modified by the holder at the holder's expense. The Authorized Officer shall specify a completion date for corrective work in the notice.

11. The holder and the holder's successors, agents, and assigns shall have sole responsibility for the safety of the authorized dam and appurtenant structures and any associated liability.

12. If a State regulatory entity claims jurisdiction over the dam authorized by this permit, the holder shall provide correspondence and reports associated with regulation of the dam to the Authorized Officer upon request.

L. Water Facilities and Water Rights (D-25).

This permit does not confer any water rights on the holder. Any necessary water rights must be acquired by the holder in accordance with State law. Any expenses for acquiring water rights shall be the responsibility of the holder. The United States reserves the right to place any conditions on installation, operation, maintenance, and removal of facilities to pump, divert, store, or convey water on National Forest System lands covered by this permit that are necessary to protect public property, public safety, and natural resources on National Forest System lands in compliance with applicable law. The holder waives any claims against the United States for compensation in connection with imposition of any conditions on installation, operation, maintenance, and removal of water facilities under this permit.

M. Reservoir Storage Increase (X20). The Forest Service reserves the right to issue additional authorizations to other applicants to increase the storage capacity of this site if such action proves feasible. No authorization will be granted for additional facilities that will jeopardize the privileges granted by this authorization. Any additional authorizations permitting larger facilities will provide for payment of costs, including the cost of construction of the original project works, on a cost-benefit ratio mutually agreeable to the holder and the new applicant. If the holder and applicant cannot agree on division of costs, the Forest Service shall decide on an equitable division between the old and new works.

THIS PERMIT IS ACCEPTED SUBJECT TO ALL ITS TERMS AND CONDITIONS.

BEFORE ANY PERMIT IS ISSUED TO AN ENTITY, DOCUMENTATION MUST BE PROVIDED TO THE AUTHORIZED OFFICER OF THE AUTHORITY OF THE SIGNATORY FOR THE ENTITY TO BIND IT TO THE TERMS AND CONDITIONS OF THE PERMIT.

ACCEPTED:

John Engen, Holder
Mayor of Missoula

7/25/17
DATE

CITY OF MISSOULA
THE GARDEN CITY
MISSOULA
HUB OF FIVE VALLEYS
MISSOULA COUNTY, MONTANA

APPROVED:

Timothy Garcia, Authorized Officer
Forest Supervisor, Lolo National Forest

July 27, 2017
DATE

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0596-0082. The time required to complete this information collection is estimated to average one hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (voice and TDD). To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, 1400 Independence Avenue, SW, Washington, DC 20250-9410 or call (800) 975-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer. The Privacy Act of 1974 (5 U.S.C. 552a) and the Freedom of Information Act (5 U.S.C. 552) govern the confidentiality to be provided for information received by the Forest Service.

# EXHIBITS TO SPECIAL USE PERMIT AND APPENDICES TO EXHIBIT A

AUTH NO. MIS331

**Exhibit A**- Annual Operation and Maintenance Plan – 2017

*Appendix A* – Annual Operation and Maintenance Project List (Submitted and Approved Annually)
*Appendix B* – Leave No Trace Principles
*Appendix C* - Food/ Wildlife Attractant Storage Special Order F-11-005 Lolo-Forest
*Appendix D* - Herbicide Application Record
*Appendix E* - Right of Way BMP Project List (Out-Year; To Be Determined)
*Appendix F* - Wilderness Mechanical Transport/ Motorized Equipment Use Authorization Records

**Exhibit B** – 1) Rattlesnake Reservoirs and Access Routes Vicinity (Small Scale) Map, 2) Wilderness Area Reservoirs, Dams and Access Routes (Large Scale) Map *
**Exhibit C** – Rattlesnake National Recreation Area and Wilderness Act of 1980

*See Permit Administrator for copies of original (1915-1921) drawings of individual reservoirs and dams

# Exhibit A

Annual Operation and Maintenance Plan - 2017
City of Missoula
USDA Forest Service Special Use Permit #MIS331

**I. Authority:**

This Operation and Maintenance (O&M) Plan is a part of the Special Use Permit (Permit) authorized by the Federal Land Policy and Management Act, as Amended October 21, 1976 (FLMPA), Permit #MIS331, Permit Clause III.C. The Forest Supervisor is the Authorized Officer and the District Ranger is the Forest Service (FS) Representative. In the event that anything in this O&M Plan conflicts with the Permit, the Permit shall control.

**II. Enabling Legislation and Special Provisions - Public Law 96-476 The Rattlesnake National Recreation Area and Wilderness Act of 1980 (RNRAW):**

The RNRAWA, Section 4 item (d)(2) states that: *"Nothing in this Act shall be construed to permit the Secretary to affect or diminish any water right which is vested under either State or Federal law at the time of enactment of this Act, nor the rights of the owner of such water right to the customary and usual access, including necessary motorized use over and along existing roads and trails to any facilities used in connection therewith, and the right to operate and maintain such facilities."*

The City of Missoula (Holder) will operate and maintain the dams and reservoirs in a safe and efficient manner in compliance with current dam safety standards. The FS will work with and review the Holder's activities to ensure that they comply with the Wilderness Act of 1964, Public Law 88-577 and with the additional provisions included in the RNRAW, the National Endangered Species Act of 1973, Public Law 93-205, and FLPMA.

**III. Dams under Special Use Permit vs. Easement**

Land ownership in the RNRAWA was checker-boarded FS and private industry land before Wilderness designation. Montana Power Company exchanged their privately owned sections to the Lolo National Forest. The FS accepted the exchanged land sections subject to an Easement held by Mountain Water Company. Easement dated March 30, 1979 and recorded April 24, 1979, Volume #138, page 375; allows the right use, maintain, reconstruct, operate, and remove; to affect with storage waters, structures, dams, pipes and associated facilities, including trails; and to use and maintain certain roads, on the exchanged land sections. The Holder is now the successor interest to this Easement.

Rattlesnake Dams Under Special Use Permit

- Sanders #2 (South) – Significant (previous moderate) Hazard; Height/Storage Capacity Classification C; rock crib dam
- Sheridan #1 (East) – Significant (previous moderate) Hazard; Height/Storage Capacity Classification C; rock crib dam
- Sheridan #2 (West) – Significant (previous moderate) Hazard; Height/Storage Capacity Classification D; rock crib dam
- Worden – Significant (previous moderate) Hazard; Height/Storage Capacity Classification C; rock crib dam (one report shows earth dam, so there's uncertainty here that should be clarified)
- Carter – Low Hazard; Height/Storage Capacity Classification C; earth dam

Rattlesnake Dams under Easement, not under jurisdiction of the FS.

- Big Lake – Significant (previous moderate) Hazard; rock crib dam
- Glacier Lake – Significant (previous moderate) Hazard; rock crib dam
- Little Lake – Significant (previous moderate) Hazard; rock crib dam
- McKinley Lake – Significant (previous moderate) Hazard; earth dam
- Sanders Lake (North) – Significant (previous moderate) Hazard; rock crib dam

**IV. O&M Plan Revision, Project Proposals, and Authorization Process:**

All O&M Plan activities must be pre-approved by the Authorized Officer to ensure that wilderness character is considered and protected while allowing continued use of the dam and reservoir facilities authorized by the Permit.

The holder shall submit revisions or amendments to the O&M Plan including an annual project list **(Appendix A)** by June 1st annually. For all activities not included in this O&M Plan, the holder will request approval from the Authorized Officer in writing.

The Holder and the FS will meet annually, prior to the implementation of annual maintenance projects, to discuss the program of work and review wilderness resource protection measures.

**V. General Operation and Maintenance Requirements:**

1) Reservoir and Dam Operation and Maintenance Plan

   a) Operating requirements: Reduce water levels to facilitate necessary inspections and maintenance activities. Operate and maintain dams and reservoirs in a safe and efficient manner in compliance with current dam safety standards.
   b) Procedures to be followed for operation of structures, including flood conditions: There are no specific procedures to follow. Facilities provide no flood protection and are self-regulated through uncontrolled spillways. Outlet pipe capacities are small and provide only long-term water level control.
   c) Routine or reoccurring maintenance log and inspection report: the Holder will maintain a professional logbook for each dam that records all visits including date and mode of transport, type of maintenance required, description of work completed, type of equipment utilized, # of employees or staff, operational status of each dam, out-year projects, and general observations.
   d) Annual Inspection Report: The Holder will submit an annual inspection report and maintenance log to the FS by October 31st of each year.
   e) Dam hazard Assessments: To occur at least every five years for a significant hazard dam. Beginning in 2017 for all dams, and also after earthquakes, major storms, or overflow of spillways other than the service spillways. Three copies of the assessment report will be forwarded to the authorized officer within 30 days of the assessment inspection.
   f) Water storage and release, including dates and/or criteria for filling and release: N/A
   g) Any water storage limits: Only what is provided by uncontrolled spillways.
   h) Safety requirements: In accordance with current standards. Assure spillways are serviceable.
   i) Erosion prevention plans and activities in reservoir area and spillway channel: Any erosion plans and activities will be shown in the Holder's annual inspection report.
   j) Trash and debris removal provisions: Annually remove debris from dam upstream surfaces and in spillway channels.

2) Hazard Assessment Frequency and General Requirements:
    - Every 10 years for designated Low Hazard Potential Classification.
    - Every 5 years for designated Significant Hazard Potential Classification.
    - Current schedule for Rattlesnake Dams: Previous assessment was primarily conducted in 2010 and report finalized in 2011. Fresh assessment currently due.
    - Required for significant and high hazard classifications and warranted for low depending on significance or complexity.
    - Revise when there is a change of status: change of ownership, classification, SUP, etc.
    - Inspected per schedule below depending on hazard potential classification.
    - Maintenance categories are required in pertinent documentation:
        - "Priority 1 - Emergency": maintenance needed immediately to correct deficiencies
        - "Priority 2 – Non-Emergency": maintenance is needed to restore functional use, but dam integrity and public safety are not threatened.
    - "Routine": minor "housekeeping" is needed and typically included in O & M Plan (e.g. vegetation removal, animal control, drain maintenance, debris removal from spillway, etc.).Inspections are required per the schedule below to reduce risk to human life and property damage from failure. The FS is allowed inspection at any time to evaluate and issue corrective actions
    - A qualified engineer conducts inspections and the FS Regional Director of Engineering reviews and approves (FSM 7504.5)
    - Informal and special inspections: may involve any FS employee to assess unusual situations (i.e. changes in leakage, erosion, sinkholes, boils, seepage, slope instability, undue settlement, displacement, tilting, cracking, deterioration, improper functioning of drains and relief wells, and overtopping of the dam by flood waters). Unusual situations are to be reported immediately.
    - Special inspections by a qualified engineer are required immediately after an unusual event including, but not limited to a large flood, earthquake, or vandalism.
    - The Forest Supervisor can increase the frequency of inspection if deemed necessary.

**VI. Special Provisions and Requirements for the Holder and their employees, contractors and/ or agents:**

1) Utilize "Leave No Trace" techniques and ethics **(See Appendix B)**

2) Grizzly Bear Management and Protection Plan (Permit clause VIII.H.) and general Wildlife Protection Plan: For the purpose of minimizing potential conflicts resulting in adverse interactions between wildlife and humans any activity in the RNRAW must comply with the Lolo National Forest's Food/Wildlife Attractant Storage Special Order F11-005-LOLO-FOREST **(See Appendix C)**, as well as Northern Continental Divide Ecosystem requirements.
    a) Utilize "Bear Aware" to reduce conflicts between humans and bears, as well as information regarding the Lolo National Forest's food and attractant storage requirements.

3) Noxious Weed/Exotic Plant Prevention and Control (Permit clause VIII.F.) requires that a site specific plan must be developed when determined necessary by the Authorized Officer. Due to the degree and extent of disturbance and high risk of weed spread and/or introduction from general operations, a specific weed plan must be prepared on an annual basis by the Holder and submitted to the Authorized Officer for approval. A site specific weed plan must also be submitted prior to any ground disturbing activities.
    a) Be educated regarding environmental threats from the introduction of noxious weeds and how to prevent weed spread.

**Table 1 - Minimum Weed Treatment Requirements (for Areas Under Special Use Permit):**

| Location | Treatment | Common Name | Estimated Acres | Schedule | Comments |
|---|---|---|---|---|---|
| Lake Creek Trail (TR534) | Spot Treat / Pull and pack out | Musk thistle, Dalmatian toadflax, St. Johnswort, oxeye daisy, spotted knapweed | 1 – 2 | Yearly | from the junction with Wrangle Creek trail to the first switchback beyond the Sheridan Creek crossing |
| Carter Lake Dam | Spot Treat / Pull and pack out | Oxeye daisy, common tansy, Canada thistle | <1 | Yearly | |
| Carter Lake Campsites | Spot Treat / Pull and pack out | Spotted knapweed | <1 | Yearly | |
| Carter Lake Shoreline* | Pull and pack out | Oxeye daisy | <1 | Yearly; until population is eradicated | Once eradicated, continue to monitor |
| Wrangle Creek Trail (TR502) | Spot Treat | Oxeye daisy, common tansy and spotted knapweed | 1 – 2 | Every other year | from Wz boundary to creek crossing in Section 18 |
| Big Lake Trail (TR1265) | Pull and pack out | Oxeye daisy | <1 | Yearly | Quarter mile from the junction with the Lake Creek Trail |
| | | | | | |
| All Dams and Shoreline* | Inventory and Monitor | All Weed Species | <5 | Yearly | |
| RD99/TR515 | Spot Treat/Pull | All Weed Species | <5 | Every other year | |
| All equipment and vehicles must be inspected and cleaned prior to entering the RNRAW. | | | | | |

*If water levels are to decrease on any lake, all shorelines will be monitored yearly for noxious weed spread and establishment until native plants are established.

**Table 2 - Lolo National Forest Weeds**

| **Potential invaders (currently absent)**<br>**Goal is to prevent and eradicate promptly if found** | |
|---|---|
| *Bryonia alba* | White bryony |
| *Centaurea repens* | Russian knapweed |
| *Centaurea solstitalis* | Yellow starthistle |
| *Chondrilla juncea* | Rush skeletonweed |
| *Crupina vulgaris* | Common crupina |
| *Iris pseudacorus* | Yellowflag iris |
| *Isatis tinctoria* | Dyers woad |
| *Lythrum spp.* | Purple loostrife |

| | |
|---|---|
| *Polgonum cuspidatum* | Japanese Knotweed |
| *Tamarix spp.* | Salt cedar |
| **New invaders**<br>**Goal is to eradicate small new infestations and reduce larger infestations** | |
| *Cardaria draba* | White top |
| *Centaurea diffusa* | Diffuse knapweed |
| *Echium vulgare* | Blue weed |
| *Hieracium aurantiacum* | Orange hawkweed |
| *Hieracium piloselloides / pratense/ et al* | Meadow/Yellow hawkweed complex |
| *Lepidium latifolium* | Perennial pepperweed |
| *Linaria vulgaris* | Common toadflax |
| *Ranunculus acris* | Tall buttercup |
| *Senecio jacobaea* | Tansy ragwort |
| **Widespread Weeds**<br>**Goal is to contain inside infested area and reduce plant populations** | |
| *Cardus nutans* | Musk thistle |
| *Centaurea maculosa* | Spotted knapweed |
| *Chrysanthemum leucanthemem* | Oxeye daisy |
| *Cirsium arvense* | Canada thistle |
| *Cynoglossum officinale* | Houndstongue |
| *Euphorbia esula* | Leafy spurge |
| *Hypericum perforatum* | St. Johnswort |
| *Linaria dalmatica* | Dalmatian toadflax |
| *Potentilla recta* | Sulfur cinquefoil |
| *Sisymbrium altissimum* | Tumble mustard |
| *Tanacetum vulgare* | Common tansy |
| *Verbascum spp.* | Common mullein |

The Holder must maintain treatment records and submit Herbicide Application Records **(Appendix D)** with a map to the Authorized Officer by Oct. 31st, annually

4) Right of Way Management Plan
   a) The Holder shall notify the Authorized Officer prior to taking any motorized inspection or operation & maintenance trips from the Rattlesnake Main Trailhead to any of the Rattlesnake dam sites. The holder must post signs at the Rattlesnake Main Trailhead notifying recreationists when Holder's wheeled motorized vehicles are operating within the RNRAW. The Holder must utilize a readily visible freestanding post, tripod, or sandwich board. Placement of signs on FS signs is prohibited.
   b) The Holder must notify and request approval from the Authorized Officer in advance of any proposed helicopter use.
   c) The Holder is only authorized to use approved system access routes. Off road driving is prohibited.
   d) Annual Right of Way maintenance activities must be planned and approved in advance by the Authorized Officer. The FS will work with the Holder to identify sub-standard Best Management Practices (BMP) conditions and develop a list of work items necessary to meet low-impact BMP standards **(Appendix E)**.
   e) Major maintenance or improvement projects for access roads must be planned and approved in advance by the Authorized Officer.
   f) It is prohibited to maintain (clear, brush, improve tread, etc.) the non-system trail from Big Lake to Sheridan Lake.

5) Continuous Minimum Flow (Permit clause VIII. E.)
To the extent feasible without diminishing the Holder's historic existing water rights or the cost of water storage or yield from the Holder's facilities, the Holder shall work cooperatively with the FS to establish discharges from the project area that provide a continuous minimum flow or cubic feet per second (cfs) as pursuant to State water rights during specified yearly periods to the extent necessary to accommodate the FS's resource goals and as pursuant to State water rights. The cfs and seasonal dates will be determined through review of historic data and a current resource assessment, and will be agreed to by the FS and the Holder within the first five years of permit issuance.

6) Bull Trout mitigation measures will be incorporated into this O&M Plan following consultation with the U.S. Fish and Wildlife Service pursuant to the Endangered Species Act of 1973, Public Law 93-205 to the extent feasible without diminishing the Holder's historic water rights or the cost of water storage or yield from the permitted facilities.

7) Construction Materials – Natural colors and natural construction materials will be used to the greatest extent practical to protect wilderness character. The Holder will submit construction substrate/material type, for materials that would be visible to the public, to the FS for approval.

8) Removal of Construction Debris and Materials – Non-historical construction debris or materials will be removed from all dam sites on an annual basis by the Holder. Caching is prohibited.

9) Long Term Rodent Control and Monitoring Devices – The use of rodent control or monitoring devices that produce noise that is audible to humans within the RNRAW is prohibited. Use of these items for specific short term projects may be approved on a case by case basis.

10) Minimum Tool - To the greatest extent practical, the Holder will strive to use the minimum tool to complete maintenance projects in order to protect wilderness values. Holder must request approval from the Authorized Officer in advance of any proposed motorized or mechanized equipment use.

11) All overnight camp locations must be approved by the Authorized Officer in advance. Site approval will be on a case by case basis. Leave No Trace camping techniques will be utilized.

12) The Holder and FS will work together to develop a dam monitoring plan that includes monitoring to protect wilderness values.

13) The Holder must complete and submit the "Wilderness Mechanical Transport/Motorized Equipment Use Authorization Record" form (Appendix F) that documents special provision use to the Authorized Officer by Sept. 30th, annually. A separate form must be submitted for each motorized and mechanized entry and or use.

14) The Holder will provide a continuous and adequate supply of mutt mitts in the receptacle at the Rattlesnake main trailhead to help protect watershed values.

**VI. Reporting and Submissions:**

| Due Date: | Report or Submission: | Appendix: | Submitted To: | Routed To: | Notes: |
|---|---|---|---|---|---|
| June 1 | Annual Project List | A | Permit Administrator | RNRAW Manager | Dam maintenance projects, ROW aintenance projects, camp locations, other |
| Prior to Entry | Motorized or Mechanized Access | Not Applicable | Permit Administrator | RNRAW Manager | Motorized or Mechanized use along approved access routes; indicate routes to be travelled, type and # of vehicles |
| Prior to Entry | Helicopter Landings | Not Applicable | Permit Administrator | RNRAW Manager | Indicate dams or sites to be visited |
| Prior to use | Motorized or Mechanized Equipment Use | Not Applicable | Permit Administrator | RNRAW Manager | Motorized or mechanical equipment use; type and duration |
| Oct. 31 | Herbicide Application Records and Map | D | Permit Administrator | Weed Specialist, RNRAW Manager | Include map that displays area treated, type of weed, and treatment method, new infestations found, other |
| Oct. 31 | Annual Inspection Report and Maint Log | | Permit Administrator | RNRAW Manager | Includes inspections information, hazard assessments data and draft or final reports |

**VII. Principle Contacts – City of Missoula:**

| Title | Name: | Contact Information | Responsible For: |
|---|---|---|---|
| Public Works Director | John Wilson | Phone: 406-241-7283<br>Email: JWilson@ci.missoula.mt.us | Overall supervision of water system |
| Water System Superintendent | Dennis Bowman | Phone: 406-274-3338<br>Email: DBowman@ci.missoula.mt.us | Water system superintendent |
| Mick Kammerer | Control & Inst-rumentation Tech | Phone: 406-370-8613<br>Email MKammerer@ci.missoula.mt.us | Maintains logbooks, insures O&M activities implemented |
| Logan McInnis | Utility Engineer | Phone: 406-370-8285<br>Email: lMcinnis@ci.missoula.mt.us | General Engineering Support |

**VIII. Principle Contacts for Administrative or Emergency Purposes– U.S. Forest Service:**

| Title | Name: | Contact Information | Responsible For: |
|---|---|---|---|
| District Ranger | Jennifer Hensiek | Phone: 406-329-3948/ cell - 529-8159<br>Email: jhensiek@fs.fed.us | Authorized Officer |
| Realty Specialist | Ron Ewart | Phone: 406-677-3938/ cell- 240-0002<br>Email: rewart@fs.fed.us | Permit Administration |
| RNRAW Manager | Al Hilshey | Phone: 406-329-3962/ cell 531-3662<br>Email: ahilshey@fs.fed.us | RNRAW Operations |
| Botanist and Noxious Weed Coordinator | Karen Stockmann | Phone: 406-329-3936<br>Kstockmann02@fs.fed.us | Noxious Weed Control |

## APPENDICES TO EXHIBIT A, ANNUAL OPERATION AND MAINTENANCE PLAN

**Appendix A – Annual Operation and Maintenance Project List Considerations (Not All-Inclusive; Finite List to be Submitted and Approved Annually by June 1 of each year)**

1) Access Roads and Trails- Review, assess road and trail needs i.e. proper base and drainage; establish standards to maintain, develop a list of work items necessary to meet low-impact BMP standards, perform acceptable level of repairs.

2) Monitor dams with helicopter flights during high magnitude rain-on-snow events and runoff as frequently as necessary to assess if spillway blockage of ice, snow, and/or debris is causing failure or elevating failure risk. Will likely have to land and check spillway gate valves and mechanics as well.

3) Conduct hazard assessments of all dams under permit, conducted by a qualified engineer, to be reviewed and approved by the Regional Director of Engineering (FSM 7504.5). (This will be a requirement for 2017).

**4)** Specific Dam Maintenance Considerations: Several dams do not meet current standards for adequate spillway capacity and need immediate remedy, especially with predicted increases in rain-on-snow climate changes. Each dam needs work to varying degrees. Erosion and earth movement (depressions, sink holes, cracking, etc.) are noted for most.

5) Stabilization Mimicking Natural Conditions: Consider if any of the reservoirs could be rehabilitated to mimic natural lake and stream outlet functions while maintaining acceptable stability. If stability is in question for a given capacity, the outlet(s) and spillway(s) could potentially be lowered to a natural or more stable level and adjacent slopes reshaped and revegetated. This approach could:
   a) Leave options open for future management scenarios while eliminating or reducing costly upgrades, disturbance, maintenance, or other issues.
   b) Allow for lake storage beneficial to maintaining higher summer baseflow conditions, which is becoming more important under predicted increases in drought.
   Require determination of how dam safety standards would be applied.
   c) Utilize recommended natural stream rehabilitation techniques. If deemed feasible, the design and implementation using natural stream rehabilitation techniques should be conducted by an approved specialist with appropriate experience in environmental river mechanics and fluvial geomorphology.

6) Remove debris from the spillways of all dams under permit.

7) Monitor and remedy as needed- dams and sloughs on dam crest and spillway head cuts.

8) Conduct annual noxious weed control per Table 1, Para. V. 3 in consultation with Lolo NF Botanist and Noxious Weed Coordinator.

9) Remove any non-historic construction debris.

10) Holder has agreed to implement tasks listed in the 2016 Rattlesnake Lakes Maintenance Plan

**ACCEPTANCE TO IMPLEMENT 2017 ANNUAL OPERATION AND MAINTENANCE PLAN**

Holder Name: City of Missoula

By: _____
Dennis Bowman, Water Superintendent

Date: 7-19-17

U.S. Department of Agriculture, Forest Service

By: _____
Jennifer Hensiek, Missoula District Ranger

Date: 7/27/17

**Appendix B – Leave No Trace Principles**

**Plan Ahead and Prepare**

- Know the regulations and special concerns for the area you'll visit.
- Prepare for extreme weather, hazards, and emergencies.
- Schedule your trip to avoid times of high use.
- Visit in small groups when possible. Consider splitting larger groups into smaller groups.
- Repackage food to minimize waste.
- Use a map and compass to eliminate the use of marking paint, rock cairns or flagging.

**Travel and Camp on Durable Surfaces**

- Durable surfaces include established trails and campsites, rock, gravel, dry grasses or snow.
- Protect riparian areas by camping at least 200 feet from lakes and streams.
- Good campsites are found, not made. Altering a site is not necessary.
    - In popular areas:
        - Concentrate use on existing trails and campsites.
        - Walk single file in the middle of the trail, even when wet or muddy.
        - Keep campsites small. Focus activity in areas where vegetation is absent.
        - In pristine areas:
        - Disperse use to prevent the creation of campsites and trails.
        - Avoid places where impacts are just beginning.

**Dispose of Waste Properly**

- Pack it in, pack it out. Inspect your campsite and rest areas for trash or spilled foods. Pack out all trash, leftover food and litter.
- Deposit solid human waste in catholes dug 6 to 8 inches deep, at least 200 feet from water, camp and trails. Cover and disguise the cathole when finished.
- Pack out toilet paper and hygiene products.
- To wash yourself or your dishes, carry water 200 feet away from streams or lakes and use small amounts of biodegradable soap. Scatter strained dishwater.

**Leave What You Find**

- Preserve the past: examine, but do not touch cultural or historic structures and artifacts.
- Leave rocks, plants and other natural objects as you find them.
- Avoid introducing or transporting non-native species.
- Do not build structures, furniture, or dig trenches.

**Minimize Campfire Impacts**

- Campfires can cause lasting impacts to the backcountry. Use a lightweight stove for cooking and enjoy a candle lantern for light.
- Where fires are permitted, use established fire rings, fire pans, or mound fires.
- Keep fires small. Only use sticks from the ground that can be broken by hand.
- Burn all wood and coals to ash, put out campfires completely, then scatter cool ashes.

**Respect Wildlife**

- Observe wildlife from a distance. Do not follow or approach them.
- Never feed animals. Feeding wildlife damages their health, alters natural behaviors, and exposes them to predators and other dangers.
- Protect wildlife and your food by storing rations and trash securely.

- Control pets at all times, or leave them at home.
- Avoid wildlife during sensitive times: mating, nesting, raising young, or winter.

**Be Considerate of Other Visitors**

- Respect other visitors and protect the quality of their experience.
- Be courteous. Yield to other users on the trail.
- Step to the downhill side of the trail when encountering pack stock.
- Take breaks and camp away from trails and other visitors.
- Let nature's sounds prevail. Avoid loud voices and noises.

## FOOD/WILDLIFE ATTRACTANT STORAGE SPECIAL ORDER F11-005-Lolo-Forest

# OCCUPANCY AND USE RESTRICTIONS
LOLO NATIONAL FOREST
REGION ONE
USDA, FOREST SERVICE

For the purpose of minimizing potential conflicts resulting in adverse interactions between wildlife and humans and pursuant to 36 Code of Federal Regulations 261.50 (a) and (b), **the following uses are restricted in those areas of the Lolo National Forest as shown on the attached map (Exhibit A)** and hereby made a part of this Order. Also attached, and hereby made a part of this Order are definitions of terms used in support of these restrictions (Exhibit B). **This Order is effective April 1 through December 1, annually**. These restrictions are in addition to those enumerated in Subpart A, Part 261, Title 36, Code of Federal Regulations and become effective when signed, and shall remain in effect until rescinded or revoked.

1. Possessing or storing any food or refuse, as specified in the order from April 1 to December 1, annually [36 CFR 261.58(cc)]
2. Possessing, storing or transporting any bird, fish or other animal, or parts thereof as specified in the order from April 1 to December 1, annually [36 CFR 261.58(s)]

*These restrictions supercede the following special order previously in place on Lolo National Forest lands only: Special Order LC_10_D1_01. This order rescinds Lolo National Forest Supervisor's Order F07-053-LOLO-D3.*

## UNDER THIS ORDER IT IS REQUIRED THAT:

1. During daytime hours, attractants, including human, pet and livestock food (except baled or cubed hay without additives), and garbage shall be attended or stored in a bear-resistant manner when unattended (see definitions in Exhibit B).
2. During nighttime hours, in front country areas (shown in Exhibit A Map), attractants must be stored in a "bear resistant manner" unless it is being prepared for eating, consumed (eaten/drank), transported, or prepared for acceptable storage .(see definitions in Exhibit B).
3. During nightime hours, **in limited back country areas only** (shown in Exhibit A, Map), attractants may be attended rather than stored in a bear resistant manner (see definitions in Exhibit B). However, it is strongly recommended that attractants be stored in a bear-resistant manner.
4. Any harvested animal carcass (including big game, birds, fish, or other animal parts) that are within 1/2-mile of any camping or sleeping area shall be stored in a bear- resistant manner by the responsible party (see definitions in Exhibit B). If an animal carcass is within an attended camp during daytime hours it may be on the ground.
5. Attractants (such as food leftovers or bacon grease) shall not be buried, discarded, or burned in an open campfire. Leftover food or food waste may be placed in an appropriate sealed container and packed out with garbage, burned in a contained stove fire or placed in a suitable container (i.e. tin can) to prevent leaching into the ground and burned over an open campfire.

6. The responsible party shall report the death and location of livestock to a Forest Service official within 24 hours of discovery.

**EXEMPTIONS:**

Pursuant to 36 CFR 261.50(e) the following persons may be exempt from this order

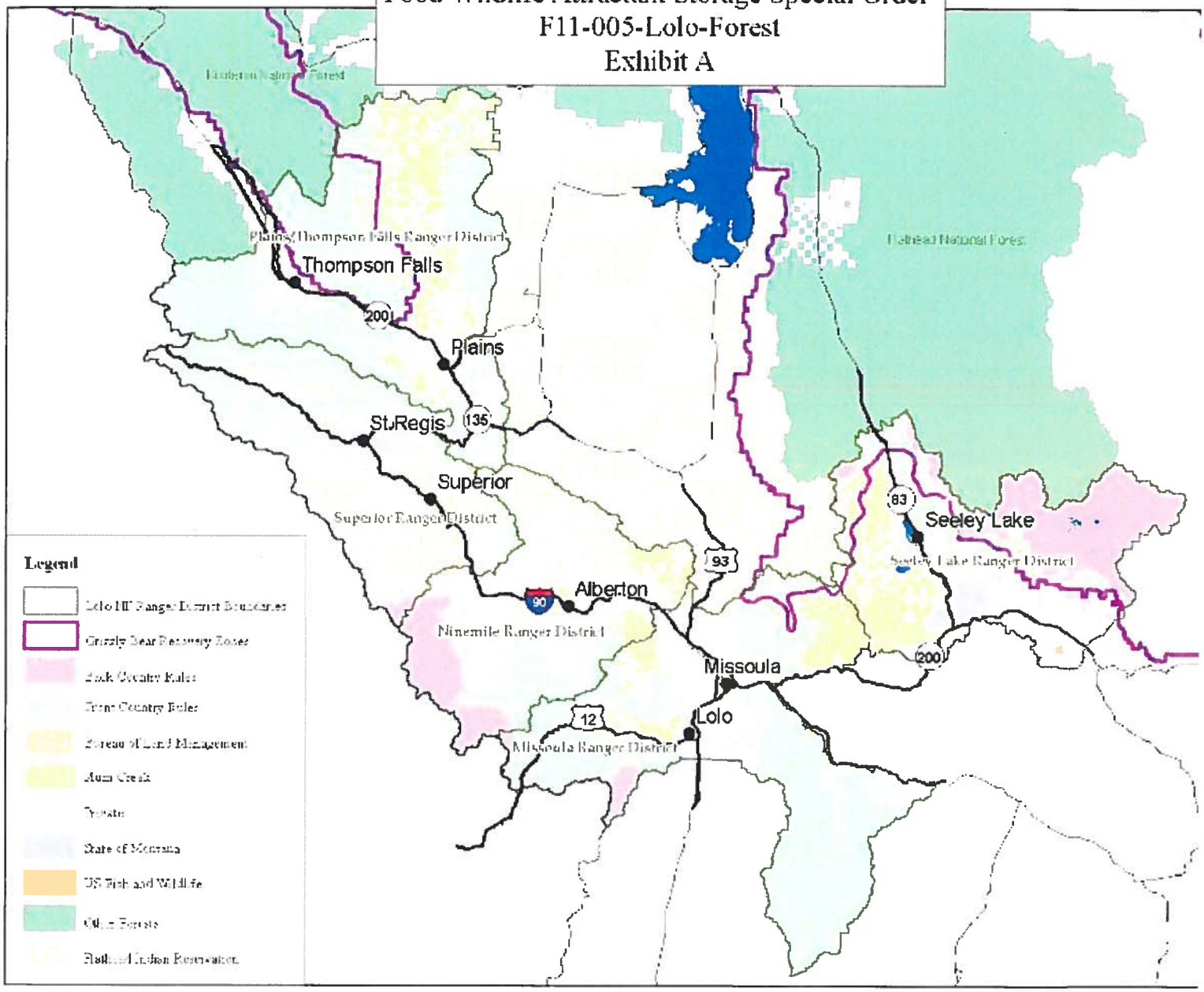
1. Persons with a permit **issued by the Forest Supervisor** specifically authorizing a prohibited act.
2. Any Federal, State, or local officer, or member of an organized rescue or firefighting force in the performance of an official duty.

Done this 25th day of March, 2011.

***/s/ Deborah L. R. Austin***
DEBORAH L. R. AUSTIN
Forest Supervisor
Lolo National Forest

Violations of these prohibitions are punishable by a fine of not more than $5,000 for an individual or $10,000 for an organization, or imprisonment for not more than 6 months, or both (16 U.S.C 551 and 18 U.S.C. 3559 and 3571).

# Food Wildlife Attractant Storage Special Order
# F11-005-Lolo-Forest
# Exhibit A



## EXHIBIT B: DEFINITIONS

1. **Animal carcass:** The dead body, or any parts thereof, of any harvested mammal, bird, or fish, including the head or skull plate with antlers or horns and hide or cape of big game animals and any domestic livestock that may be found in the restricted area. Packaged or prepared animal carcass products transported into the restricted area for consumption, game birds, small mammals, or fish harvested for consumption in the restricted area are considered food as defined below.

2. **Attended:** At least one adult person (attendee) is physically present within 100 feet of **attractants** during **daytime hours**. During the **nighttime hours**, all attractants must be within 50 feet of the attendee, or attractants must be stored in a bear-resistant manner. During the **nighttime hours**, no physical barrier, except tents or containers or attractant packaging material may exist between the attendee and attractants which are not stored in a bear-resistant manner.

3. **Attendee:** An adult (18 years of age or older) in control of attractants.

4. **Attractant:** Food as defined below and garbage from human, livestock or pet foods as well as other human, livestock, or pet items that emit an odor such as personal hygiene products.

5. **Bear-resistant container:** A securable container constructed of solid material capable of withstanding 200 foot-pounds of energy applied by direct impact. The container, when secured and under stress, will not have any openings greater than one-quarter (1/4) inch, that would allow a bear to gain entry by biting or pulling with its claws. A bear-resistant container developed commercially must be approved by the USDA, Forest Service, Missoula Technology and Development Center (MTDC). Bear-resistant containers developed for personal use may be inspected for approval by the local District Ranger or their designated representative(s). For commercial operations, the MTDC has an impact testing machine available to evaluate containers for strength.

6. **Bear-resistant manner** means any attractants, including food and garbage, must be stored in one of the following ways:

   a. secured in a hard-sided camper or vehicle trunk or cab or trailer cab;
   b. secured in a hard-sided dwelling or storage building;
   c. suspended at least 10 feet up (from the bottom of the suspended item) and 4 feet out from any upright support, i.e. tree, pole;
   d. stored in an approved bear-resistant container;
   e. stored within an approved and operating electric fence;
   f. stored in any combination of these methods;
   g. or stored by methods other than those described in Section #7, a-f, that shall be approved in writing by the Forest Supervisor responsible for their area of jurisdiction.

7. **Contained stove fire:** a metal stove that completely encloses the fire.
8. **Daytime:** 1/2-hour before sunrise until 1/2-hour after sunset.
9. **Food:** Any nourishing substance, which includes human food or drink (canned, solid or liquid), livestock feed (except baled or cubed hay without additives) and pet food.

10. **Livestock:** A domesticated animal, such as mule, horse, llama, or goat.
11. **Nighttime:** 1/2-hour after sunset until 1/2-hour before sunrise.
12. **Approved electric fences will meet, as a minimum, the following specifications:**

a. **7 Strand Fence** (refer to Forest Service publication 9923-2321-MTDC, "Electric Fence Systems: Requirements for Meeting the NCDE Food Storage Special Order, 1999", for more description of fence specifications and set-up):
   i) The fence will be set up as a "tight wire" fence. The wire will be tight and under tension, not loose or sagging.
   ii) Minimum fence height.....4 feet.
   iii) Minimum post height.....5 feet.
   iv) Maximum spacing between posts.....8 feet.
   v) Conductors (wire): Minimum of 7 wires, with 6-10 inch spacing between wires. Bottom wire must be within 2 inches of the ground. All wire must be smooth metal fence wire of at least 16 gauge or poly wire, except the top wire which may be poly tape of at least six strand stainless steel.
   vi) The system will be set up to operate both as a ground wire return and a grounded system. The 2 top wires will be hot, with all other wires alternating hot and ground. The minimum length ground rod is 2 feet.
   vii) Fence charger (minimum): (1) energizer output of 0.7 joules; (2) tested peak output of 5000 volts; (3) 40 shocks per minute. **User must be able to test electrical output in the field.**
   viii) The charger must be made inaccessible to disturbance from a bear. The charger may be stored within the interior of the fence or located a minimum of 10 feet above ground.
   ix) Minimum distance between fence and items enclosed by fence.....3 feet.

b. **Portable Electric Mesh Fence** (refer to Forest Service publication 0723-2305-MTDC, "Specifications for Portable Electric Fence Systems as Potential Alternative Methods for Food Storage, 2007", for more description of fence specifications and set-up):
   i) Portable electric mesh fence shall not be left in any location for more than 14 days.
   i) Minimum fence height.....33 inches.
   ii) Minimum post length.....42 inches.
   iii) Post construction required to be polyethylene with metal spike on bottom.
   iv) Minimum of 3 strands of stainless steel wire per horizontal wire.
   v) Minimum number of horizontal wires.....8.
   vi) Horizontal opening in mesh required to be less than 12 inches.
   vii) Minimum length of ground rod required to be 1 foot. Earth ground is mandatory.
   viii) Fence charger (minimum): (1) energizer output of 0.11 joules; (2) Minimum tested peak output voltage (on every hot conductor, with no load other than the fence) required to be 5,000 volts.; (3) Minimum pulse duration (with a 10,0000-ohm load applied) required to be 0.05 milliseconds; (4) Minium shocks per minute....35. **User must be able to test electrical output in the field.**
   ix) Minimum distance between fence and items inside.....1½ feet.
   x) Readable placard indicating fence is electrified is required.
   xi) Maximum fence length.....60 feet.
   xii) Mimimum of 2 LED lights.

**Appendix D – Herbicide Application Record**

**20___ DAILY HERBICIDE APPLICATION RECORD**
**Name:**_____
**License No.**_____
**Address:**_____
**Phone No.**_____
**BEFORE** spraying fill-in blocks 1-12.
**AFTER** spraying start with block 18 and work your way back up to block 13 Circle/Fill-in Approriate Response

<table>
<tr><td>County</td><td>Missoula Granite</td><td>(10) Temp. R H.</td><td colspan="2">_____ *F _____ *RH</td></tr>
<tr><td>(1) Operator Name</td><td></td><td>(11) Wind speed /Direction (from)</td><td colspan="2">____MPH (N, NE, E, SE, S, SW, W, NW)</td></tr>
<tr><td>(2) Method Code</td><td>Manual Chem. (710), Mech. Chem. (720), Aerial Chem. (730)</td><td>(12) Pesticide (chart below)</td><td colspan="2">1 2 3 4 5 6 7 8 9 10 11 12</td></tr>
<tr><td rowspan="2">(3) Equipment Code</td><td rowspan="2">Handsprayer (711)<br>Backpack (712)<br>Hand Spreader (714)<br>Mobile Grnd Sprayer (721)<br>Aerial (731)</td><td rowspan="2">(13) Total lbs AI Applied</td><td colspan="2">___ oz/128oz per gal * AI Rate/gal<br>= ____ lbs AI Applied<br>(of 1st pesticide identified in #12 above)</td></tr>
<tr><td colspan="2">___ oz/128oz per gal * AI Rate/gal<br>= ____ lbs AI Applied<br>(of 2nd pesticide identified in #12 above)</td></tr>
<tr><td>(4) Treatment Type</td><td>Pulling<br>Mowing (M),<br>Pesticide (P)</td><td>(14) Total Oz. Pesticide Applied</td><td>_____oz<br>(1st pesticide from #12 above)</td><td>_____oz<br>(2nd pesticide from #12 above)</td></tr>
<tr><td>(5) Weed (s) (*)</td><td>Ciar, Lida, Livu, Hype, Cyof, Eues, Canu, Chle, Hiau, Pore, Cema, Tavu, Hipr</td><td>(15) Product Rate/Ac.</td><td>_____oz/Ac<br>(1st pesticide from #12 above)</td><td>_____oz/Ac<br>(2nd t pesticide from #12 above)</td></tr>
<tr><td>(6) Weed Stage</td><td>Rosette Bud Flower Fall</td><td>(16) Area Treated (Ac.)</td><td colspan="2">_____Ac.</td></tr>
<tr><td>(7) Site</td><td>Admin, Campgrnd, Forest, Irrigation ditch, Pasture, Rangeland, Right-of-Way, Riparian, Trailhead</td><td>(17) Calibrated Volume (Gal Water/Ac.)</td><td colspan="2">_____ gal/Ac</td></tr>
</table>

| | | | |
|---|---|---|---|
| **(8)** Date: | ____/____/20 | **(18)** Total gallons Diluent Applied | _____ **gal** (From flow meter or graduations on tank) |
| **(9)** Time | _____**Start** _____**Finish** | **BEIN2** = hoary allyssum; **BRAL4** = white bryony; **BRTE** = cheatgrass; **CADR** = white top; **CANU4** = musk thistle; **CEDI3** = diffuse knapweed; **CESO3** = yellow starthistle; **CEMA4** = spotted knapweed; **CERE6** = Russian knapweed; **CHJU** = rush skeletonweed; **CHLE80** = oxeye daisy; **CIAR4** = Canada thistle; **CRVU2** = common crupina; **CYSC4** = scotch broom; **CYOF** = houndstongue; **ECVU** = blue weed; **ELAN** = russian olive; **EUES** = leafy spurge; **HIAU** = orange hawkweed; **HIPR** = meadow hawkweed; **HYPE** = St. Johnswort; **ISPS** = yellowflag iris; **ISTI** = Dyer's woad; **LELA2** = perennial pepperweed; **LIDA** = Dalmatian toadflax; **LIVU2** = common toadflax; **LYSA2** = purple loostrife; **POCU6** = japanese knotweed; **PORE5** = sulfur cinquefoil; **RAAC3**= tall buttercup; **SEJA** = tansy ragwort; **SIAL2** = tumble mustard; **TARA** = salt cedar; **TAVU** = common tansy; **VETH** = mullein | |

| | |
|---|---|
| **Surfactant/Adjuvant:** | |
| **Ingredient Type:** | |
| **Rate Applied (oz/ac):** | |

| | **Product Name** | **Manufacture** | **EPA Registration #** | **Active Ingredient (AI)** | **AI Rate** |
|---|---|---|---|---|---|
| **1** | Tordon 22 K | Dow Agro | 62719-6 | Picloram | 2 lb/gal |
| **2** | Milestone | Dow Agro | 62719-519 | Aminopyralid | 2 lb/gal |
| **3** | Base Camp Amine 4 | Wilbur Ellis | 71368-1-2935 | **2,4-D**ichlorophenoxyacetic Acid | 3.8 lbs/gal |
| **4** | Amine 4 | Wilbur Ellis | 2935-512 | **2,4-D**ichlorophenoxyacetic Acid | 3.8 lbs/gal |
| **5** | 2,4D Amine 4 | Wilbur Ellis | 1381-103 | **2,4-D**ichlorophenoxyacetic Acid | 3.8 lbs/gal |
| **6** | Transline | Dow Agro | 62719-259 | Clopyralid | 3 lb/gal |
| **7** | Telar | Dupont | 352-522 | Chlorsulfuron | |
| **8** | Escort | Dupont | 352-439 | Metsulfuron | |
| **9** | Vanquish | Nufarm | 100-884 | Diacamba | 4 lb/gal |
| **10** | Plateau | BASF | 241-365 | Imazapic | 2 lb/gal |
| **11** | | | | | |

Site Location:_____

_____

**FACTS ID:** _____ **SITE ID:** _____

Date _____ FACTS ID: _____ SITE ID: _____

| TIME | TEMP/ RH | WIND SP/DIR. | LAT./LONG. | REMARKS |
|---|---|---|---|---|
| | | | | |
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Comments:

_____

_____

_____

_____

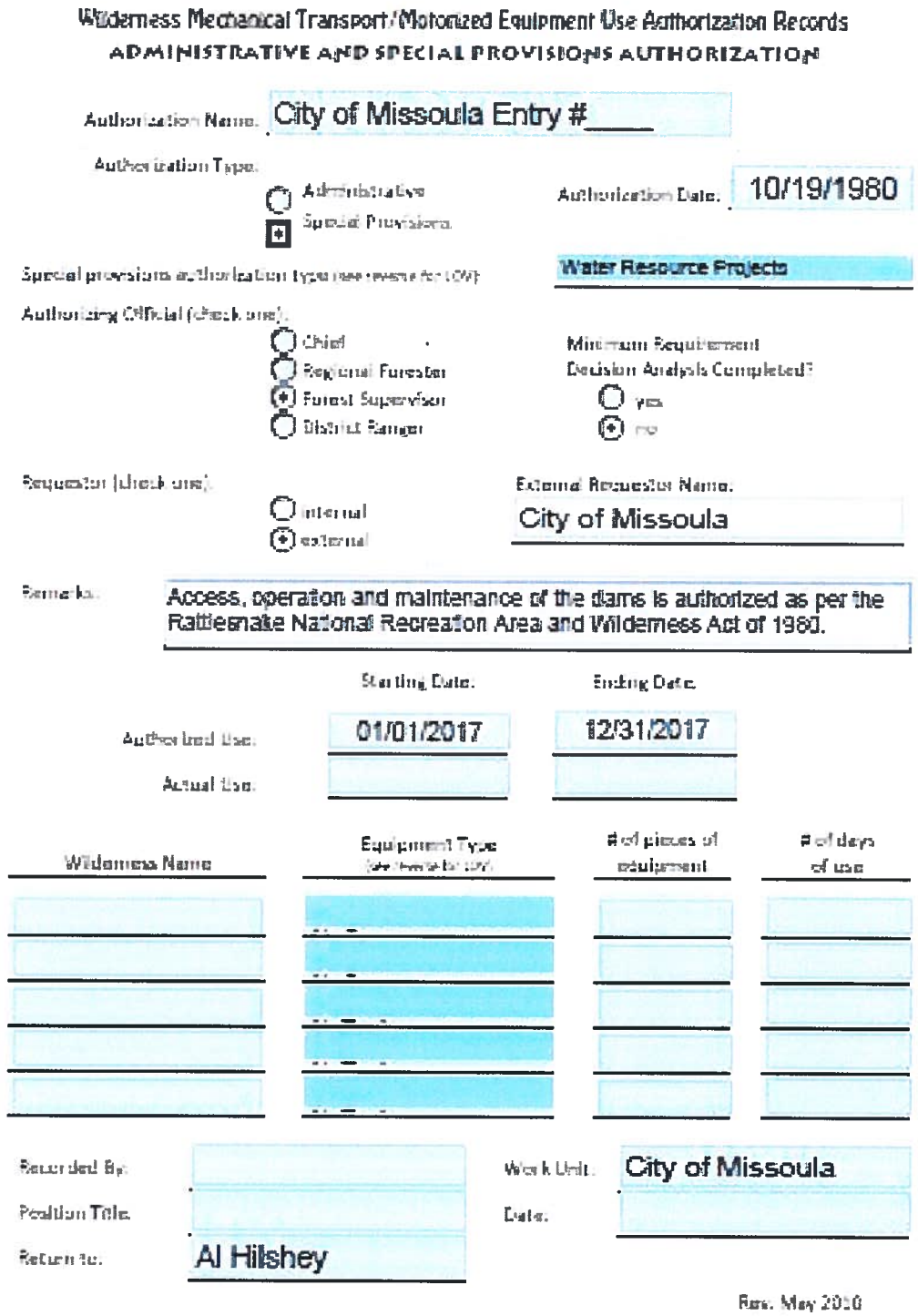
_____

_____

Map:

**Appendix E – Right of Way BMP Project List (Out-Year; To Be Determined)**

**Appendix F - Wilderness Mechanical Transport/ Motorized Equipment Use Authorization Records**
(Note: Request Electronic .pdf from Permit Administrator or Wilderness Ranger and Enter Information as Shown)



Wilderness Mechanical Transport/Motorized Equipment Use Authorization Records
ADMINISTRATIVE AND SPECIAL PROVISIONS AUTHORIZATION

Authorization Name: City of Missoula Entry #____

Authorization Type:
- ○ Administrative
- ⊡ Special Provisions

Authorization Date: 10/19/1980

Special provisions authorization type (see reverse for CW): Water Resource Projects

Authorizing Official (check one):
- ○ Chief
- ○ Regional Forester
- ⊡ Forest Supervisor
- ○ District Ranger

Minimum Requirement Decision Analysis Completed?
- ○ yes
- ⊡ no

Requestor (check one):
- ○ internal
- ⊡ external

External Requestor Name: City of Missoula

Remarks: Access, operation and maintenance of the dams is authorized as per the Rattlesnake National Recreation Area and Wilderness Act of 1980.

| | Starting Date: | Ending Date: |
|---|---|---|
| Authorized Use: | 01/01/2017 | 12/31/2017 |
| Actual Use: | | |

| Wilderness Name | Equipment Type (see reverse for CW) | # of pieces of equipment | # of days of use |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Recorded By:
Position Title:
Return to: Al Hilshey

Work Unit: City of Missoula
Date:

Rev. May 2010

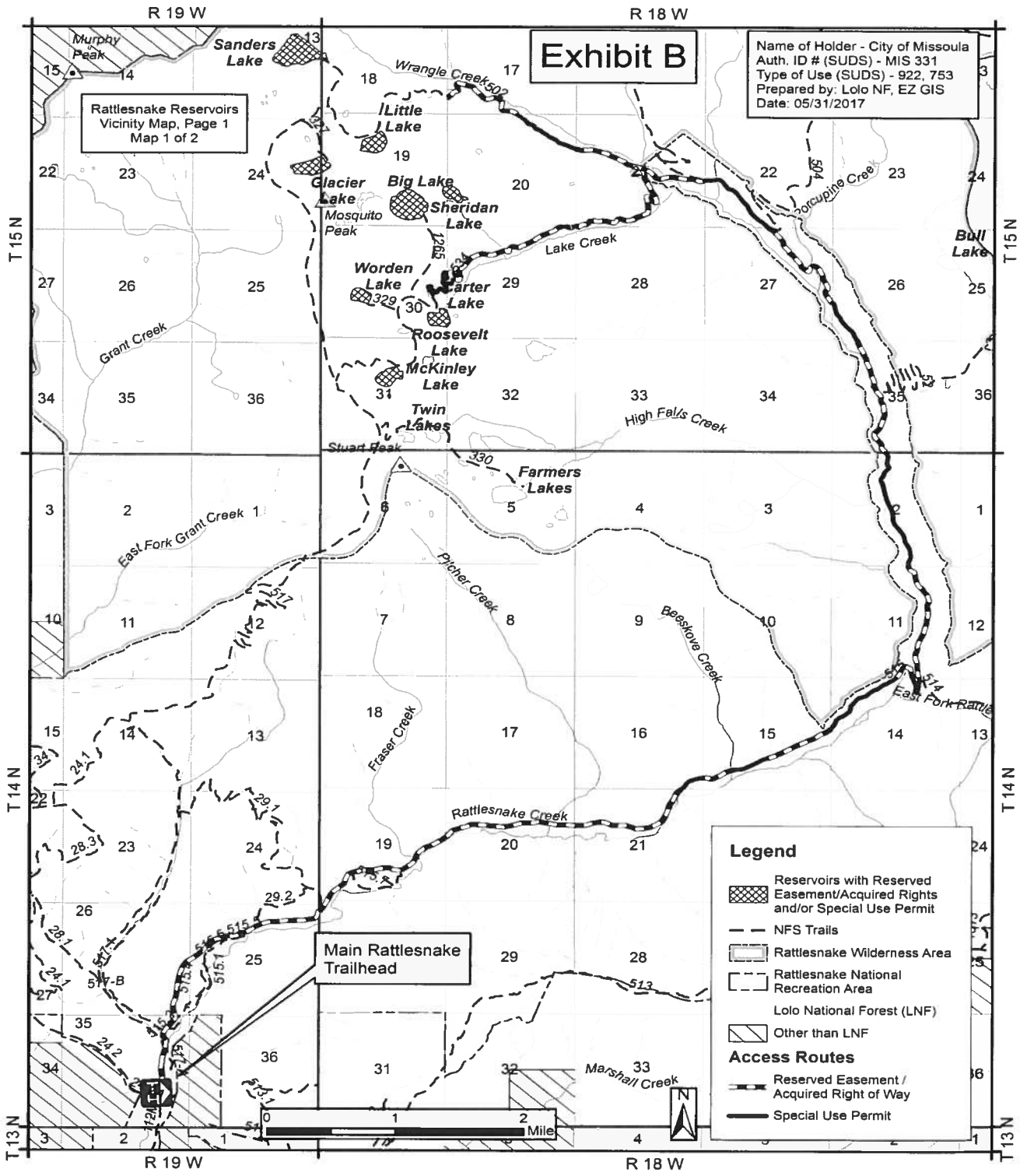
**Appendix F (Cont'd)** - List of Values for Wilderness Mechanized Transport / Motorized Equipment Use Authorizatio Record Form

## Administrative and Special Provisions Authorization

***Special Provision Authorization Type:***
ANILCA 1010 Mineral Assessment
ANILCA 1303 Cabins
ANILCA 1315 Facilities Access
ANILCA 1316 Taking Fish & Wildlife
ANILCA 803 and 811 Subsistence
Commercial Livestock Management
Fixed Equipment Installation and Maintenance
Mineral Rights
State & Private land Access
Utility Corridors
Water Resource Projects
Wildlife Management
***Equipment Type:***
Air compressor
Air Tanker
All Terrain Vehicle
Battery Powered Tool
Bicycle
Brush cutters
Chainsaw
Concrete Equipment
Fixed Wing Aircraft
Float Plane
Generator
Heavy Equipment
Helicopter
Leaf blower
Mist blower
Motorcycle
Motorized watercraft
Portable Pump
Power auger
Rock Drill
Snow Machines
Truck
Wheelbarrow
Wheeled Litter
Winch, Motorized

Note: The values listed above for Special Provision types and Equipment Types represent the current national standard data set. If you need a value that is missing, please either write it in the appropriate field if you are using a hard-copy forn or include it in the Remarks field if you are using the electronic version. Your Wilderness Data Steward will then request tl value be added in Infra-WILD by submitting a BASE ticket in time for the upward reporting in the fall.

**EXHIBIT B TO PERMIT- Rattlesnake Reservoirs Area Maps**



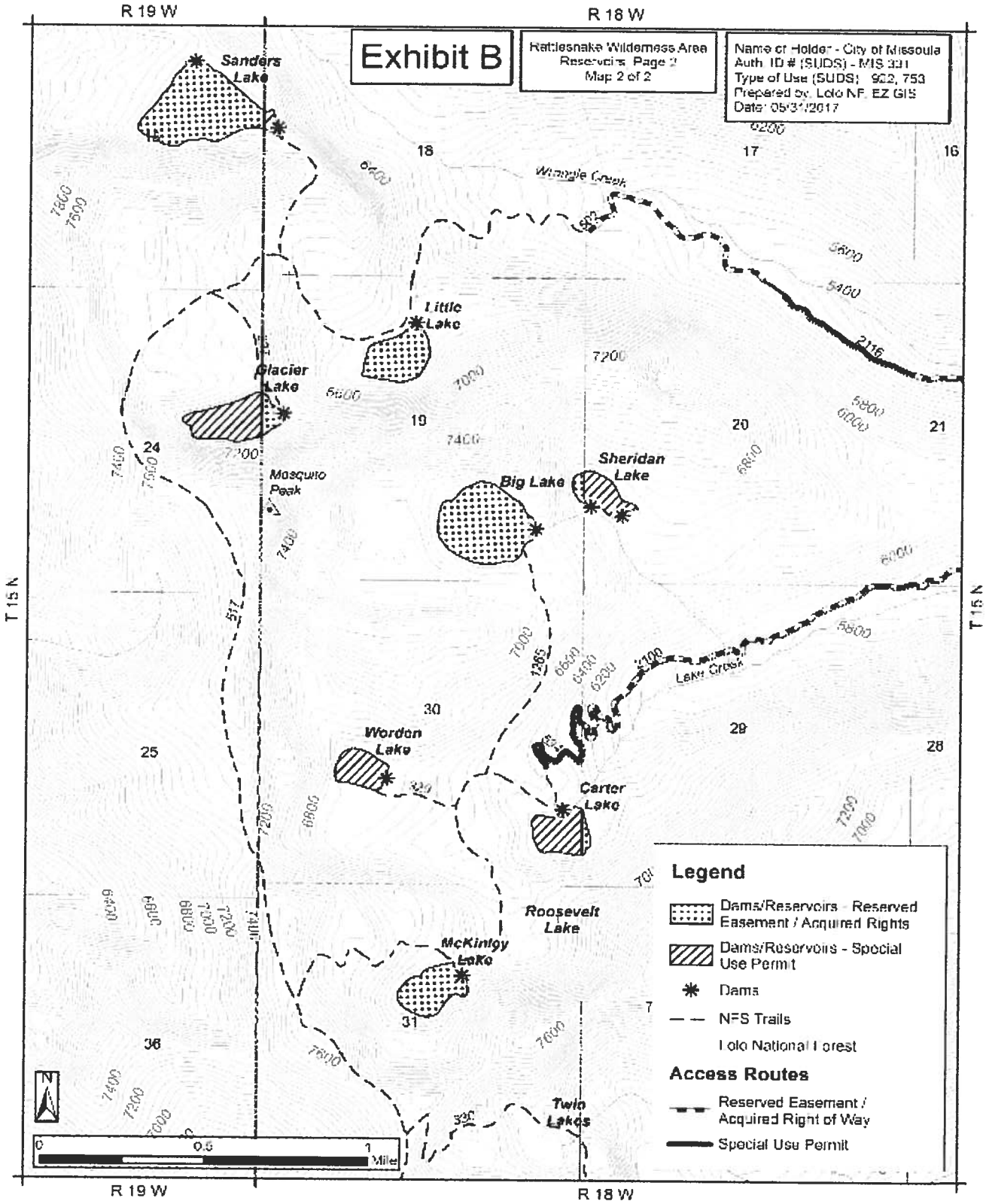


Exhibit B
Rattlesnake Wilderness Area
Reservoirs Page 2
Map 2 of 2
Name of Holder - City of Missoula
Auth ID # (SUDS) - MIS 331
Type of Use (SUDS): 902, 753
Prepared by: Lolo NF EZ GIS
Date: 05/31/2017
R 19 W
R 18 W
T 15 N
Sanders Lake
Little Lake
Glacier Lake
Mosquito Peak
Big Lake
Sheridan Lake
Wordon Lake
Carter Lake
Roosevelt Lake
McKinley Lake
Twin Lakes
Lake Creek
Wrangle Creek
Legend
Dams/Reservoirs - Reserved Easement / Acquired Rights
Dams/Reservoirs - Special Use Permit
Dams
NFS Trails
Lolo National Forest
Access Routes
Reserved Easement / Acquired Right of Way
Special Use Permit
0
0.5
1
Miles

EXHIBIT C TO PERMIT- Rattlesnake National Recreation Area and Wilderness Act of 1980



Public Law 96-476
96th Congress

# An Act

To establish the Rattlesnake National Recreation Area and Wilderness in the State of Montana.

Oct. 19, 1980
[S. 3072]

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That this Act may be cited as the "Rattlesnake National Recreation Area and Wilderness Act of 1980".

Rattlesnake National Recreation Area and Wilderness Act of 1980.
16 USC 460*ll* note.

## STATEMENT OF FINDINGS AND POLICY

16 USC 460*ll*.

SECTION 1. (a) The Congress finds that—

(1) certain lands on the Lolo National Forest in Montana have high value for watershed, water storage, wildlife habitat, primitive recreation, historical, scientific, ecological, and educational purposes. This national forest area has long been used as a wilderness by Montanans and by people throughout the Nation who value it as a source of solitude, wildlife, clean, free-flowing waters stored and used for municipal purposes for over a century, and primitive recreation, to include such activities as hiking, camping, backpacking, hunting, fishing, horse riding, and bicycling; and

(2) certain other lands on the Lolo National Forest, while not predominantly of wilderness quality, have high value for municipal watershed, recreation, wildlife habitat, and ecological and educational purposes.

(b) Therefore, it is hereby declared to be the policy of Congress that, to further the purposes of the Wilderness Act of 1964 (16 U.S.C. 1131) and the National Forest Management Act of 1976 (16 U.S.C. 1600), the people of the Nation and Montana would best be served by national recreation area designation of the Rattlesnake area to include the permanent preservation of certain of these lands under established statutory designation as wilderness, and to promote the watershed, recreational, wildlife, and educational values of the remainder of these lands.

## DESIGNATION AND MANAGEMENT OF RATTLESNAKE WILDERNESS AREA

16 USC 460*ll*-1, 1132 note.

SEC. 2. (a) In furtherance of the purposes of the Wilderness Act (78 Stat. 890; 16 U.S.C. 1131), certain lands within the Rattlesnake National Recreation Area as designated by this Act, which comprise approximately 33,000 acres as generally depicted as the "Rattlesnake Wilderness" on a map entitled "Rattlesnake National Recreation Area and Wilderness—Proposed", and dated October 1, 1980, are hereby designated as wilderness and shall be known as the Rattlesnake Wilderness.

(b) Subject to valid existing rights, the Rattlesnake Wilderness as designated by this Act shall be administered by the Secretary of Agriculture, hereafter referred to as the Secretary, in accordance with the provisions of the Wilderness Act governing areas designated

(3) If for any reason, including but not limited to the failure of the Secretary of the Interior to offer for lease lands in the Montana portion of the Powder River Coal Production Region as defined in the Federal Register of November 9, 1979 (44 FR 65196), or the failure of the holder of the bidding rights to submit a successful high bid for any such leases, any bidding rights issued in an exchange under this Act have not been exercised within three years from the date of enactment of this Act, the holder of the bidding rights may, at its election, use the outstanding bidding rights as a credit against any royalty, rental, or advance royalty payments owed to the United States on any Federal coal lease(s) it may then hold.

(4) It is the intent of Congress that the exchange of bidding rights for the private lands or interests therein authorized by this Act shall occur within three years of the date of enactment of this Act.

(5) In order to facilitate the exchange authorized by this Act, the Executive order captioned "Order of Withdrawal", of June 6, 1929, creating "Coal Reserve No. 1, Montana, No. 1", is hereby revoked to the extent that it constitutes a withdrawal of the lands therein from disposal under the Mineral Lands Leasing Act of 1920, as amended. 30 USC 181 note.

(c) The exchange of lands involving Burlington Northern, Inc. shall be in accordance with the agreement entitled "Statement of Intent" entered into by Burlington Northern, Inc. and the Regional Forester of the United States Forest Service, Region 1, signed September 18, 1980, and it is the intent of Congress that this exchange shall occur within three years of the date of enactment of this Act.

(d)(1) As non-Federal lands and interests in the Rattlesnake National Recreation Area are acquired, the lands shall become part of the Rattlesnake National Recreation Area. As non-Federal lands and interests in the Rattlesnake Wilderness are acquired, the lands shall become part of the Rattlesnake Wilderness. The Secretary shall publish from time to time a notice of such classifications in the Federal Register. It is the intention of Congress that acquisition of the non-Federal lands shall be completed no later than three years after the date of the enactment of this Act. Non-Federal lands. Publication in Federal Register.

(2) Nothing in this Act shall be construed to permit the Secretary to affect or diminish any water right which is vested under either State or Federal law at the time of enactment of this Act, nor the rights of the owner of such water right to the customary and usual access, including necessary motorized use over and along existing roads and trails to any facilities used in connection therewith, and the right to operate and maintain such facilities. Water rights.

FILING OF MAPS AND DESCRIPTIONS

SEC. 5. As soon as practicable after enactment of this Act, a map and legal description of the Rattlesnake National Recreation Area and a map and legal description of the Rattlesnake Wilderness shall be filed with the Committee on Interior and Insular Affairs of the House of Representatives and the Committee on Energy and Natural Resources of the United States Senate, and such maps and legal descriptions shall have the same force and effect as if included in this Act: *Provided, however,* That correction of clerical and typographical errors in such legal descriptions and maps may be made. Filing with congressional committees. 16 USC 460*ll*–4.

AUTHORIZATION OF APPROPRIATIONS

16 USC 460*ll*-5. SEC. 6. Effective October 1, 1981, there is hereby authorized to appropriated such funds as may be necessary to carry out purposes of this Act.

Approved October 19, 1980.

LEGISLATIVE HISTORY:

SENATE REPORT No. 96-996 (Comm. on Energy and Natural Resources).
CONGRESSIONAL RECORD, Vol. 126 (1980):
Oct. 1, considered and passed Senate.
Oct. 2, considered and passed House.

# Appendix O

# Original Rattlesnake Dam Plans

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Sketch showing type of construction
Not to scale
Approx. dimensions as shown are from best available data




Cu. yds. earth fill 1,659.25
Cu. ft. rock filled Crib 5,760.
Sq. ft. rock rip rap
Approx. acre's shore line cleared 33

# GLACIER LAKE

Storage 210 Acre-Feet

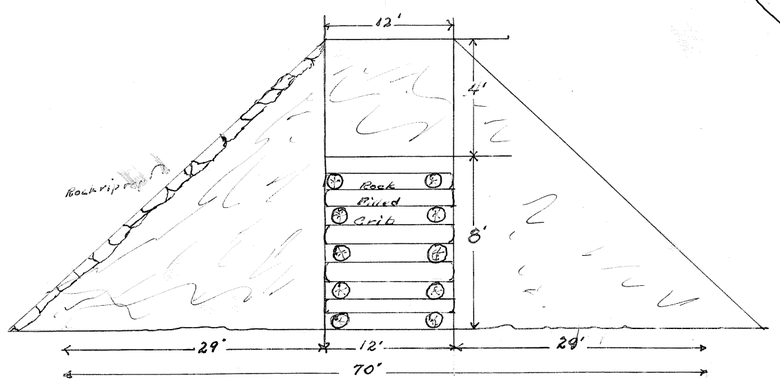
Lake built 1911
This lake broke in spring 1934
it took 5 men approx. 5 days to repair damage

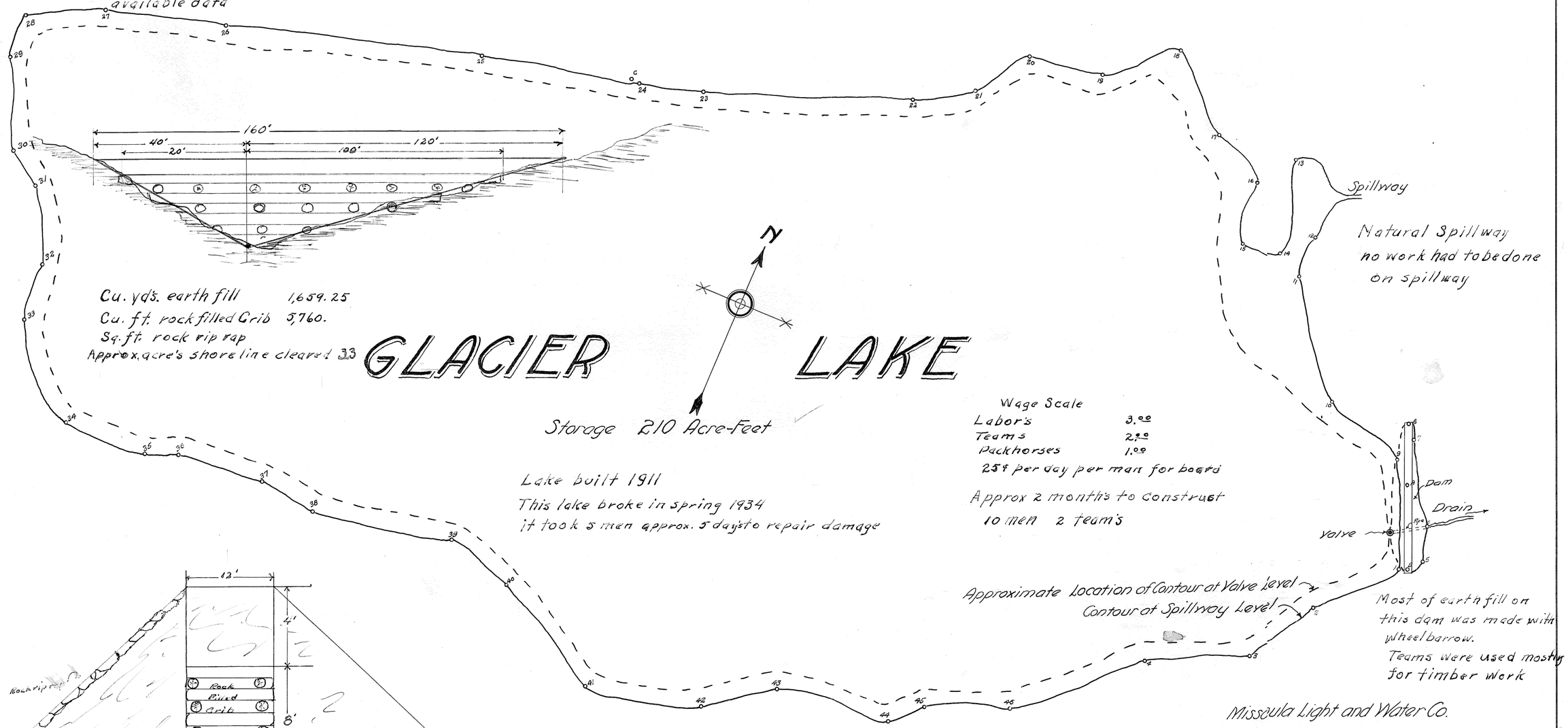
Wage Scale

| | |
|---|---|
| Labor's | 3.00 |
| Teams | 2.00 |
| Packhorses | 1.00 |

25¢ per day per man for board

Approx 2 months to construct
10 men 2 team's




Most of earth fill on this dam was made with wheelbarrow.
Teams were used mostly for timber work

Missoula Light and Water Co.
MAP OF
# LAKE No 1
Missoula, Mont. Aug. 27, 1915
Scale 1"=100'

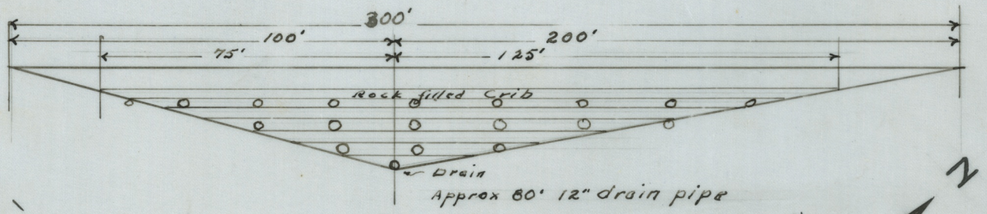
Area at Spillway Level - 928,600 sq ft = 21 Acres
" " Valve " - 829,800 " = 19 "
Depth from Spillway to Valve 10 Ft.
Capacity 69,000,000 Gallons.
Surveyed Aug. 15, 1915 - H.S. Thone

2181 F

Sketch showing type of construction
Not to Scale.
Approx dimensions as shown are
from best available data.
No. Slope of Lake Mostly rock ledges.
160'
40'
120'
20'
100'
Crest
Log Crib Rock filled
Rock Riprap
12'
4'
8'
Rock
Filled
Crib
29'
70'
Total cu. yds. earth fill 1,659.25
Total cu. ft. rock filled crib 5,760
3.3 Acres of Shoreline Cleared
This Lake had a natural
Spill way after Lake was filled
No Work had to be done on
Spillway
Wages.
Men labor 3.00 Per day
teamsters 4.00 " "
team's 2.00 " "
the above scale dose not
include Board
25¢ Per day Per man for board
Men had to furnish own
bedding
N
GLACIER LAKE
Storage 210 Acre-Feet
Work done in 1911
Building trail from Spring Gulch to
#1 Lake 3 men from July 16 to Aug. 9.
12'x 18' Log Cabin built at
same time dam was built
in Approx this location
Dam approx. 125'
long on top about 30' on
bottom at lowest point
Approx 2 months to Construct
10 men including Cook.
from about 12th Aug. to
about 12th Oct.
2 Teams about 1 month
about 10' or 12' in width
Wide enough for
road way
Rock Riprap
Approx in width 12'
12'
earth fill
Crib filled Mostly with Rock
Slope Approx. 2:1
Teams were used mostly
for timber work
loging off shores etc.
Hight of dam at this
point about 4'
Valve
Hight of dam at this
point about 18'
Approximate Location of Contour at Valve Level
dam about
70' Wide on Bottom
Contour at Spillway Level
Most of dirt fill was made
with Wheelbarrow on this dam
Very little dirt moved by team
This dam broke in Spring of 1924
Bill Sheridan took in 5 men (including himself)
and one team of horses, to repair break.
it took about 6 days to repair dam
dam was broke in approx center.
No cribbing had to be replaced.
At this time Cabins at Lakes #1 & 4
were tore down and New Cabin built
at present site
Jones & E. Head worked on this job
Some timber had to be loged off
of the No. & W. Slopes a strip that would
average about 35' in width had to be cleared
off.
Size of trees were 2' and down
Timber not very thick Some brush.
20
30
10
Befor this Lake was Completed about
3 men & 2 teams went #2 Lake site to
log off. this gang worked at #2 about 3 weeks
this times included in the two months
of Constrction of #1 Lake.
Earth in barrow Pits
was mostly Clay with some rock
no rock larger than could be handled by hand.
Crew lived in tents
during Construction
Pratt from Butte was in Chg. of Job
Mrs Pratt was Cook for Crew
MAP OF
LAKE No 1
Missoula Mont
Scale 1:400
Area at Spillway Level - 928600
Valve 820
Depth from Spillway to Valve 10
Capacity 69,000,000
Surveyed Aug. 15

Lake built 1912

Sketch showing type of construction
Not to Scale
Approx. dimensions as shown are from best available data.




Cu. yds. earth fill - - - - - 2,429.97
Cu ft. rockfilled crib - - - 9,600.
Sq. ft. rock rip rap - - - - - -
Approx. acres cleared - - - - - 3.7

Wage Scale

| | | |
|---|---|---|
| Labor's | 3.00 | per day |
| Team's | 2.00 | " " |
| Pack horse's | 1.00 | " " |
| Packer's | 5.00 | " " |

About 15 men and 6 teams worked on this job about 2½ month's
25¢ per. day per. man deducted for board

# LITTLE LAKE

Storage 297 Acre-Feet ✓

Timber extends approx the whole distant around this lake a strip about 50' wide had to be cleared.

Approximate Location of Contour at Valve Level
Contour at Spillway Level

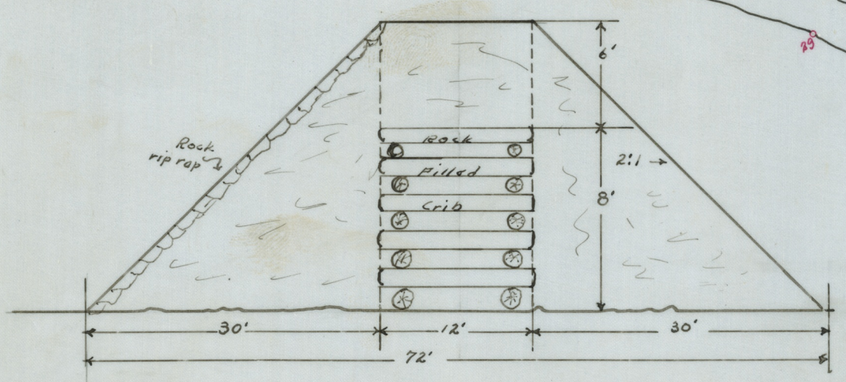
Cribbing at valve was built in 1935 about 5 men about 3 Weeks also had 4 pack horses also 1 team used

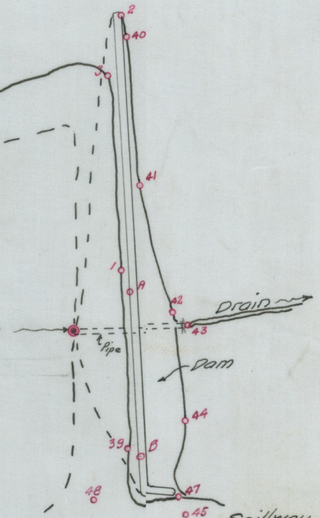
Wage's for above job

| | | |
|---|---|---|
| Labors | 5.00 | per. day |
| Team's | 2.00 | " " |
| Pack horse's | 1.00 | " " |

Approx. all of dirt work done With team's and slips
Most of labor used on clearing land

Earth mostly clay and rock



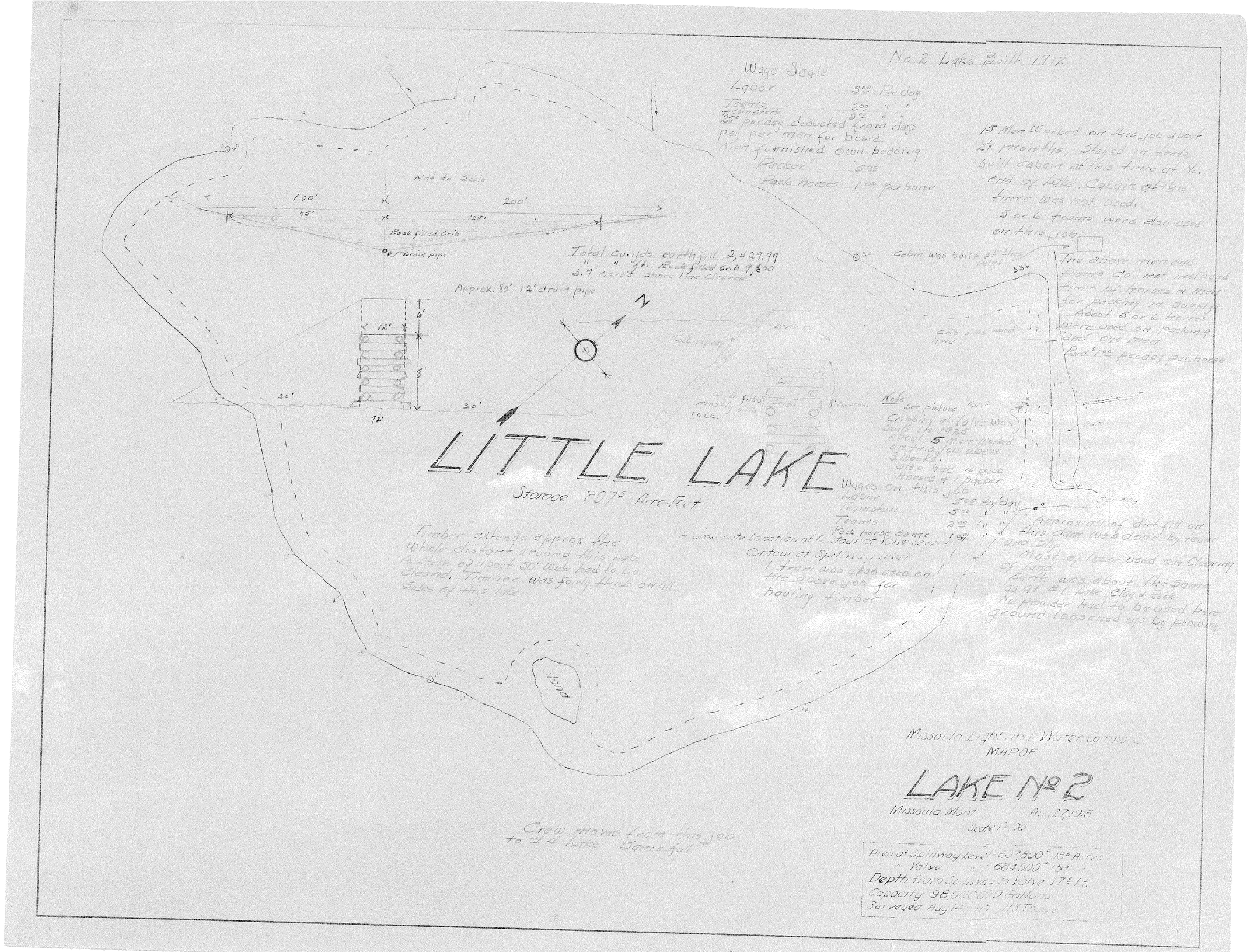

Missoula Light and Water Company
MAP OF

# LAKE № 2

Missoula, Mont. Aug. 27, 1915
Scale 1"=100'

Area at Spillway Level - 807,800 □' = 18.5 Acres
" " Valve " - 684,500 □' = 15.5 "
Depth from Spillway to Valve 17.5 Ft.
Capacity 98,000,000 Gallons
Surveyed Aug. 14, 1915 - H.S. Thorpe.

21816


No. 2 Lake Built 1912
Wage Scale
Labor 3.00 Per day
Teams 2.00 " "
Teamsters 3.00 " "
25¢ per day deducted from days pay per man for board
Men furnished own bedding
Packer 5.00
Pack horses 1.00 per horse
15 Men Worked on this job about 2½ months, Stayed in tents built cabin at this time at No. end of Lake. Cabin at this time was not used.
5 or 6 teams were also used on this job.
Not to Scale
100'
200'
75'
125'
Rock filled Crib
Drain pipe
Total cu. yds earth fill 2,429.97
" " ft. Rock filled Crib 9,600
3.7 Acres Shore line Cleared
Approx. 80' 12" drain pipe
Cabin was built at this point
The above men and teams do not included time of horses & men for packing in supplys
About 5 or 6 horses were used on packing and one man
Paid $1.00 per day per horse
12'
6'
8'
30'
30'
72'
N
Rock riprap
Crib filled mostly with rock
8' Approx.
Crib ends about here
Note See picture
Cribbing at Valve was built in 1925
About 5 men worked on this job about 3 weeks.
Also had 4 pack horses & 1 packer
LITTLE LAKE
Storage 297.5 Acre-Feet
Wages on this job
Labor 5.00 Per day
Teamsters 5.00 " "
Teams 2.00 " "
Pack horse same 1.00 " "
Approx all of dirt fill on this dam was done by team and slip
Most of labor used on Clearing of land
Earth was about the same as at #1 Lake Clay & Rock
No powder had to be used here ground loosened up by plowing
Timber extends approx the whole distant around this lake
A strip of about 50' wide had to be cleared. Timber was fairly thick on all sides of this lake
Approximate location of Contour at Valve level
Contour at Spillway level
1 team was also used on the above job for hauling timber
Crew moved from this job to #4 Lake Same fall
Missoula Light and Water Company
MAP OF
LAKE No 2
Missoula, Mont Aug 27, 1915
Scale 1"=100
Area at Spillway level 807,800 □' 18.5 Acres
" Valve " 684,500 □' 15.5 "
Depth from Spillway to Valve 17.5 Ft.
Capacity 98,000,000 Gallons
Surveyed Aug 14 1915 H.S. Toone

# BIG LAKE

N

Contour at Spillway Level

Approximate Location of Contour at Valve Level

Spillway

Dam

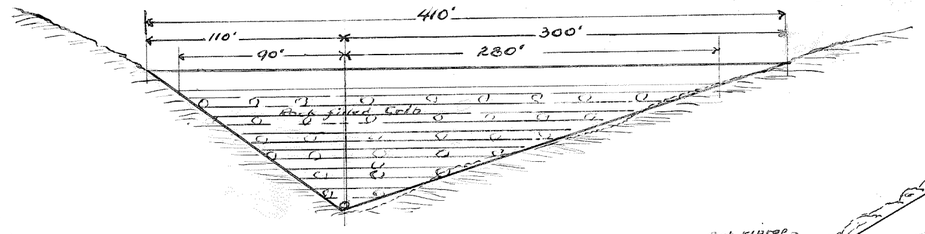
Pipe

Drain

Valve

Creek

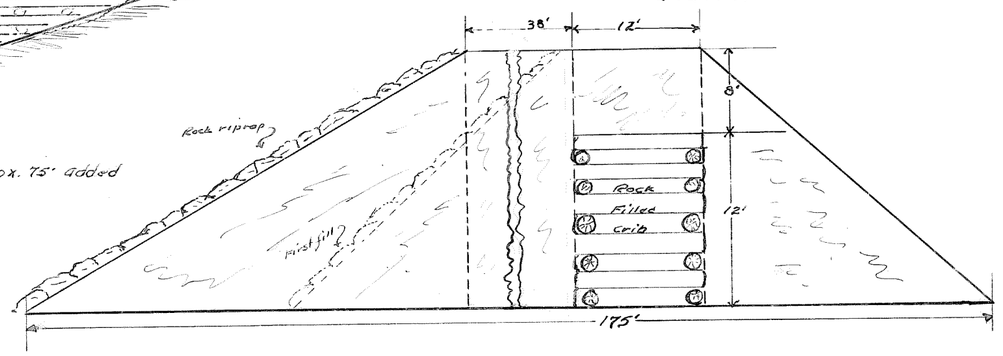
Storage 621.25 Acre-Feet




Dam was widened in 1920 approx. 75' added on bottom and 50' on top

15 men and 8 team's on this job approx. 3½ months.

Sketch Showing type of Construction
Not to Scale
Approx. dimensions as showing are from best available data




| | |
|---|---|
| Cu. yd's. earth fill | 13,925.38 |
| Cu. ft. rock filled crib | 26,640 |
| Sq. ft. rock riprap | |

Approx. 5-acre's of shore line logged off

Shore line heavely timbered a strip approx. 50' wide had to be cleared

Wage Scale

| | | |
|---|---|---|
| All labor | 3.50 | per day |
| Team's | 2.00 | " " |
| Pack horses eq. | 1.00 | " " |

25¢ per day per man for board

| | | |
|---|---|---|
| 15 Men | approx | 6 Month's |
| 8 Team's | " | " " |
| 8 Pack horse's | " | " " |

The above time dose not include time for widening dam in 1920

Missoula Light and Water Co.

MAP OF

## LAKE № 3

Missoula, Mont. Aug. 26, 1915

Scale 1"=100'

Area at Spillway level 1,652,750 □' = 38 Acres
" " Valve " 1,449,600 □' = 33 "
Depth from Spillway to Valve 17.5 Ft.
Capacity 203,000,000 Gallons
Surveyed Aug. 13, 1915 - H.S. Thane.

2181 L

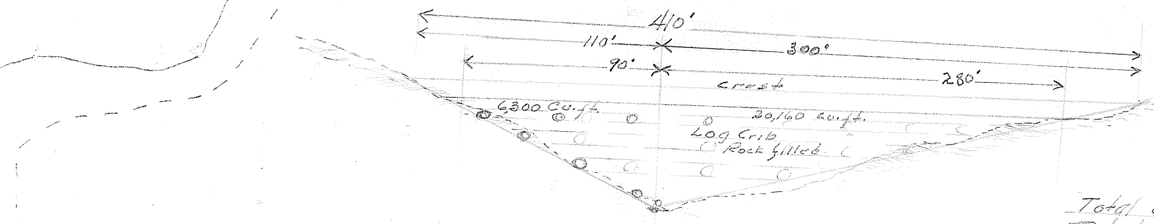
This Lake Was Constructed 1916 + 1917 + 1920?

## Wage Scale

| | |
|---|---|
| Laborers | 3.50 |
| Teamsters | 3.50 |
| Packer | 3.50 |
| Teams | 2.00 |
| Pack horses. Per head | 1.00 |

25¢ per day per mea
Men furnished own bedding.

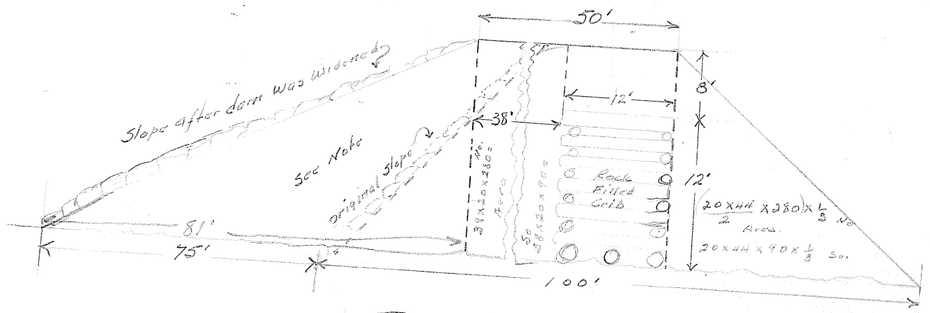
15 men about 6 months
6 Teams
1 Packer
8 Pack horses.
Note This time does not include time for widening dam at later date.



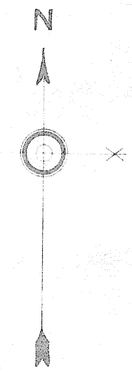

Total Cu. yds. earth fill dam 13,925.58
Total Cu. ft. Rock filled Crib 26,640
5 Acres of Shore line cleared

Dam was widened about 1920
15 men about 3½ months
8½ teams
1 Packer
8 Pack horses

Some powder had to be used at borrow pits to loosen dirt at time when this job was done

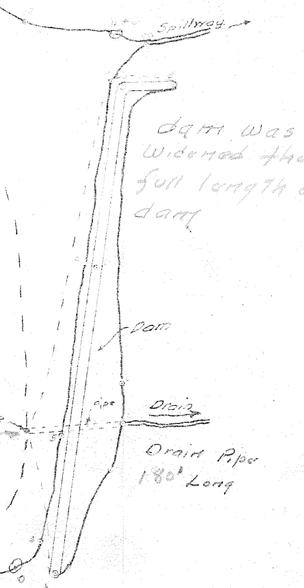



Contour at Spillway Level
Approximate Location of Contour at Valve Level




# BIG LAKE

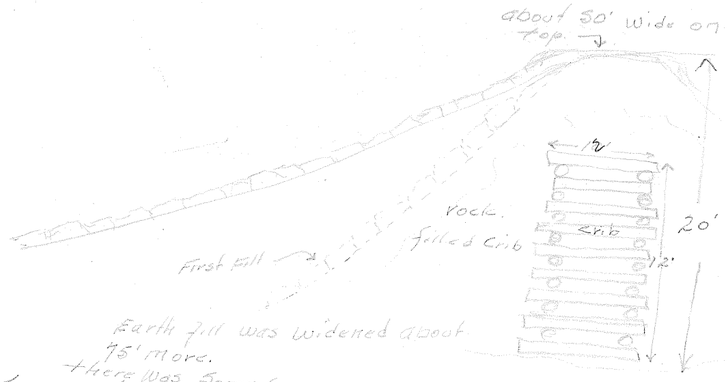
Storage 621.25 Acre-Feet




Dam about 20' deep at deepest point

12" Valve + 12" pipe

dam was widened the full length of dam




earth in borrow pits was clay + some rock
All dirt moved with Teams and Slips
Rocks also hauled by teams & Slips

Cabin

Cabin & Barn Built in 1916

Barn about 100' long

Cabin & Barn tore down in 1934 at time new Cabin was built at present site.

Shore line heavely timbered Strip approx 50' wide had to be cleared on all Shore lines Some brush

Missoula Light and Water Co.
MAP OF
# LAKE № 3
Missoula, Mont. Aug. 26, 1915
Scale 1"=100'

City Surveyer Hathaway was on this job about 3 weeks

Area at Spillway level 1,652,750 ☐' = 38 Acres
" " Valve " 1,449,600 ☐' = 33 "
Depth from Spillway to Valve 17.5 Ft.
Capacity 20,300,000 Gallons
Surveyed Aug. 13, 1915 - H.S. Thane.

Trail

Underbrush But Standing

# SANDERS LAKE

N

Storage 897.75 Acre-Feet

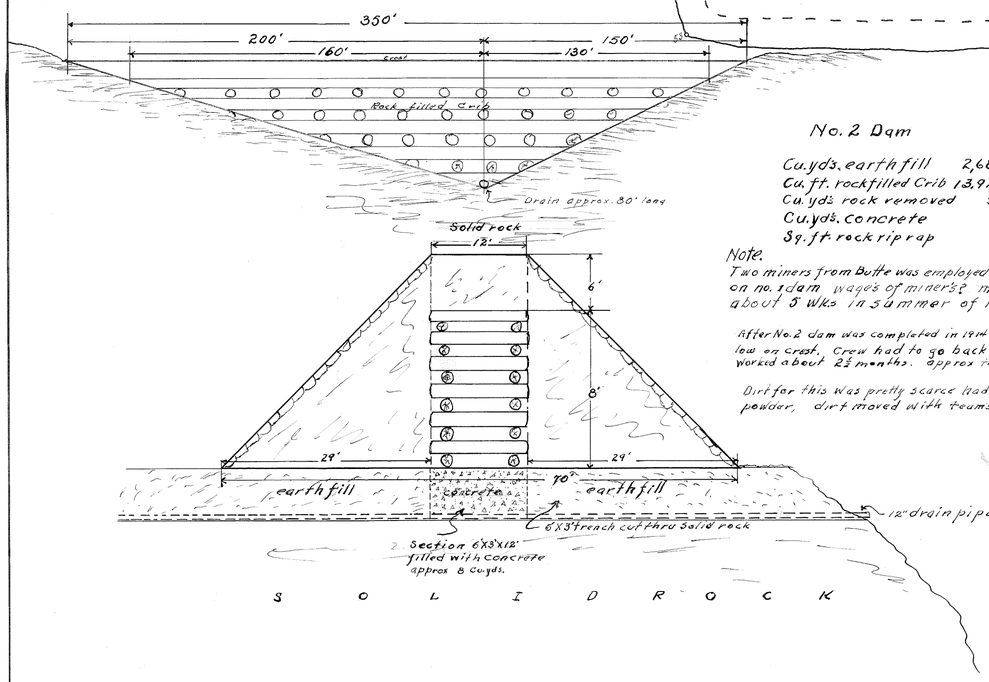
Approx. 6.7 acres of shore line cleared of timber
Timber not very heavy some brush a strip approx.
50' Wide had to be cleared.

No. 2 dam built in 1914 and 1915
15 men worked on this job about 3 months also had about
6 teams 1 packer and 5 or 6 pack horses
Same wage scale.
This dam built on ledge of rock

## Totals of No's 1 and 2 dams

| | |
|---|---|
| Cu. yds. earth fill | 4,367.62 |
| Cu. ft. rock filled crib | 25,440. |
| Cu. yds. solid rock removed | 50 |
| Cu. yds. concrete | 8 |
| Sq. yds. rock rip rap | |

## No. 2 Dam

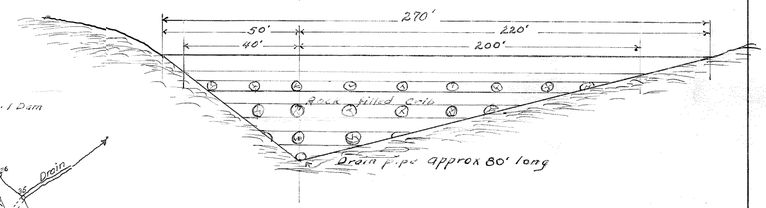



| | |
|---|---|
| Cu. yds. earth fill | 2,687.63 |
| Cu. ft. rock filled Crib | 13,920. |
| Cu. yds. rock removed | 50 |
| Cu. yds. concrete | 8 |
| Sq. ft. rock rip rap | |

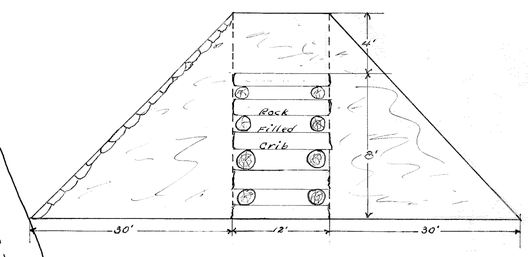
Note.
Two miners from Butte was employed to do rock work on no. 1 dam wages of miners? miners worked about 5 wks in summer of 1914.

After No. 2 dam was completed in 1914 it was checked for hight and found to be about 4 ft. low on crest. Crew had to go back in spring of 1915 and raise dam at this time they worked about 2½ months. approx the same size worked this time as in 1914

Dirt for this was pretty scarce had to be hauled considerable distance and loosened with powder, dirt moved with teams and slips.




## No. 1 Dam




## No 1 Dam

| | |
|---|---|
| Cu. yds earth fill | 1679.99 |
| " ft. rock filled crib | 11,520 |
| Sq. yds rock rip rap | |

## Wage Scale

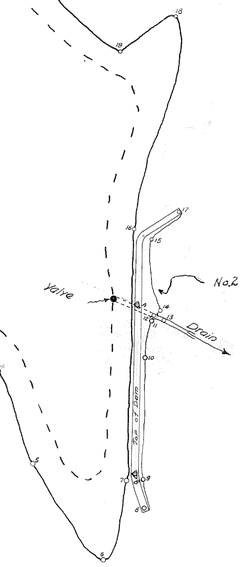
| | | |
|---|---|---|
| Labor's | per. day | 3.00 |
| Teamster's | " " | 5.00 |
| Teams | " " | 2.00 ea. |
| Pack horses | " " | 1.00 " |
| Packers | " " | 3.00 " |

25¢ per. day per. man deducted for board.

No. 1 Dam built in 1912 and 1913
15 men and 6 teams worked on this job about 4 months they also had 1 packer and 6 pack horses this time dose not include foreman who got 4.00 per day. No work done on No. 2 dam at this time Same wage Scale as above

Contour at Spillway Level
Approximate Location of Contour at Valve Level

NOTE.
Sketches showing type of construction — Not to Scale —
Approx. dimensions as shown are from best available data.



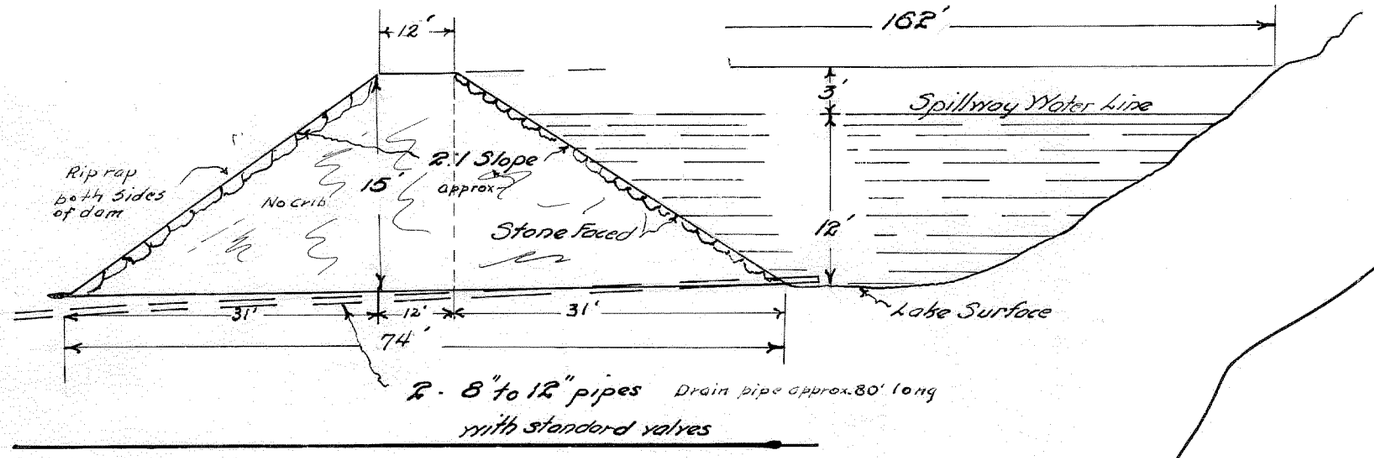

Missoula Light and Water Co.
MAP OF
# LAKE No 4

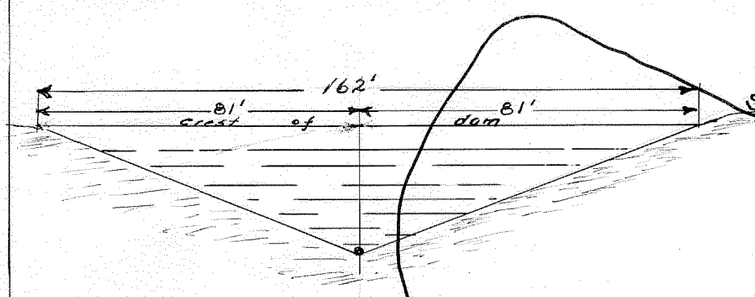
Missoula, Mont. Aug 24, 1915
Scale 1" = 100'

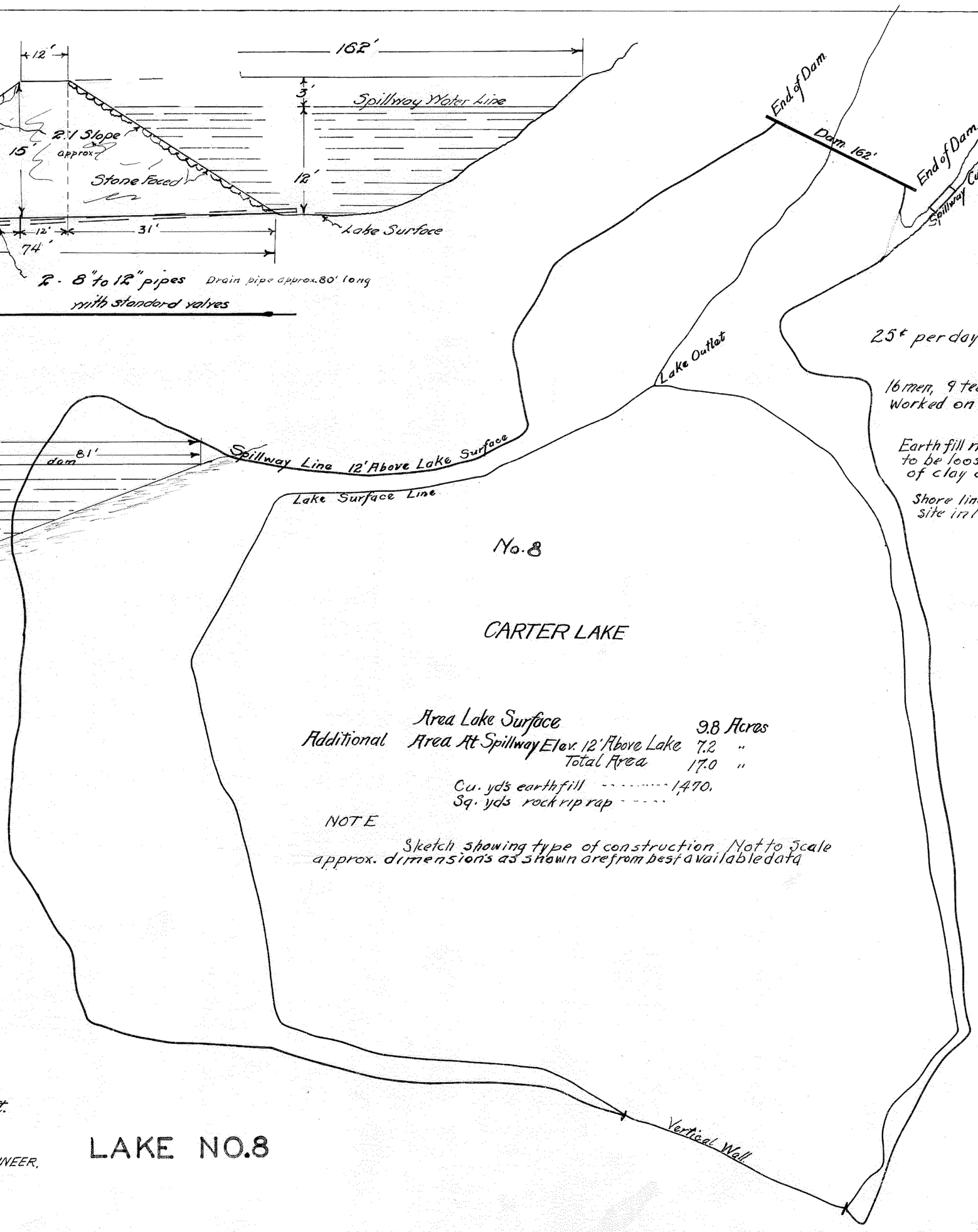
Area at Spillway level 1,965,300 Sq ft = 45 Acres
" " Valve " 1,769,300 " = 40⅝ "
Depth from Spillway to Valve 21 Ft.
Capacity 295,000,000 Gallons
Surveyed Aug 16, 1915 - H.S. Thane.

3181 B

No.1 Dam
270'
50'
40'
220'
200'
Rock filled Crib
No.1 Dam
Total Cu. yds earth fill - 1,679.99
Total Cu. ft of rock filled Crib 11,520.
12'
4'
8'
Rock Filled Crib
30'
72'
30'
#1
Construction of this dam is approx the Same as dams at #1 + #2 Lakes Earth fill Was made teams + Slip dirt from borrow pits Was Mostly Clay with Some rock. dirt was loosened with horses + Plows
Cabin and Barn was built at Same time that dam was being Const. timber for all Const. Was gotten off of clearing on Shore lines.
Note
This Cabin + Barn was tore down in 1934 See #1 Lake Print for details.
Cabin
Barn
#1 Dam
Drain
Valve
Spillway
#1 Dam
This Dam was built in Fall 1912 and Spring and Summer of 1913
It took About 4 months to build this dam 15 men, 6 teams on job besides Brown Who was in chg of work Brown got 4.00 Per day
1 Packer + 6 Pack horses.
Wage Scale
Labors 3.00 Per day
Teamsters 5.00 " "
Teams 2.00 " "
Pack horses 1.00 " "
Packers 3.00 " "
25¢ per day deducted for board
Men furnished own bedding
Note
2 Miners from Butte Was employed to do rock work on #1 dam
Wages of Miners — ?
Miners Worked about 5 Weeks in Summer of 1914
Crest of Dam
Total Cu. yds 4367.62
Total Cu. yds. rock filled Crib 25,440
SANDERS LAKE
N
6.7 Acre's of Shore line cleared of timber
Concrete
Rock Filled
3'
12" Steel
Solid
Solid
rock
Mostly Timber
Trail to dam
Storage 897.75 Acre-Feet
Rock rip rap
Earth fill
Crib
Rock Filled
Rock Filled Crib
Valve Key
Valve
10'
Solid
rock
12" Steel Pipe
Solid
rock
#2
This dam was built in 1914
15 men worked on this dam about 3 months about 6 teams, 1 packer + about 5 or 6 pack horses.
Note
After this dam was Completed in 1914 it Was Checked for height By Sheridan and Thane and found to be 4' Low on Crest.
Gang had to go back in Spring of 1915 and Spent about 2½ months raising dam about 4'
Approx Same amount of men and equipment was used this time as time before in 1914
No.2 Dam
350'
200'
150
160'
130'
Rock filled crib
Solid Rock
Total cu. yds earth fill 2,687.63
Total cu. ft Rock filled Crib 13,920.
Cu. yds Solid rock removed
Cu. yds Con crete - - - Approx 8
60
dirt for this dam Was pretty Scarce had to be hauled quite a distance and loosened Some with powder.
Contour at Spillway Level
Approximate Location of Contour at Valve Level
12'
4'
8'
Rock Filled Crib
Riprap
29'
29'
6 x 3' Trench cut in Solid rock for drain pipe
— Solid rock —
Very little timber had to be cleared off of this site timber Scarce Some brush Strip approx 50' wide
This dam was constructed in 1914 + 1915
Valve
Drain
#2 dam
this dam built on ledge of rock
Missoula Light and Water Co.
MAP OF
LAKE No 4
Missoula, Mont. Aug. 24, 1915
Scale 1"=100'
Rock Ledge
Information From
Bill Sheridan
Area at Spillway level - 1,965,500 Sq. ft = 45 Acres
Valve - 1,689,300 = 40
Depth from Spillway to Valve 21.11
Capacity 293,000,000 Gallons
Surveyed Aug 16, 1915 - H.S. Thane
3181 B




Wage Scale per day

Labor's all kinds ..... 5.00
Team's ..... 2.00
Pack horse's ..... 1.00

25¢ per day per man deducted for board

16 men, 9 team's, 1 packer and 15 packhorse's worked on this job approx. 1¼ month's

Earth fill made with team's and slips, earth had to be loosened with powder, earth consists of clay and some rock.

Shore line timber, was cleared off of this lake site in 1922 - See note on print of No. 6 lake.

Area Lake Surface 9.8 Acres
Additional Area At Spillway Elev. 12' Above Lake 7.2 "
Total Area 17.0 "

Cu. yds earth fill ..... 1,470.
Sq. yds rock rip rap .....

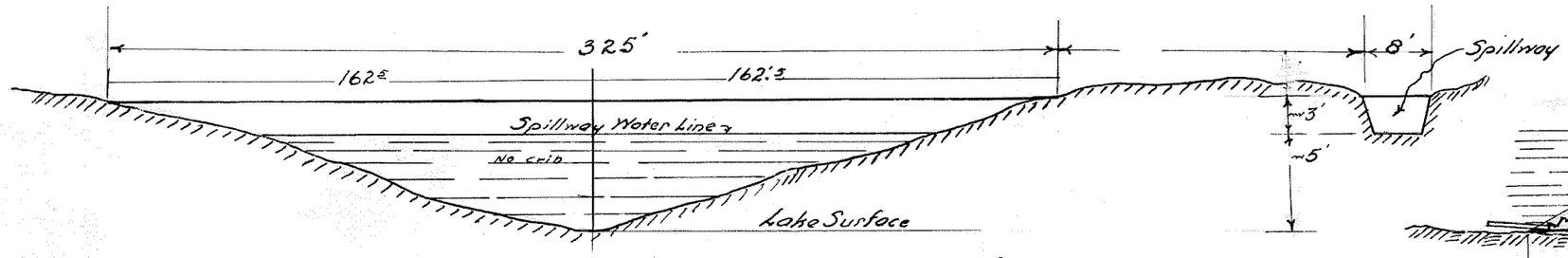
NOTE

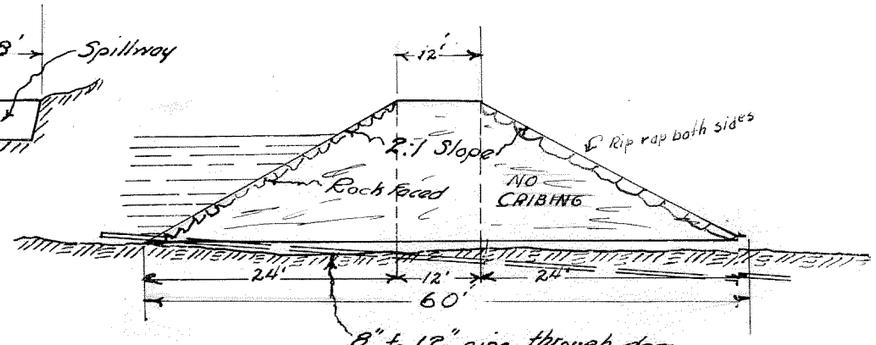
Sketch showing type of construction. Not to Scale approx. dimension's as shown are from best available data

Scale 1 IN. - 100 Ft.
Sept 20 - 1921.
E. S. HATHAWAY - ENGINEER.

# LAKE NO. 8

5'
12'
162'
3'
Spillway Water Line
Both Sides of dam riprapped
2-1 Slope
No Crib in dam
15'
Stone faced
12'
Lake Surface
65' 74'
2 - 8" to 12" pipes with standard valves
162'
12"
Approx Length of drain pipes 80'
12'
15'
31'
12'
31'
End of Dam
Dam 162'
End of Dam
Spillway Cut 3'
Lake Outlet
Spillway Line 12' Above Lake Surface
Lake Surface Line
No. 8
Total cu. yds. of Earth fill 1490
CARTER LAKE
Area Lake Surface 9.8 Acres
Additional Area At Spillway Elev. 7.2 "
Timber Cleared off in 1922
See Note on Print # 6 lake
Wage Scale
Labors 5.00
Teamsters 5.00
Packer 5.00
Teams 2.00
Pack horses 1.00
25¢ per day per Man deducted for Board + Room
1½ months
16 Men ~~1 month + 1 Wk~~
9 teams " " " "
1 Packer " " " "
15 Pack horses " " " "
Earth fill made with teams and Slips
Earth loosened with powder
Earth Clay + Some rock Loosened with powder
Quite a bit of powder used.
Approx 1 wk. was spent in Clearing brush + dead timber from dam site



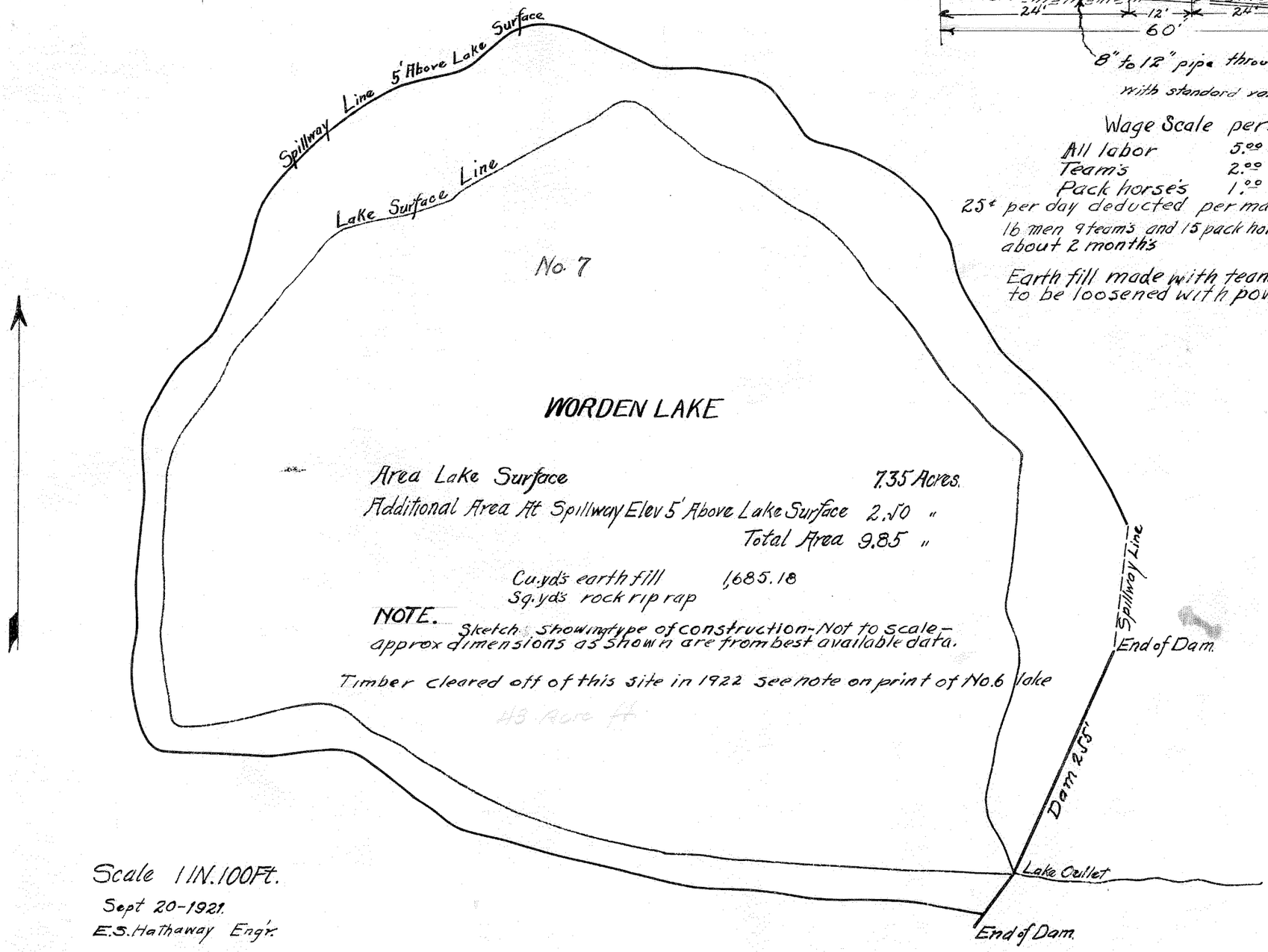

Wage Scale per. day

| | |
|---|---|
| All labor | 5.00 |
| Team's | 2.00 |
| Pack horse's | 1.00 |

25¢ per day deducted per man for board

16 men 9 team's and 15 pack horse's worked on this dam about 2 month's

Earth fill made with team's and slip's, earth had to be loosened with powder — Clay and rock




Area Lake Surface 7.35 Acres.
Additional Area At Spillway Elev 5' Above Lake Surface 2.50 "
Total Area 9.85 "

Cu.yd's earth fill 1,685.18
Sq.yd's rock rip rap

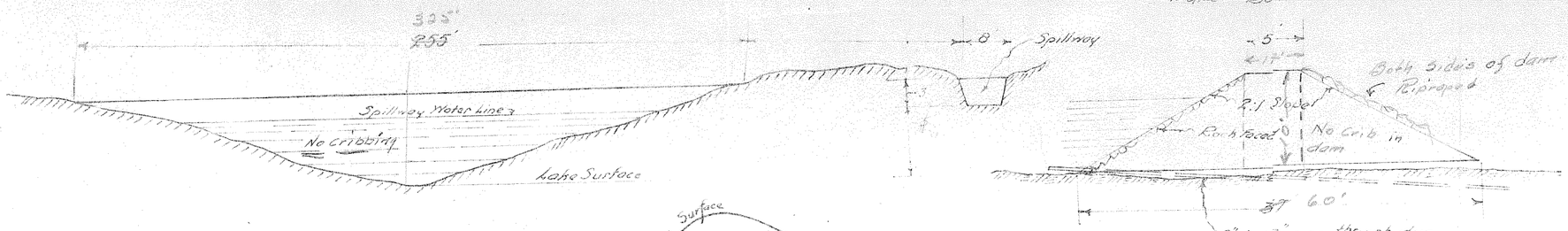
NOTE. Sketch showing type of construction-Not to scale-approx dimensions as shown are from best available data.

Timber cleared off of this site in 1922 see note on print of No.6 lake

Scale 1 IN. 100 Ft.
Sept 20-1921.
E.S. Hathaway Eng'r.

# LAKE NO. 7

Lake Built in 1923



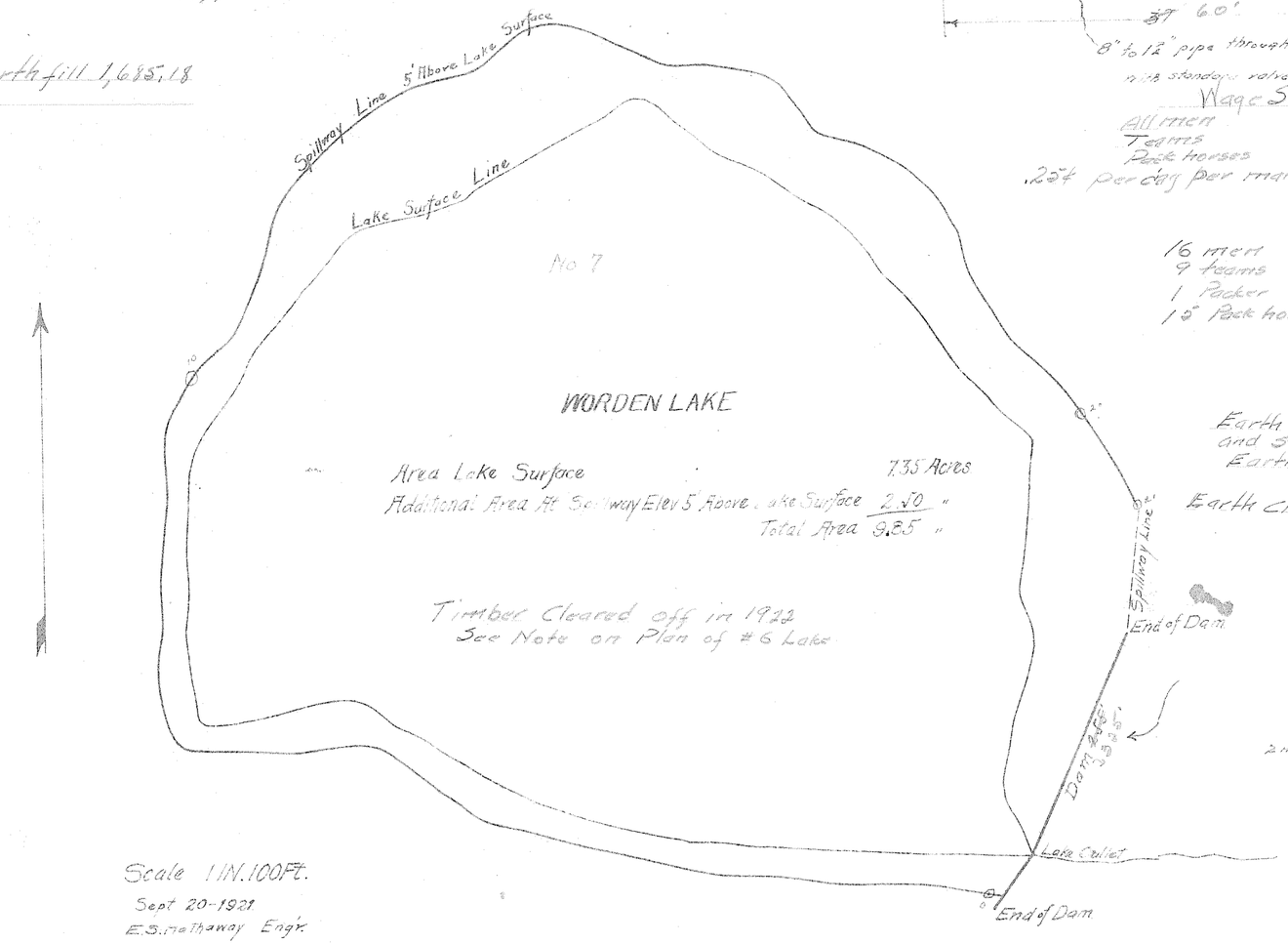

Total Cu.yds earth fill 1,685.18

Wage Scale

| | Per day |
|---|---|
| All men | 5.00 |
| Teams | 2.00 |
| Pack horses | 1.00 |

.25¢ per day per man for board & room

| | |
|---|---|
| 16 men | 2 months |
| 9 teams | " " |
| 1 Packer | " " |
| 15 Pack horses | " " |




Earth fill made with teams and Slips
Earth loosened with powder
Earth clay with some rock

Scale 1 IN. 100 Ft.
Sept 20-1923
E.S. Hathaway Engr.

Information — Bill Sheridan

Bill Sheridan In Chg. of Work

# Appendix P

# Rattlesnake Wilderness Designation

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Public Law 96-476
96th Congress

# An Act

To establish the Rattlesnake National Recreation Area and Wilderness in the State of Montana.

Oct. 19, 1980
[S. 3072]

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That this Act may be cited as the "Rattlesnake National Recreation Area and Wilderness Act of 1980".

Rattlesnake National Recreation Area and Wilderness Act of 1980.
16 USC 460*ll* note.

## STATEMENT OF FINDINGS AND POLICY

16 USC 460*ll*.

SECTION 1. (a) The Congress finds that—

(1) certain lands on the Lolo National Forest in Montana have high value for watershed, water storage, wildlife habitat, primitive recreation, historical, scientific, ecological, and educational purposes. This national forest area has long been used as a wilderness by Montanans and by people throughout the Nation who value it as a source of solitude, wildlife, clean, free-flowing waters stored and used for municipal purposes for over a century, and primitive recreation, to include such activities as hiking, camping, backpacking, hunting, fishing, horse riding, and bicycling; and

(2) certain other lands on the Lolo National Forest, while not predominantly of wilderness quality, have high value for municipal watershed, recreation, wildlife habitat, and ecological and educational purposes.

(b) Therefore, it is hereby declared to be the policy of Congress that, to further the purposes of the Wilderness Act of 1964 (16 U.S.C. 1131) and the National Forest Management Act of 1976 (16 U.S.C. 1600), the people of the Nation and Montana would best be served by national recreation area designation of the Rattlesnake area to include the permanent preservation of certain of these lands under established statutory designation as wilderness, and to promote the watershed, recreational, wildlife, and educational values of the remainder of these lands.

## DESIGNATION AND MANAGEMENT OF RATTLESNAKE WILDERNESS AREA

16 USC 460*ll*-1, 1132 note.

SEC. 2. (a) In furtherance of the purposes of the Wilderness Act (78 Stat. 890; 16 U.S.C. 1131), certain lands within the Rattlesnake National Recreation Area as designated by this Act, which comprise approximately 33,000 acres as generally depicted as the "Rattlesnake Wilderness" on a map entitled "Rattlesnake National Recreation Area and Wilderness—Proposed", and dated October 1, 1980, are hereby designated as wilderness and shall be known as the Rattlesnake Wilderness.

(b) Subject to valid existing rights, the Rattlesnake Wilderness as designated by this Act shall be administered by the Secretary of Agriculture, hereafter referred to as the Secretary, in accordance with the provisions of the Wilderness Act governing areas designated

16 USC 1131 note.

by that Act as wilderness: *Provided,* That any reference in such provisions to the effective date of the Wilderness Act shall be deemed to be a reference to the effective date of this Act.

DESIGNATION AND MANAGEMENT OF RATTLESNAKE NATIONAL RECREATION AREA

16 USC 460*ll*-2.

SEC. 3. An area of land as generally depicted as the "Rattlesnake National Recreation Area" on a map entitled "Rattlesnake National Recreation Area and Wilderness—Proposed", and dated October 1, 1980, is hereby established as the Rattlesnake National Recreation Area.

LAND ACQUISITION AND EXCHANGE

16 USC 460*ll*-3.

SEC. 4. (a) Within the boundaries of the Rattlesnake National Recreation Area and Rattlesnake Wilderness, the Secretary is authorized and directed to acquire with donated or appropriated funds including amounts appropriated from the Land and Water Conservation Fund, by exchange, gift, or purchase, such non-Federal lands, interests, or any other property, in conformance with the provisions of this section. Nothing in this Act shall be construed to limit or diminish the existing authority of the Secretary to acquire lands and interests therein within or contiguous to the Rattlesnake National Recreation Area or Rattlesnake Wilderness.

(b)(1) The Secretary of the Interior, in consultation with the Secretary of Agriculture, is authorized to consider and consummate an exchange with the owner of the private lands or interests therein within or contiguous to the boundaries of the Rattlesnake National Recreation Area and Rattlesnake Wilderness, as described in sections 2 and 3 of this Act, by which the Secretary of the Interior may accept conveyance of title to these private lands for the United States and in exchange issue bidding rights that may be exercised in competitive coal lease sales, or in coal lease modifications, or both, under sections 2 and 3 of the Mineral Lands Leasing Act of 1920, as amended (30 U.S.C. 201(a), 203). Any lands so acquired shall become national forest lands under the jurisdiction of the Secretary of Agriculture to be managed in accordance with the provisions of this Act and other laws applicable to the management of national forest lands. Nothing in this Act shall be construed to limit or diminish any existing authority of the Secretaries of the Interior and Agriculture to acquire private lands and interests therein in the Rattlesnake National Recreation Area and Rattlesnake Wilderness. Nothing in this Act shall be construed to require any owner of the lands within or contiguous to the Rattlesnake National Recreation Area or Rattlesnake Wilderness to accept coal lease bidding rights in exchange for title to those private lands.

Coal lease bidding rights.

(2) The coal lease bidding rights to be issued may be exercised as payment of bonus or other payment required of the successful bidder for a competitive coal lease, or required of an applicant for a coal lease modification. The bidding rights shall equal the fair market value of the private lands or interests therein conveyed in exchange for their issuance. The use and exercise of the bidding rights shall be subject to the provisions of the Secretary of the Interior's regulations governing coal lease bidding rights, to the extent that they are not inconsistent with this Act, that are in effect at the time the bidding rights are issued.

(3) If for any reason, including but not limited to the failure of the Secretary of the Interior to offer for lease lands in the Montana portion of the Powder River Coal Production Region as defined in the Federal Register of November 9, 1979 (44 FR 65196), or the failure of the holder of the bidding rights to submit a successful high bid for any such leases, any bidding rights issued in an exchange under this Act have not been exercised within three years from the date of enactment of this Act, the holder of the bidding rights may, at its election, use the outstanding bidding rights as a credit against any royalty, rental, or advance royalty payments owed to the United States on any Federal coal lease(s) it may then hold.

(4) It is the intent of Congress that the exchange of bidding rights for the private lands or interests therein authorized by this Act shall occur within three years of the date of enactment of this Act.

(5) In order to facilitate the exchange authorized by this Act, the Executive order captioned "Order of Withdrawal", of June 6, 1929, creating "Coal Reserve No. 1, Montana, No. 1", is hereby revoked to the extent that it constitutes a withdrawal of the lands therein from disposal under the Mineral Lands Leasing Act of 1920, as amended. 30 USC 181 note.

(c) The exchange of lands involving Burlington Northern, Inc. shall be in accordance with the agreement entitled "Statement of Intent" entered into by Burlington Northern, Inc. and the Regional Forester of the United States Forest Service, Region 1, signed September 18, 1980, and it is the intent of Congress that this exchange shall occur within three years of the date of enactment of this Act.

(d)(1) As non-Federal lands and interests in the Rattlesnake National Recreation Area are acquired, the lands shall become part of the Rattlesnake National Recreation Area. As non-Federal lands and interests in the Rattlesnake Wilderness are acquired, the lands shall become part of the Rattlesnake Wilderness. The Secretary shall publish from time to time a notice of such classifications in the Federal Register. It is the intention of Congress that acquisition of the non-Federal lands shall be completed no later than three years after the date of the enactment of this Act. Non-Federal lands. Publication in Federal Register.

(2) Nothing in this Act shall be construed to permit the Secretary to affect or diminish any water right which is vested under either State or Federal law at the time of enactment of this Act, nor the rights of the owner of such water right to the customary and usual access, including necessary motorized use over and along existing roads and trails to any facilities used in connection therewith, and the right to operate and maintain such facilities. Water rights.

FILING OF MAPS AND DESCRIPTIONS

SEC. 5. As soon as practicable after enactment of this Act, a map and legal description of the Rattlesnake National Recreation Area and a map and legal description of the Rattlesnake Wilderness shall be filed with the Committee on Interior and Insular Affairs of the House of Representatives and the Committee on Energy and Natural Resources of the United States Senate, and such maps and legal descriptions shall have the same force and effect as if included in this Act: *Provided, however,* That correction of clerical and typographical errors in such legal descriptions and maps may be made. Filing with congressional committees. 16 USC 460*ll*–4.

AUTHORIZATION OF APPROPRIATIONS

16 USC 460*ll*-5.

SEC. 6. Effective October 1, 1981, there is hereby authorized to be appropriated such funds as may be necessary to carry out the purposes of this Act.

Approved October 19, 1980.

LEGISLATIVE HISTORY:

SENATE REPORT No. 96-996 (Comm. on Energy and Natural Resources).
CONGRESSIONAL RECORD, Vol. 126 (1980):
Oct. 1, considered and passed Senate.
Oct. 2, considered and passed House.

# Appendix Q

# Rattlesnake Dam Meeting Minutes

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# Agenda

| | |
|---|---|
| Project: | City of Missoula Water Facilities Master Plan |
| Subject: | Rattlesnake Dams Feasibility Study - Forest Service Meeting |
| Date: | Thursday, September 13, 2018 |
| Location: | Missoula Water Division, 1345 W. Broadway |
| Attendees: | See attached list |

Attendees Column 2 (Tab to add more rows)

- Introductions
- Water Master Plan / Rattlesnake Dams Feasibility Study Overview
- Meeting Purpose and Objective
- Long term vs. short term considerations
- Long Term Considerations:
    - FS requirements for existing dams
    - FS requirements for dam removal
- Permitting requirements
- Short Term Considerations:
    1. Oversight
    2. National Weather Service hydrometeorological reports
    3. Changes in hazard classification – none requested at this time
    4. FSM references
    5. Maintenance and repair goals
    6. Stability of rock cribs
- Wrap Up / Summary
- Next Steps / Action Items

# Meeting Minutes

- **Introductions**
- **Water Master Plan / Rattlesnake Dams Feasibility Study Overview**

  In 2018, HDR started a Water Master Plan process for the city of Missoula. This is essentially an analysis of the entire water system, including estimates of future population growth and water demand. The plan will culminate in a document that includes valuable data about the system, including prioritized projects with triggers, and a long-term look (20-years) at the future of the system.
- **Meeting Purpose and Objective**

  As part of the water master plan process, we are incorporating an evaluation of the Rattlesnake Wilderness Dams. Historically, the dams were used to release late season flows into Rattlesnake Creek, when the creek was an active part of the potable water supply. In the early 1980's, the system moved away from surface water to a water source supplied entirely by groundwater. Since that time the Rattlesnake Wilderness Dams have been maintained as an emergency backup water source. It should be noted that they have some of the most senior water rights in the valley. As the utility moves forward, they are faced with large and difficult choices. The dams are over 100 years old and will not last forever. They are costly to repair, rebuild, or remove. We are trying to determine what is in the best long term interested of the community with respect to these facilities and illuminate a path to get there. The purpose of today's meeting is to open a dialogue with the forest service to try, as best as we can, to understand what the requirements would be for dam reconstruction or dam removal, so we can do reasonable cost estimates that will be part of the overall cost-benefit analysis.
- **Long term vs. short term considerations:** Today's meeting is primarily focused on long-term considerations. However, there are short-term issues associated with finalizing the hazard assessments that we may try to discuss near the end of the meeting.
- **Long Term Considerations:**
  - **FS requirements for existing dams, rehabilitation, etc.:**

    Teresa – the dams need to be brought up to FS standards as stated in the FS 7500. The FS is open to a reasonable timeframe.

Where the FS 7500 manual is not specific, Hydrometrics uses the TR-60 as a guide for dam requirements.

- **FS requirements for dam removal:**

  Tracy – not restoration (return to pre-dam condition), but rehabilitation. Creating positive impacts to the resource, rehabilitation of functions, addressing aesthetic concerns, in alignment with forest plans, stabilize the area, etc.

  FS can provide trees.

  There are no specific FS standards for decommissioning a dam. However, Gary stated that the state does have dam abandonment criteria and the dam must pass the 100-year flood. This could include widening the emergency spillway, stabilizing all the adjacent slopes, stabilizing the channel through this reach using step pools, wetlands, or other stream restoration techniques.

- Considerations that apply to any or all of these alternatives include impacts to water rights, ability to release late season stream flows in Rattlesnake Creek, ability to have high elevation water storage, especially in light of a changing climate, and costs and requirements. HDR/City needs to estimate the cost of dam removal and restoration – depending upon what is required. It was noted that dam removal costs could rival the costs of a dam reconstruction.
- **Fisheries discussion:**
  - Need to determine if the dams could be a source of cold water for Rattlesnake Creek. Cold water released late in the summer could have a positive benefit to fisheries. Data would need to be collected to determine the temperature of water being released from the dam.
  - Need to determine the quantity of water storage available, and how that storage being released could impact Rattlesnake Creek in terms of additional flow.
  - Ladd - The lakes themselves are not a high value fishery.
  - Ladd – Rattlesnake Creek is a high value fishery, particularly for bull trout, and it is utilized for fish migration. The smaller tributaries in the wilderness area are too steep for bull trout.
- **Partnerships:**

        - It may not make sense for the city to continue ownership and operation of the dams under the water utility. Other owners and/or partners may be identified to take over or share in the maintenance and operations of the dams. Partners could include FS, Trout Unlimited, Clark Fork Coalition, etc. FS could partner on temperature monitoring and valve operation. If a dam was decommissioned, the SUP would no longer apply and it would be treated as any other FS property. If an easement dam was decommissioned, the City could relinquish their easement and, again, the property would be treated as any other FS property. FS is not interested in taking ownership of any dams.
    - **Increased Storage:**
        - After evaluation it may be feasible to decommission some of the dams and re-build other dams. FS would consider increasing the storage at a dam, but it would be very difficult given the requirement to maintain the character of the wilderness.
    - **Water Rights:** If a dam is decommissioned, the water rights would be abandoned. The in stream flow rights have been moved to 8 wells, but the storage rights have never been moved. It would be difficult to move the water rights to another location, due to timing and other issues. These decisions have permanent consequences.
    - **Easement vs. Special Use Permit Dam:**
        - 5 dams are easements, 5 SUP. Historically, the dams have been treated similarly in terms of operation and maintenance. However, if requirements are different for easement vs. SUP dams that may factor into the ultimate determination of a chosen alternative. Tracy said the easement dams need to meet the same requirements as the SUP dams. Teresa said that work on the easement dams needs to have no impact on downstream FS land, and the process involved to decommission the dam could be limited.
- **Permitting requirements:**
    - NEPA could be necessary if federal dollars are involved and/or the activities go above and beyond maintenance. Traci stated that she wasn't certain that decommissioning dams would trigger NEPA.
- **Short Term Considerations:** We ran out of time, and this item was put off for another meeting.
    - Oversight

- National Weather Service hydrometeorological reports
- Changes in hazard classification – none requested at this time
- FSM references
- Maintenance and repair goals
- Stability of rock cribs

- **Insurance:** The FS has requested that the city obtain liability insurance for the dams. However, the City has not been able to secure such a policy, since it is a self-insured entity and their current insurance broker has not been able to find an insurer. There is a possibility the USFS could accept a written statement from the City that the City would cover a claim up to $1 million. Ryan Sudbury will have a conversation with Jim Nugent about potential language in the statement, spelling out how the claims would be funded (i.e. through a judgment levy is one possible mechanism).

  Tracy – Dam owners in other regions have found liability insurance. Tracy will provide Logan and Ryan with additional information such as the contact information for the dam owner and/or insurance provider. Julie Merritt recommended we contacts the Montana Association of Dam and Canal Systems (MADCS) to inquire about how other dams are insured.

- Wrap Up / Summary
- Next Steps / Action Items
  - Tracy – provide additional information to the City on dam liability insurance
  - Tracy – provide HDR with a list of issues, thoughts, and comments pertaining to the dams
  - Ryan Sudbury to work with Jim Nugent on potential language to assure the USFS that the City can self-insure up to a $1 million liability claim.
  - Logan to follow up with MADCS on insurance
  - Logan / Ron – set up a meeting to discuss maintenance items
  - HDR / City will continue work on the feasibly study.
  - A follow up meeting will be held with FS once alternatives have been identified and vetted for each dam.

| Name | Organization | Email |
| --- | --- | --- |
| Logan McInnis | Missoula Water | lmcinnis@ci.missoula.mt.us |
| Julie Merritt | Missoula City Council | jmerritt@ci.missoula.mt.us |
| Teresa Morales | USFS | teresadmorales@fs.fed.us |
| Craig Caprara | HDR | craig.caprara@hdrinc.com |
| Dennis Bowman | Missoula Water | dbowman@ci.missoula.MT.us |
| Dan Brewer | USFWS | dan_brewer@fws.gov |
| John Wilson | Missoula Public Works | jwilson@ci.missoula.mt.us |
| SHANNA ADAMS | HDR | shanna.adams@gmail.com |
| Ross Mollenhauer | City of Missoula | rmollenhauer@ci.missoula.mt.us |
| RON EWART | FOREST SERVICE | rewart@fs.fed.us |
| Ryan Sudbury | City of Missoula | rsudbury@ci.missoula.mt.us |
| Tami Sylte | USFS | tsylte@fs.fed.us |

# Meeting Minutes

| | |
|---|---|
| Project: | City of Missoula Water Facilities Master Plan |
| Subject: | Rattlesnake Dams Feasibility Study - Forest Service Meeting |
| Date: | Monday, December 10, 2018 |
| Location: | Missoula Water Division, 1345 W. Broadway |
| Attendees: | See attached list |

Attendees Column 2 (Tab to add more rows)

**Meeting Notes:**

- HDR gave a presentation on the Rattlesnake Dams feasibility study work completed to date (attached).
- Dam releases into Rattlesnake Creek: the city has the right to release water whenever they choose, for as long as they choose. Based on preliminary data, dam releases could significantly impact flow in Rattlesnake Creek.
- Water rights change application could take 18 months to 2 years. This step should be successfully completed before moving forward with other tasks. $2,000 / ac-ft was used in the analysis for the value of water rights – Julie Merritt agreed that this was a reasonable value.
- FS would like to see an implementation plan with dates.
- NEPA process: may be advantageous to go through the NEPA process once looking at all 10 dams.
- Hydrometrics provided an overview of the response to the FS comments on the hazard assessment. This written response was later provided to the FS.

**Action Items:**

- HDR will complete the Rattlesnake Dams Feasibility Study and provide a copy to FS
- FS can provide a cost on native seed mix.
- Ladd Knotek can provide bathymetric data.
- Ladd Knotek may have temperature data.

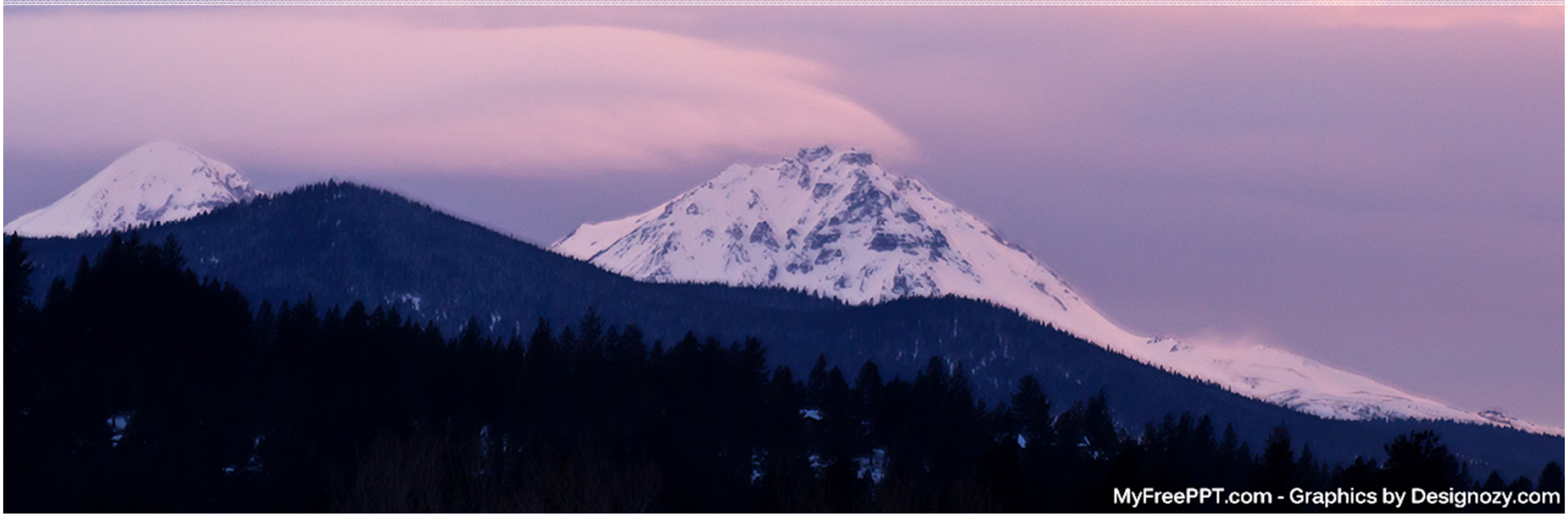
| Project: | Computed: | Date: |
|---|---|---|
| Subject: | Checked: | Date: |
| Task: | Page: | of: |
| Job #: | No: | |

12/10/2018 Rattlesnake Dams

| NAME | ORGANIZATION | PHONE | EMAIL |
|---|---|---|---|
| SHANNA ADAMS | HDR | 406-546-1483 | shanna.adams@hdrinc.com |
| Dennis Bowman | City | 406-552-6700 | |
| Ladd Knotek | FWP | 406.542.5506 | LKnotek@mt.gov |
| Ryan Sudbury | City | 406-552-6024 | rsudbury@ci.missoula.mt.us |
| Julie Merritt | WGM Group | 406-207-2358 | jmerritt@wgmgroup.com |
| RON EWART | USFS | 240-0002 | rewart@fs.fed.us |
| Katie Knotek | USFS | 329-3962 | KKnotek@fs.fed.us |
| Teresa Morales | USFS | 329-3293 | teresadmorales@fs.fed.us |

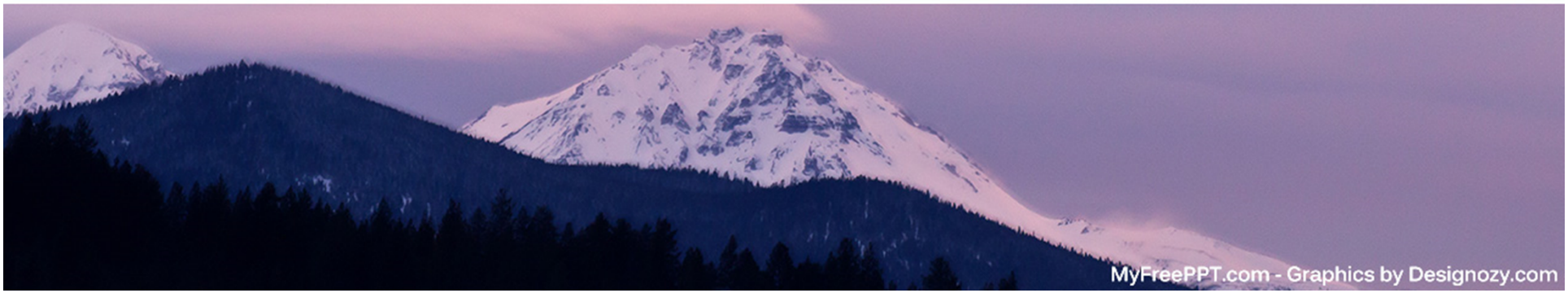
| Name | Organization | Email |
| --- | --- | --- |
| Logan McInnis | City | lmcinnis@ci.missoula.mt.us |
| Morgan Valliant | City | mvalliant@ci.missoula.mt.us |
| Jen Hensiek | USFS | jhensiek@fs.fed.us |
| Ross Mollenhaver | City | rmollenhaver@ci.missoula.mt.us |

# Rattlesnake Dams



# Feasibility Study

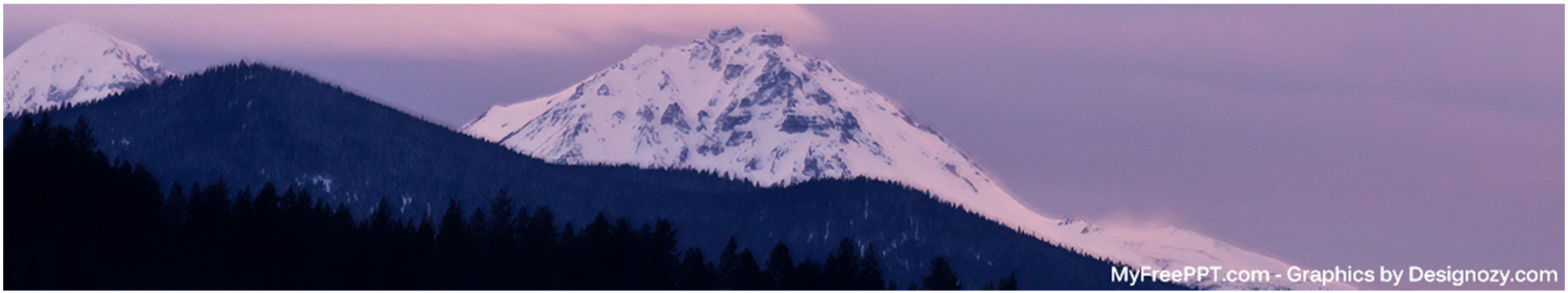
- Capital costs
- Life cycle costs
- Water rights – seniority, mitigation
- Climate change
- Long-term community needs
- Regulatory agency requirements & goals
- Environmental Impacts – fisheries
- Permitting



# Regulatory

- Special Use Permit
- Easement

*The City has the following rights described in Public Law 96-476; "…rights of the owner of such water right to the customary and usual access, including necessary motorized use over and along existing roads and trails to any facilities used in connection therewith, and the right to operate and maintain such facilities."*

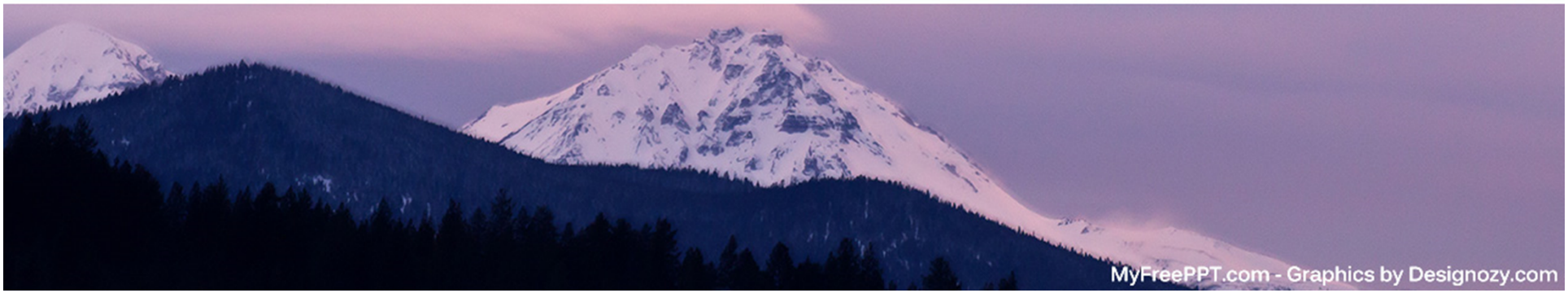


# Water Rights

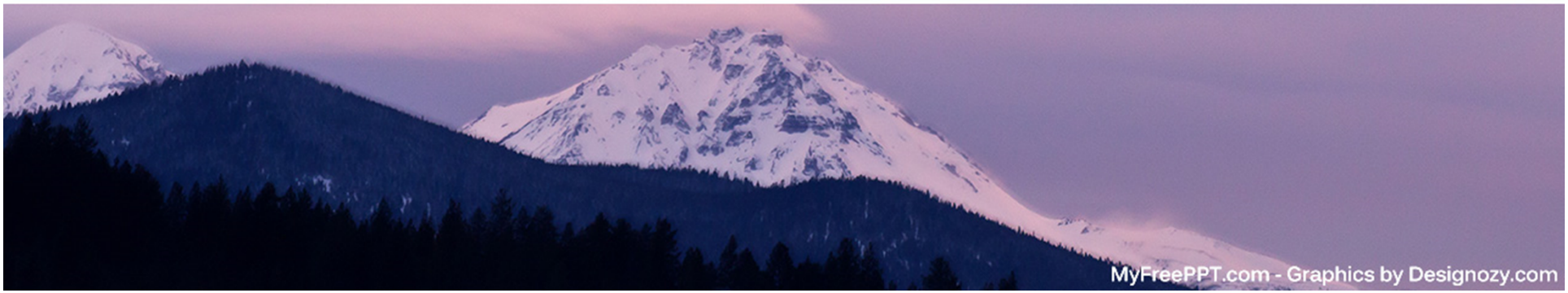
**Seniority** - Downstream hydropower corporations own water rights that pre-date the City's well water rights, but do not pre-date the Rattlesnake Wilderness water rights.

**Risk** - Without the wilderness dams in place, historically stored water would be lost during the spring runoff period and would not be available later in the year to counteract diminished flows.

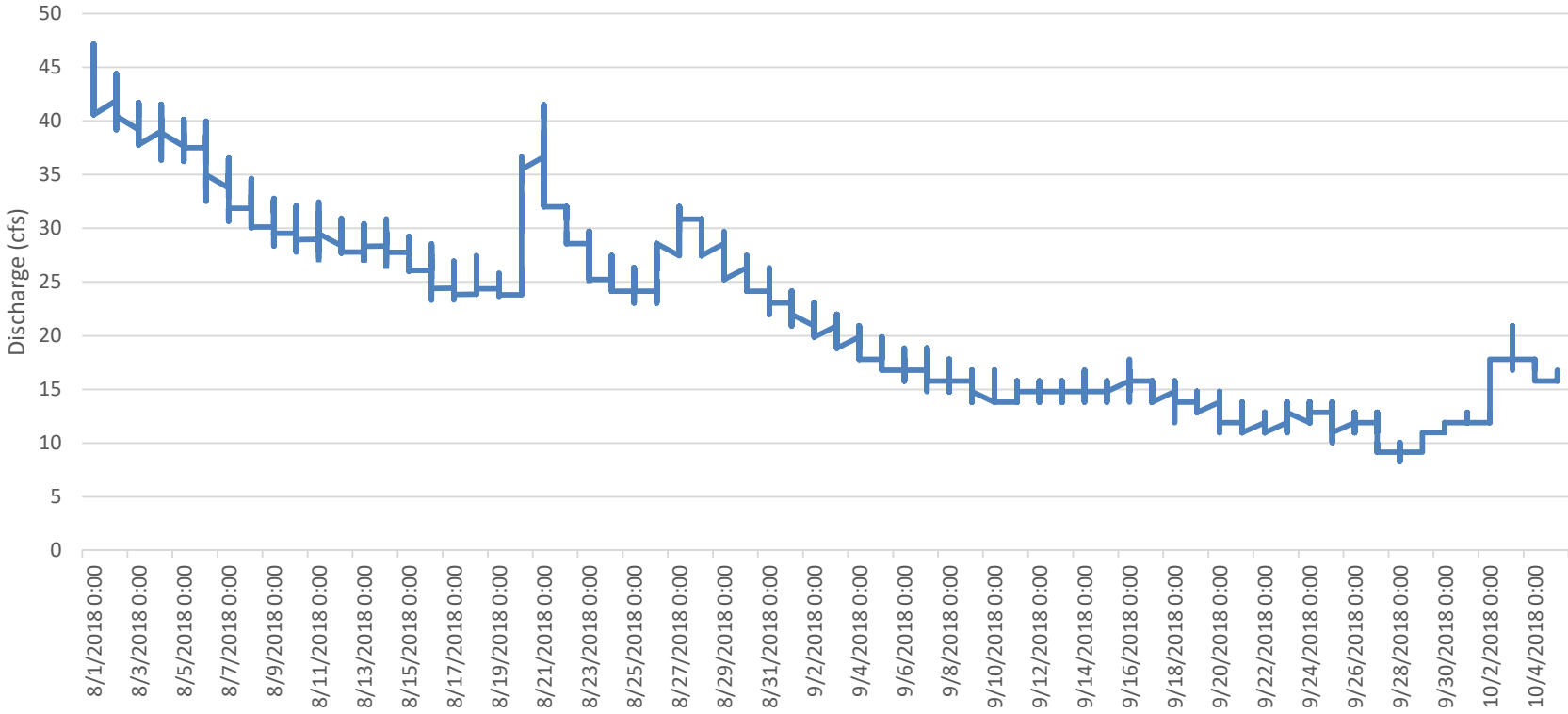
**Recommendation** - Existing storage rights be changed to add the valley wells as points of diversion – allow for late season releases to Rattlesnake Creek and continued use of senior water rights.

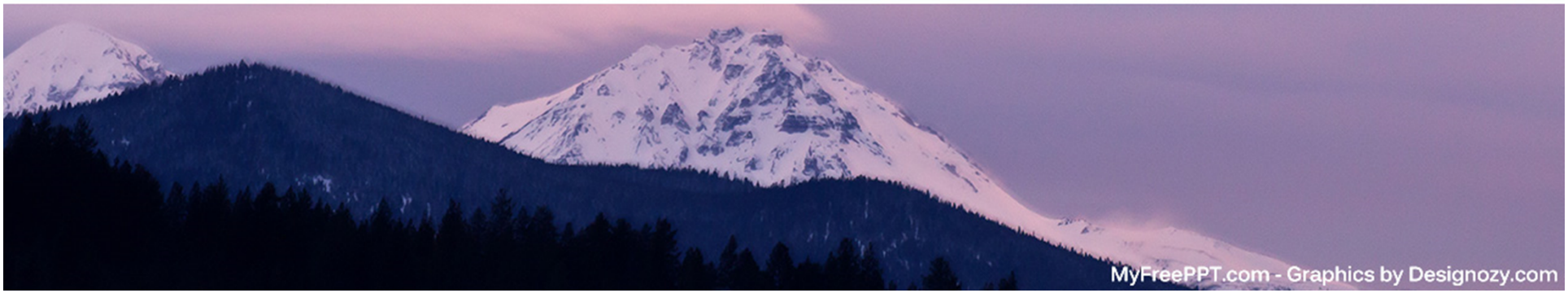


# Fisheries / Recreation



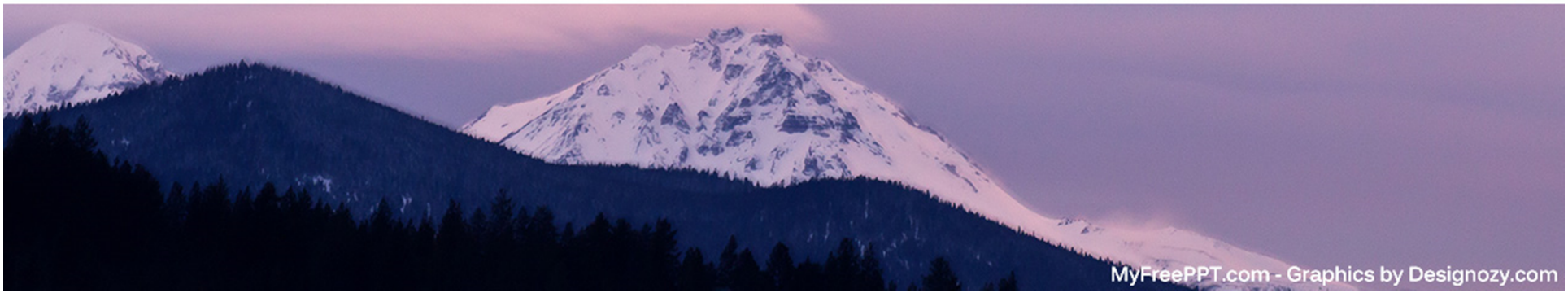
# Rattlesnake Creek Flow (Aug, Sept., Oct)



# Recommendations

- Water Rights Evaluation
- Decommissioning
- Rehabilitation



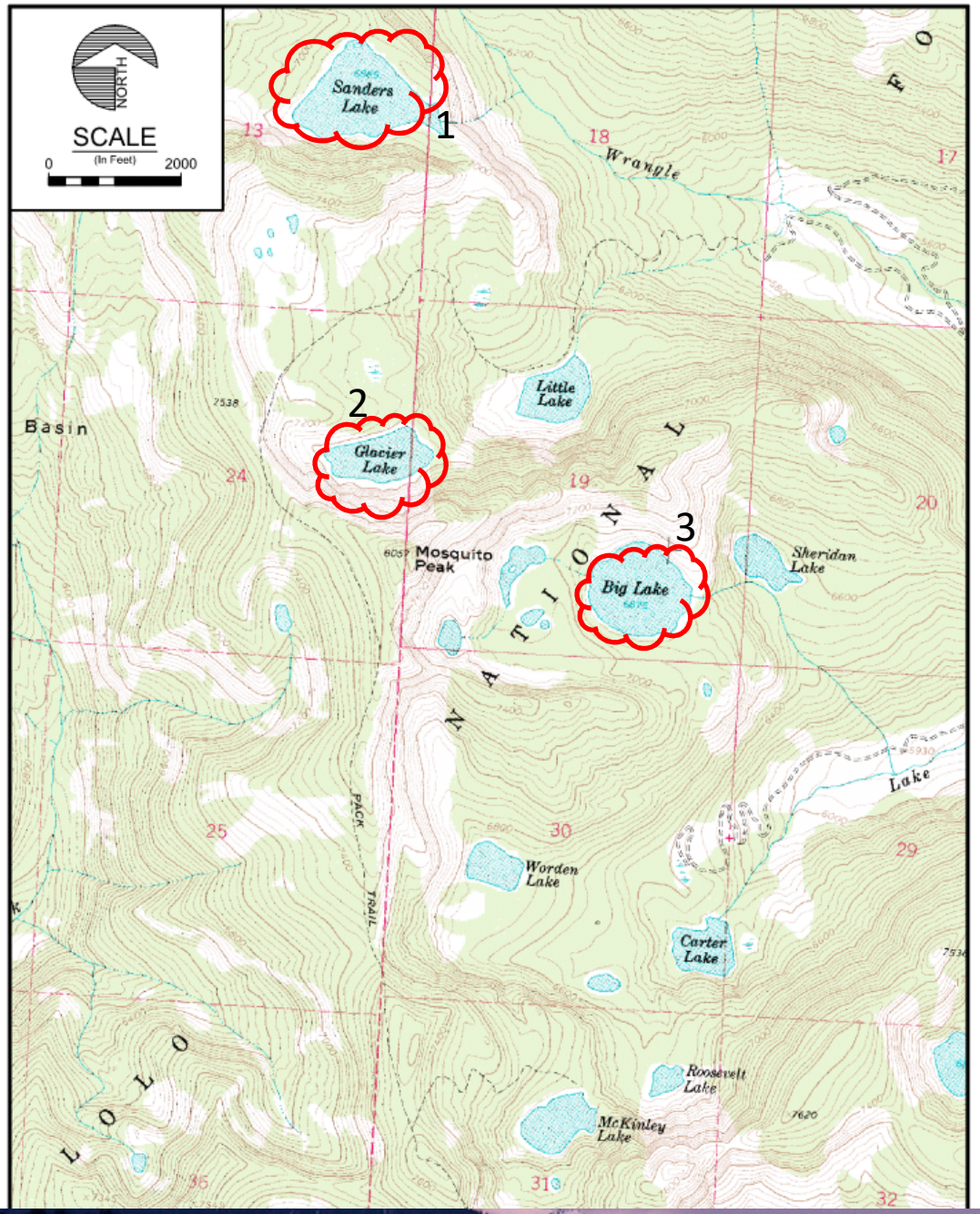
Rehabilitation:

- Most storage
- Most cost effective rehabilitation / ac-ft
- Three separate drainages

Flow Rates:

- Big Lake: 5.2 cfs
- Sanders: 7.4 cfs
- Glacier: 1.76 cfs

14.5 cfs total

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# Rehab Example

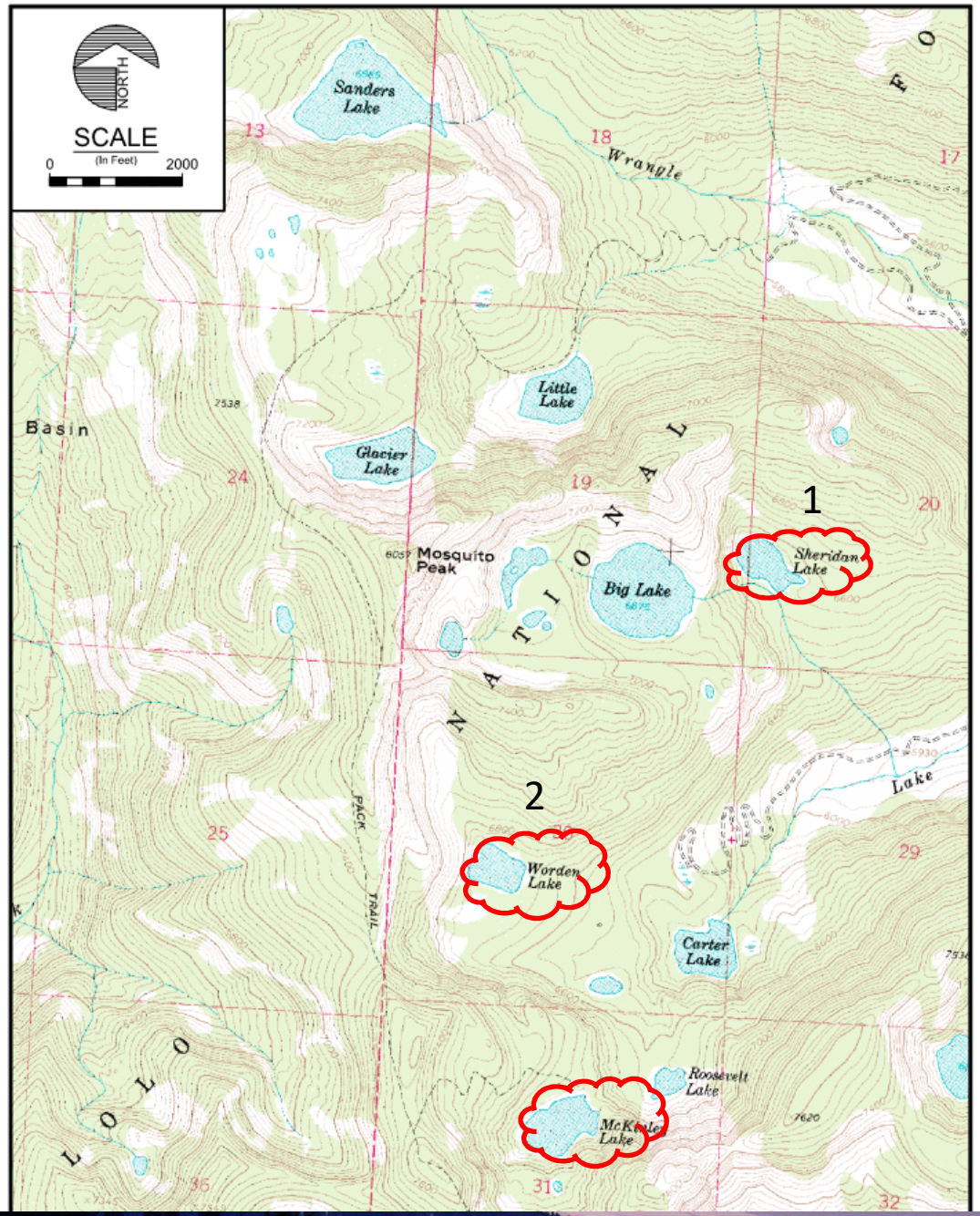
Mill Lake Dam

MyFreePPT.com - Graphics by Designozy.com

Decommission:

- Least Storage
- Least Cost

McKinley – damage, risk, etc.

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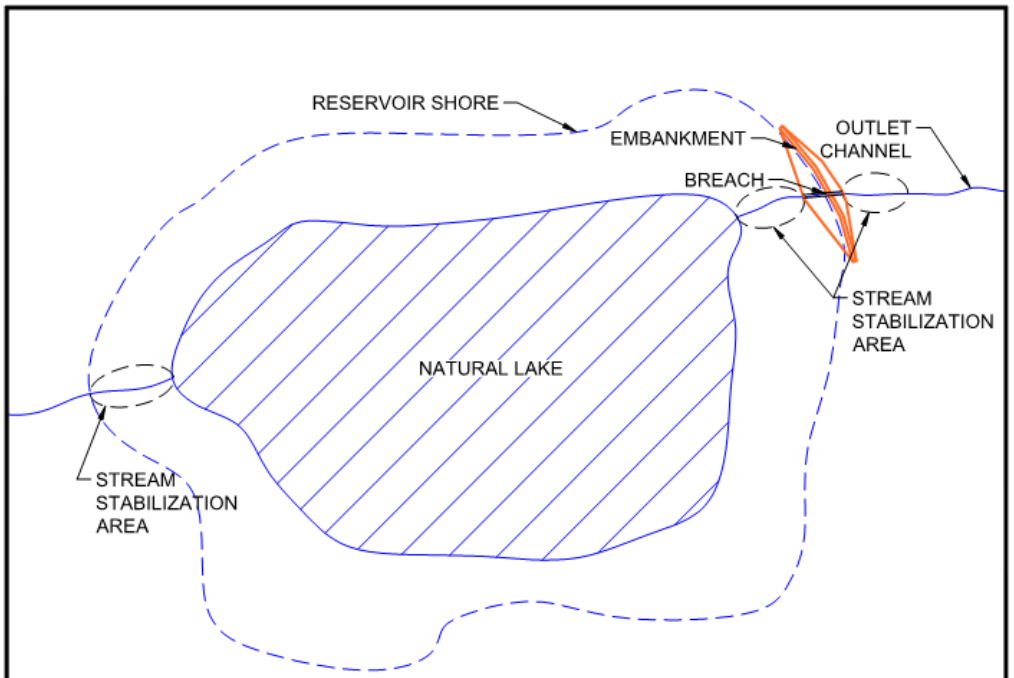
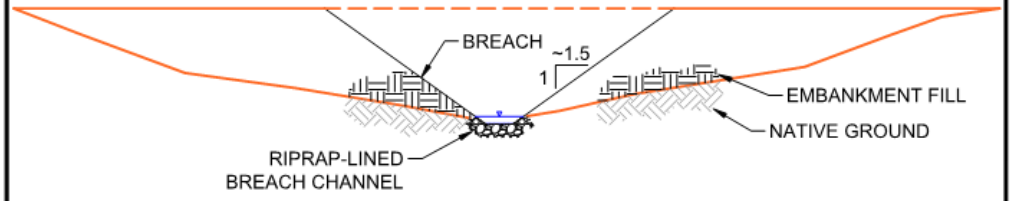



PLAN VIEW
NTS




ELEVATION VIEW
NTS

| | | |
|---|---|---|
| RATTLESNAKE DAMS FEASIBILITY STUDY | **CONCEPTUAL DAM BREACH CONFIGURATION** | FIGURE |

UPDATE TIME: 2:59 PM
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Hydrometrics, Inc.
Consulting Scientists and Engineers

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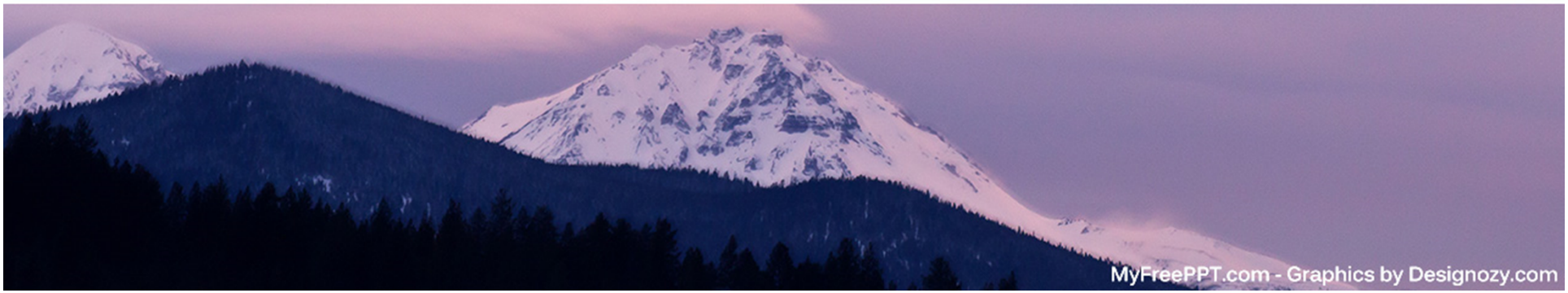
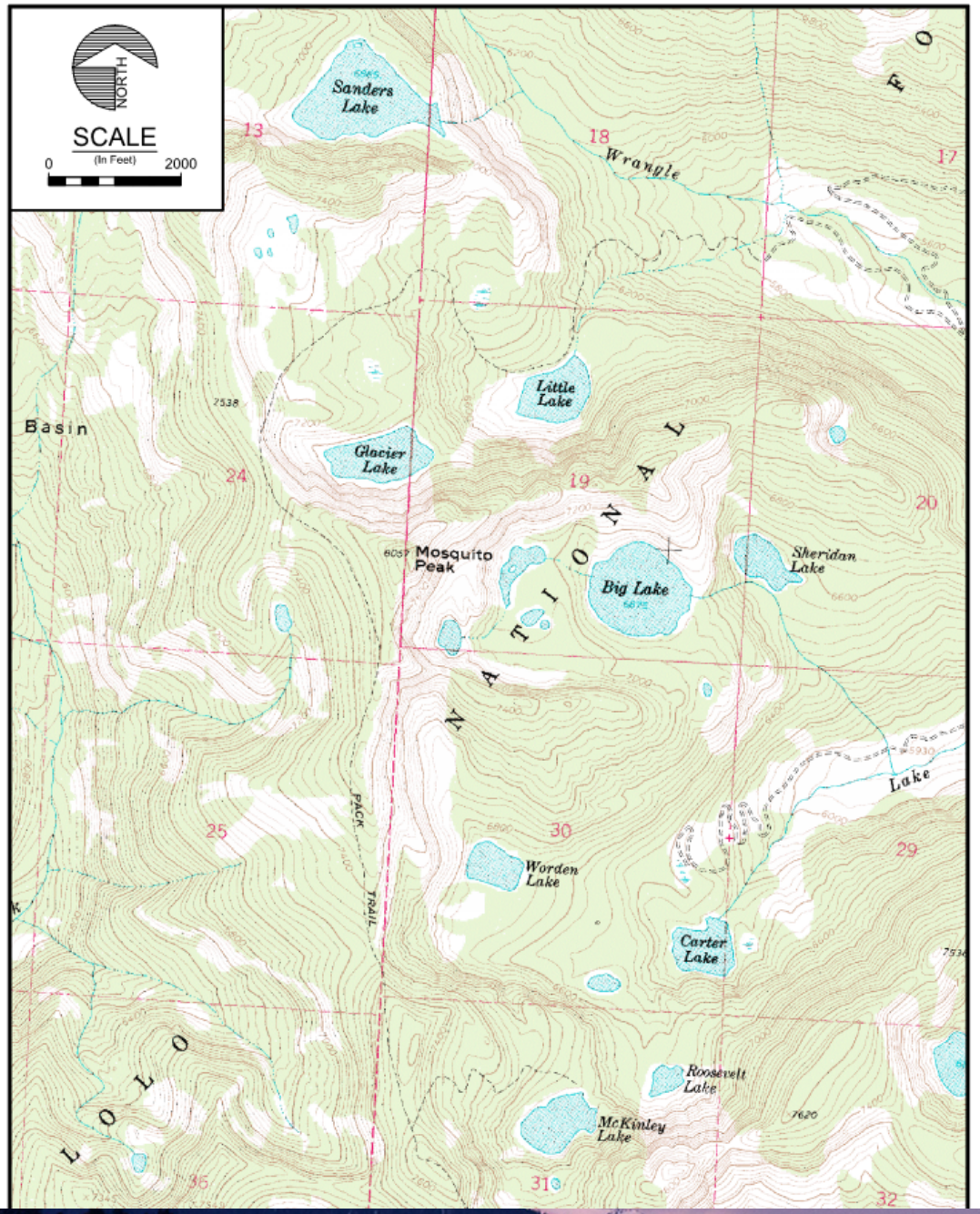
# Next Steps

- FY2020:
  - Water Rights – understanding mitigation value
  - Temperature, other studies (?)
- FY2021:
  - Decommission plans, specifications, environmental analysis, permitting
- FY2022:
  - Decommission dam (McKinley)
- FY2023:
  - Rehabilitation Plan (Sanders)



# Location

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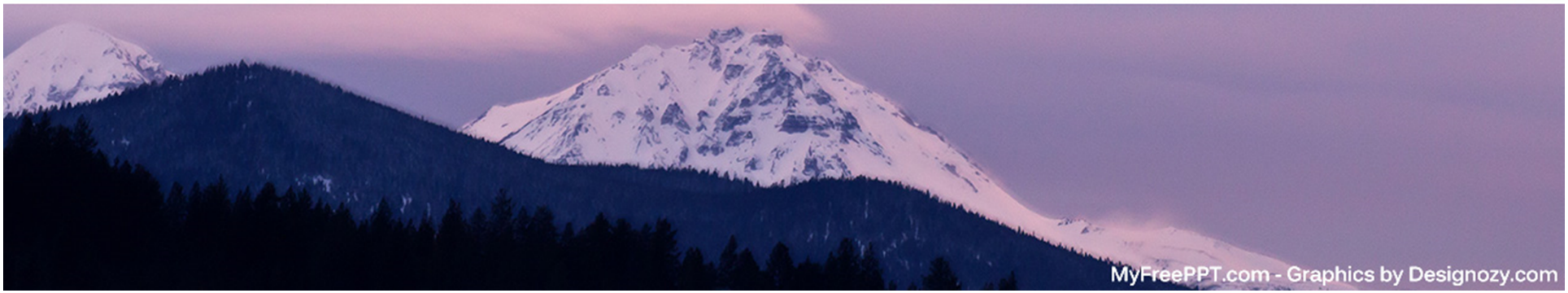
# Basic Info

| Name of Lake | Permit or Easement | Maximum Storage Volume (acre-feet) | Drainage | Claimed Flow Rate |
|---|---|---|---|---|
| **Big Lake** | Easement | 621 | Lake Creek | 5.22 cfs |
| **Carter Lake** | Permit | 161 | Lake Creek | 1.43 cfs |
| **Glacier Lake** | Easement | 240 | Wrangle Creek | 1.76 cfs |
| **Little Lake** | Easement | 298 | Wrangle Creek | 2.50 cfs |
| **McKinley Lake** | Easement | 168 | Lake Creek | 1.64 cfs |
| **Sanders South Lake** | Permit | 897 | Wrangle Creek | 7.54 cfs (total) |
| **Sanders North Lake** | Easement | 897 | Wrangle Creek | - |
| **Sheridan East Lake** | Permit | 130 | Lake Creek | 431 gpm (total) |
| **Sheridan West Lake** | Permit | 130 | Lake Creek | - |
| **Worden Lake** | Permit | 70 | Lake Creek | 398 gpm |
| | TOTAL | 2,585 | | |