Atlantic Richfield Company

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Main: (406) 782-9964

June 21, 2019

CERTIFIED - RETURN RECEIPT REQUESTED

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Jonathan Morgan, Esq.
MT Department of Environmental Quality
P.O. Box 200901
Helena, Montana 59620-0901

Re: Warm Springs Ponds Operable Units of the Silver Bow Creek Area NPL Site – **Operations and Maintenance Manual Updates**

Dear Allie, Daryl, Henry, and Jonathan:

Enclosed you will find an update to the Operations and Maintenance (O&M) Manual, Warm Springs Ponds Operable Unit (July 2017). This update documents the Pumpback System Upgrades performed in 2018 and administrative changes to call-out trees and contact lists.

A following is a list of pages to be replaced:

- Cover Sheet and Sidebar
- Entire text
- Figure 2-33
- Entire Appendix A
- Entire Appendix B
- Sheet P&ID-4 of Appendix G
- Entire Appendix H

Please insert the replacement pages into your copies of the O&M Manual. If you have any questions on these updates, please contact me at (406) 723-1834, or via email at Josh.Bryson@bp.com.

Sincerely,

Josh Bryson, PE, PMP
Operations Project Manager
Remediation Management Services Company
An Affiliate of Atlantic Richfield Company

cc: Dave Griffis – Atlantic Richfield Company (email)
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WARM SPRINGS PONDS OPERABLE UNIT

Final

Operations and Maintenance (O&M) Manual for Warm Springs Ponds Operable Unit

Atlantic Richfield Company **Revision 4**

June 2019

WARM SPRINGS PONDS OPERABLE UNIT

REVISION 4 FINAL OPERATIONS AND MAINTENANCE (O&M) MANUAL FOR WARM SPRINGS PONDS OPERABLE UNIT

Atlantic Richfield Company June 2019

WARM SPRINGS PONDS OPERABLE UNIT

Final

Operations and Maintenance (O&M) Manual for Warm Springs Ponds Operable Unit

Prepared for:

Atlantic Richfield Company
317 Anaconda Road
Butte, Montana 59701

Prepared by:

Pioneer Technical Services, Inc.
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Butte, Montana 59702

June 2019

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LIST OF ACRONYMS

Acronym	Definition
µg/L	micrograms per liter
acfm	Actual Cubic Feet per Minute
ANSI	American National Standards Institute
ARARs	Applicable or Relevant and Appropriate Requirements
Atlantic Richfield	Atlantic Richfield Company
ATS	Automatic Transfer Switch
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CO2	carbon dioxide
Cu	copper
Cu(CO3 -)	copper carbonate
Cu(OH)2	copper hydroxide
CuO	copper oxide
CV	Coefficient of Variation
DEQ	Department of Environmental Quality
DMR	Data Monitoring Report
DNRC	Department of Natural Resources
EDCMS	Environmental Data Collection Management System
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Difference
EWC	east wet closure (outlet stations)
F	Fahrenheit
Fe	iron
FS	Feasibility Study
gpm	gallons per minute
GPS	Global Positioning System
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HDPE	high density polyethylene
HMI	Human Interface Machine
HOA	Hand-off-automatic
hp	Horse Power
HSE	Health, Safety, Environmental
HSSE	Health, Safety, Security and Environment
I/O	Input/Output
IMP	Inspection and Maintenance Procedures
IRE	Instrument Reading Electronic
IRM	Interim remedial measures
kg	kilogram
kVA	kilovolt-ampere
kW	kilowatt
LT	level transmitters (stations)
mA	milliampere
MCC	Motor Control Center
MCE	Maximum Credible Earthquake
MCL	Maximum Contaminant Level
MDHES	Montana Department of Health and Environmental Sciences
MDP	Main Distribution Panel
mg	milligram

Acronym	Definition
mg/L	milligrams per Liter
MGD	millions of gallons per day
MMS	Maintenance Management System
MoC	Management of Change
MPDES	Montana Pollution Discharge Elimination System
MWB	Mill-Willow Bypass (monitoring station)
MWC	north wet closure (station)
NAD	North American Datum
NAVD	North American Vertical Datum
NGS	National Geodetic Survey
NOAA	National Oceanic and Atmospheric Administration
NOV	Notice of violation
NTU	Nephelometric Turbidity Units
NWC	north wet closure
O&M	Operations and Maintenance
OIP	Operator Interface Panel
OS	Outlet structure (as in OS-SS3E-2313)
OSHA	Occupational Safety and Health Administration
OSRO	Oil Spill Response Contractors
OU	operable unit
P&ID	Piping and Instrumentation Diagram
PD	primary pond
PE	Polyethylene
PHS	Public Health Service
PID	Proportional, Integral and Derivative
PLC	Programmable Logic Controller
PMF	Probable Maximum Flood
PPE	personnel protective equipment
PRP	Potentially Responsible Party
PSD	Protective System Devices
psig	pounds per square inch [gauge]
QA/QC	Quality Assurance/Quality Control
RA	Remedial Action
RD	Remedial Design
RDU	Remedial Design Unit
RI	Remedial Investigation
RM	Remediation Management
ROD	Record of Decision
RVF	rotary vane feeder
SCADA	Supervisory Control and Data Acquisition
scfm	Standard cubic feet per minute
SF	Screw Feeder
SOP	Standard Operating Procedure
SS	sample station
SSHASP	Site-Specific Health And Safety Plan
SWC	south wet closure
TDH	Total Dynamic Head
TSEA	Task Safety and Environmental Assessment
TSS	Total Suspended Solids
UAO	Unilateral Administrative Order
UPS	Uninterrupted Power Supply
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
WRA	work risk assessment

Acronym	Definition
WSP	Warm Springs Ponds
WWC	west wet closure (outlet stations)

REVISION SUMMARY

Revision No.	Author	Version	Description	Date
Rev 2	Casey Briggs	Draft	Issued for Internal Atlantic Richfield Company Review	November 2013
Rev 2	Casey Briggs	Final	Issued to Agencies	February 2014
Rev 3	Casey Briggs	Final	Issued for Internal Atlantic Richfield Company Review	June 2016
Rev 3	Casey Briggs	Final	Issued to Agencies	July 2017
Rev 4	Casey Briggs	Final	Issued for Internal Atlantic Richfield Company Review	November 2018
Rev 4	Casey Briggs	Final	Issued to Agencies	June 2019

NOTIFICATION SUMMARY

OBSERVE. In determining whether or not any of the following high priority or critical conditions are developing or occurring, it is very important for operations personnel to observe the conditions of the site and all equipment at the site. It is especially important to be aware of any changes in conditions, and to realize, with the aid of this list, when a situation occurs that requires notification of Atlantic Richfield Company's (Atlantic Richfield) Authorized Representative and/or the U.S. Environmental Protection Agency's (EPA) Representative.

NOTIFY. Once it has been determined that a condition exists that requires appropriate action and notification of the listed authority, the operator will notify the parties listed in the time frame indicated. Verbal notification of EPA's representative should be performed by Atlantic Richfield's Authorized Representative.

ACT. The operator will initiate and/or coordinate any necessary and appropriate actions in response to the high priority or critical condition. Such actions will be in accordance with the relevant requirements of this Operation and Maintenance Manual and such guidance or specific requirements provided by Atlantic Richfield's Authorized Representative and/or the agencies.

CONCERNS. DAM SAFETY concerns are of overriding importance from a public safety perspective. Loss of dam integrity can lead to immediate loss of life and property to those people living downstream of the Ponds. The secondary issue of concern is WATER QUALITY. Meeting discharge standards is the main purpose of the Ponds system. The issues listed in this table are relevant to dam safety and water quality concerns.

Verbal notification will be in person or by telephone. Atlantic Richfield will provide the operator with the name and phone number of the person the operator should contact if Atlantic Richfield's Authorized Representative is unavailable. If the operator is unable to reach the Authorized Representative by voice, the operator will send a short facsimile or email to Authorized Representative briefly describing the high priority or critical condition. To the extent that conditions allow, the operator is to continue to attempt to reach Atlantic Richfield's Authorized Representative until that person is contacted.

The call-out trees included with this document summarize appropriate contacts and contact information related to Regulatory Upset Conditions or Noncompliance, health, safety or environmental (HSE) Incidents, Actual or Immediate Dam Failure, and Potentially Hazardous Dam Safety situations. The following table provides specific detail for handling potential situations. Whomever observes the conditions listed herein must follow the call-out trees in order to provide proper notification.

Potential Situation – Handling Instructions - November 2013

ISSUE	REFERENCE	HOW AND WHEN TO CONTACT	WHO TO NOTIFY
Dam Safety	Dam Safety Emergency Action Plan	Verbal - immediate	Follow Call-Out Trees
Dam failure	Dam Safety Emergency Action Plan	Verbal - immediate	Follow Call-Out Trees Deer Lodge County Sheriff: 911 Powell County Sheriff: 911 Atlantic Richfield's Authorized Representative WSP Operations Personnel
Embankment seepage, sloughing, or significant erosion	IMP-1	Verbal - immediate	Atlantic Richfield's Authorized Representative WSP Operations Personnel
Movement/distress of foundations, embankments or hydraulic structures (misalignment, settlement, cracking)	IMP-1, IMP-6, IMP-7, IMP-9	Verbal - immediate	Atlantic Richfield's Authorized Representative WSP Operations Personnel
Significant loss of riprap or erosion protection	IMP-1	Verbal - immediate	Atlantic Richfield's Authorized Representative WSP Operations Personnel
Piezometers - if water levels exceed the level allowed in the WSP Piezometer Manual	IMP-2, WSP Piezometer Manual	Yellow = by next work day Red = immediate	Atlantic Richfield's Authorized Representative
Toe drain flows - any significant change in flow rates, freezing, plugging, silting, or turbid flow	IMP-1	Verbal - within 12 hours of observation	Atlantic Richfield's Authorized Representative
Pond levels - any change in water level greater than 1 foot in any 30-day period		Verbal - within 12 hours of observation	Atlantic Richfield's Authorized Representative

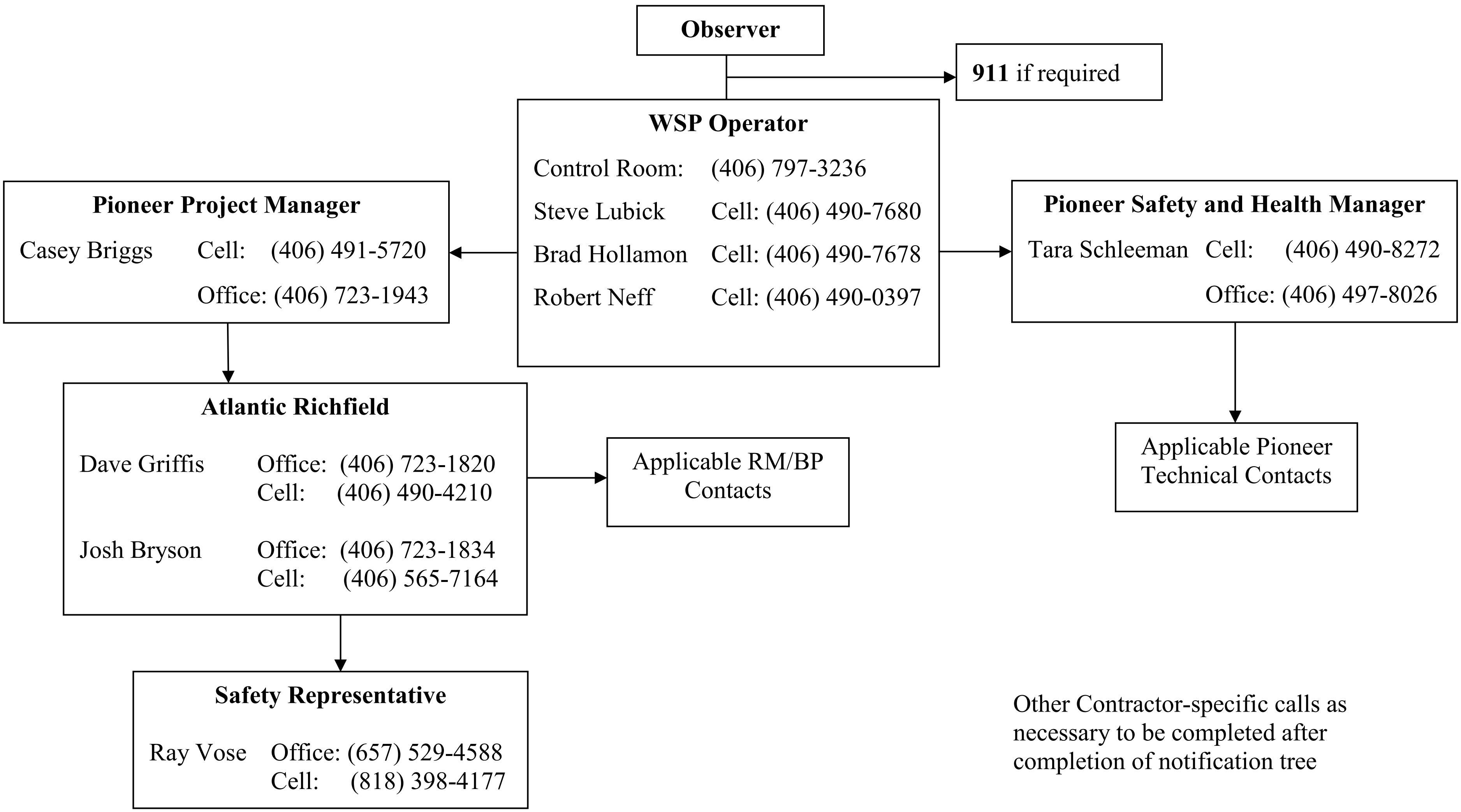
ISSUE	REFERENCE	HOW AND WHEN TO CONTACT	WHO TO NOTIFY
Inflow to Pond 3 in excess of 300 cfs		Verbal - within 12 hours of observation	Atlantic Richfield’s Authorized Representative
Any imminent or actual flow over emergency spillways, including Pond 3 inlet channel	8.2.2	Verbal - immediate	Atlantic Richfield's Authorized Representative WSP Operations Personnel
Flood flows in the Mill-Willow Bypass approaching, or at, Ponds dike toe		Verbal - immediate	Atlantic Richfield’s Authorized Representative
Change in stoplog elevation at Pond 2 Service Spillway	4.2.2	Verbal - prior to action	Atlantic Richfield’s Authorized Representative
Water Quality ↓			
Resuspension of Pond bottom sediments caused by high inflows	7.0	Verbal - when observed	Atlantic Richfield’s Authorized Representative
Seasonal turnover/resuspension of Pond bottom sediments	7.0	Verbal - when observed	Atlantic Richfield’s Authorized Representative
Resuspension of Pond bottom sediments caused by windy conditions	7.0	Verbal - when observed	Atlantic Richfield's Authorized Representative
Ice-off in Pond 2 and/or Pond 3 Color change (turning green) indicating algal bloom	7.0	Verbal - when observed Verbal - when observed	Atlantic Richfield's Authorized Representative Atlantic Richfield's Authorized Representative
Interaction of algae and metals carryover	7.0	Verbal - when observed	Atlantic Richfield's Authorized Representative
General upset conditions	7.0	Verbal - when observed	Atlantic Richfield’s Authorized Representative
Consistent and/or significant water quality differences (color, turbidity, etc.) between the East and West Outlet Works of Pond 3	7.0	Verbal - when observed	Atlantic Richfield's Authorized Representative
Potential bypass situations through Pond 3 Bypass Spillway caused by high inflows/Pond levels (imposed by nature)	2.2.2, 2.2.8, 4.2.2, 8.3.2, 9.4	Prior to bypass	Atlantic Richfield's Authorized Representative

ISSUE	REFERENCE	HOW AND WHEN TO CONTACT	WHO TO NOTIFY
Planned flow through Pond 3 Bypass Spillway caused by Pond 2 upset (Pond management decision)	2.2.2, 2.2.8, 4.2.2, 8.3.2, 9.4	Prior to bypass	Atlantic Richfield's Authorized Representative
Flow through Pond 3 Bypass Spillway caused by high inflows or Pond 2 upset	2.2.2, 2.2.8, 4.2.2, 8.3.2, 9.4	Verbal - immediate written - DMR	Atlantic Richfield's Authorized Representative
pH out of Pond 2 or Pond 3 below 8.0	3.2, 8.3.3	Email - when observed	Atlantic Richfield's Authorized Representative
pH out of Pond 2 or Pond 3 above 9.5	3.2, 8.3.3	Verbal - immediate written - immediate e-mail and DMR	Atlantic Richfield's Authorized Representative EPA and Montana DEQ Representatives
Approaching noncompliance with discharge standards	3.2, 8.3	Verbal - when observed	Atlantic Richfield's Authorized Representative
Noncompliance with discharge standards	3.2, 9.2, 9.3	Verbal - varies, see 9.2 written - varies, see 9.3	Atlantic Richfield's Authorized Representative EPA and Montana DEQ Representatives
Noncompliance with groundwater water quality standards	3.3	Verbal - when observed written - DMR	Atlantic Richfield's Authorized Representative EPA Representative
Noncompliance with groundwater hydraulic gradient standard at southwest end of Pond 1 (P-14 nest)	3.3.2	Written - monthly report	Atlantic Richfield's Authorized Representative EPA Representative
Noncompliance with groundwater hydraulic gradient standard anywhere other than southwest end of Pond 1	3.3.2	Verbal - when observed Written - monthly report	Atlantic Richfield's Authorized Representative EPA Representative
Equipment Failure - Loss of major process or monitoring equipment		Verbal when observed	Atlantic Richfield Representatives
Pumpback Facility ↓			
High water level in Interception Ditch	11.1.2	Verbal - when observed	Atlantic Richfield's Authorized Representative
Traveling Screen breakdown	11.1.2	Verbal - when observed	Atlantic Richfield's Authorized Representative
Pump failure	11.1.2	Verbal - when observed	Atlantic Richfield's Authorized Representative

ISSUE	REFERENCE	HOW AND WHEN TO CONTACT	WHO TO NOTIFY
Loss of power in excess of 12 hrs.	11.1.2	Verbal - when observed	Atlantic Richfield’s Authorized Representative
Lime Treatment Plant ↓			
Loss of process control	11.1.1, 11.2	Verbal - when observed	Atlantic Richfield's Authorized Representative
Potential inability to supply adequate lime for current flow	11.1.1, 11.2	Verbal - when observed	Atlantic Richfield’s Authorized Representative
Maintenance or repair which requires either outside contract labor or the ordering of parts not normally in stock at the site		Prior to ordering parts or labor	Atlantic Richfield’s Authorized Representative
Erosion or damage of dry closure cover	IMP-3	Verbal - when observed	Atlantic Richfield's Authorized Representative
Signs of contaminant migration off dry closure	IMP-3	Verbal - when observed	Atlantic Richfield’s Authorized Representative EPA Representative
Flow in any section of Mill-Willow Bypass exceeding bank full capacity of the low-flow channel		Verbal - when observed	Atlantic Richfield’s Authorized Representative EPA's Representative
Erosion in Mill-Willow Bypass channel, especially if the erosion breaches between meanders, or threatens encroachment on the I-90 R. of W., the high pressure gas line, or the 50 ft. buffer along the soil-cement erosion protection on the dikes	IMP-4	Verbal - when observed	Atlantic Richfield’s Authorized Representative
Low water levels or exposed tailings in Pond 1 or the lower wet closure cells	2.1.7, 2.2.4	Verbal – when observed	Atlantic Richfield’s Authorized Representative

Call-Out Trees – June 2019

Health, Safety, Environmental Incident Reporting



Regulatory Upset Condition or Noncompliance

Observer

↓

Atlantic Richfield

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1.0 INTRODUCTION

This Draft Operations and Maintenance (O&M) Manual for Warm Springs Ponds (WSP) Operable Unit (OU) contains information on the proper operation and routine maintenance of the WSP system. Ancillary information referenced in this manual is provided in the following appendices:

- Appendix A Revisions/Updates
- Appendix B List of Standard Operating Procedures
- Appendix C Inspection and Maintenance Procedures
- Appendix D Maintenance Management Systems
- Appendix E Unilateral Administrative Order (UAO) Regulations
- Appendix F Dam Safety Act
- Appendix G Piping and Instrumentation Diagrams
- Appendix H Protective System Devices (PSD) List, PSD Inspection and Maintenance Plan, SAFE Chart
- Appendix I Electrical One-Line Diagrams
- Appendix J Equipment List
- Appendix K Generator Maintenance Log
- Appendix L Critical Equipment (CE) List and Assessment Report
- Appendix M Safe Operating Limits

1.1 Purpose and Scope

The primary purpose of this O&M Manual is to define the O&M activities required to effectively implement the Remedial Design (RD) and Remedial Action (RA) activities for the WSPs Active Area and Inactive Area Operable Units of the Silver Bow Creek/Butte Area Superfund Site. It fulfills the requirements of the two pertinent Unilateral Administrative Orders (UAOs) issued by the U.S. Environmental Protection Agency (EPA) to Atlantic Richfield Company (Atlantic Richfield) (EPA, 1991a and EPA, 1993) and complies with the Comprehensive RD/RA Work Plans (ESA, 1991 and ESA, 1993). This version of the O&M Manual incorporates changes in equipment and procedures that have occurred since preparation of the initial document in 1995.

This Manual serves as a guide for operating personnel to help them both understand the facilities and perform the O&M activities. It is written with the operator in mind. The Manual addresses all O&M activities required for the WSP operable units, plus closely related activities that are slightly outside the operable unit boundaries. The O&M requirements fall under two broad categories: dam safety and water quality. This Manual covers performance standards and O&M requirements for both categories.

All WSP operators must view dam safety as their primary responsibility. The WSPs impound a substantial volume of water and are considered high hazard structures according to Montana Department of Natural Resources (DNRC) criteria. The O&M activities related to dam safety are less time consuming than activities related to water quality compliance, and therefore the bulk of this Manual is devoted to the more complex issues of water quality. However, it is critical that operating personnel be alert to their monitoring responsibilities and emergency procedures with regard to dam safety.

The initial version of this document was a first step towards achieving compliance with the water quality performance standards. Although the RA was carefully designed, the WSP system is quite complex and subject to many uncontrollable external factors. Some of those external factors still impact pond performance and activities on how best to operate the facilities to achieve optimum results. Accordingly, the UAOs outlined a two-phase time frame for compliance with the water quality performance standards.

Phase I for the Active Area included a Shakedown Period during which interim water quality performance standards were used. During Shakedown, various operating approaches were explored to identify those that were most effective. Based on experience gained through this period of operation, the procedures defined in the initial O&M Manual were monitored and refined to optimize results and efficiency. Final performance standards were in effect during the last 24 months of Phase I to demonstrate consistent compliance prior to permanent implementation of Phase II O&M. Section 3.0 contains a complete discussion of the performance standards and effective dates for implementing the standards.

Phase I performance standards for the Inactive Area require maintenance of a hydraulic gradient along the west and north sides of Pond 1 to prevent off-site movement of groundwater, coupled with attainment of groundwater standards north of the Groundwater Interception Trench. Phase II performance standards for the Inactive Area, which cannot start until after Phase I performance standards have been achieved for a consecutive 24-month period, require compliance with ambient standards and attainment of groundwater standards south of the trench. Ambient standards are now effective in the Active Area. For the Inactive Area, ambient standards will become effective after attaining Phase I groundwater standards south of the interception trench for a 24-month period.

The following sections describe the treatment system, performance goals, routine operations, recordkeeping and reporting requirements, routine inspection and maintenance programs, and emergency procedures. All activities conducted in association with this document are to be performed in compliance with the Site-Specific Health and Safety Plan.

1.2 System Background

1.2.1 Site Location and Description

The WSP Operable Units of the Silver Bow Creek/Butte Area (Original Portion) Superfund Site are located approximately 23 miles northwest of Butte, Montana, and 7 miles east of Anaconda, Montana, as shown in Figure 1-1. Figure 1-2 provides a detailed layout of the WSP site and the plot plans (Figure 1-3 through Figure 1-8) show the site utilities. The WSPs are located on the lower (northernmost) reach of Silver Bow Creek and occupy a large area that was previously the natural channel and flood plain of Silver Bow Creek. Mill and Willow Creeks are tributaries of Silver Bow Creek. The natural confluence of these three creeks was near the upstream end of the

WSP system. The Mill-Willow Bypass is a constructed channel that routes the flows of Mill and Willow Creeks around the WSP system. Silver Bow Creek flows enter the south end of Pond 3 and, after a retention period of several days to many weeks, exit Pond 3 and pass through Pond 2 with eventual discharge into the constructed Mill-Willow Bypass. A short reach of the original Silver Bow Creek channel is present below Pond 1. The lower end of the Mill-Willow Bypass merges with the Clark Fork River below the WSP and below the mouth of Warm Springs Creek. Pond 1 is no longer part of the treatment flow path and is now part of the Inactive Area.

The original tailings pond was constructed in 1911 and is now designated as Pond 1. Pond 2 was constructed near the lower end of Silver Bow Creek in 1916 to settle out mine tailings and associated sediments before the Silver Bow Creek flows entered the Clark Fork River. Pond 3 was constructed upstream of Pond 2 in the period 1956-1959 to provide additional sediment trapping capacity. Lime addition to Silver Bow Creek above the WSPs began in the mid-1960s. The lime addition was later established at the inlet to Pond 3 to aid the natural biologic precipitation of dissolved metals in the WSP system.

Figure 1-2 shows the approximate boundaries of the WSP Operable Units. As a result of the Interim Record of Decision (ROD) (EPA, 1992) for the Inactive Area, the WSP Operable Unit was divided into two distinct interim operable units, the Active Area and the Inactive Area. The Active Area Operable Unit encompasses the inlet area above Pond 3, Pond 3, Pond 2, and the portion of the Mill-Willow Bypass adjacent to Ponds 2 and 3. These areas and a narrow corridor along the Mill-Willow/Silver Bow Creek divider dike (outside the WSP Active Area Operable Unit) delineate the area initially addressed in the RD/RA. The Inactive Area includes Pond 1, the area downstream of Pond 1, and the lower portion of the Mill-Willow Bypass. The RD/RA for the Inactive Area immediately followed RD/RA for the Active Area. Both areas are covered under this O&M Manual.

1.2.2 Regulatory History

From the early 1970s until late 1991, the WSP were operated under a Montana Pollution Discharge Elimination System (MPDES) permit. Since the mid-1980s, however, the WSP area has been the subject of various studies addressing it as a Superfund Site. The early studies were completed by the Montana Department of Health and Environmental Sciences (MDHES) (that became the Montana Department of Environmental Quality [DEQ]) in collaboration with the EPA. Additional studies were conducted by Atlantic Richfield, the owner of the site.

The agency studies included Remedial Investigation (RIs), a Feasibility Study (FS), analysis of applicable or relevant and appropriate requirements (ARARs) and public health and environmental risk assessments. The primary concerns that were pertinent to the WSP Operable Units are summarized as follows:

- Potential releases of metals contained in pond bottom sediments;
- Pond embankment stability during floods or earthquakes;
- Metal loads in the Mill-Willow Bypass, Silver Bow Creek and the area below the WSP, and the Clark Fork River;

- Tailings in the Mill-Willow Bypass subject to direct contact, dissolution of metal salts, and erosional transport downstream;
- Exposed tailings and associated soils within the WSP subject to direct contact; and
- Downstream transport of tailings in Silver Bow Creek above the WSP via the Bypass.

Intensive study and dialogue involving Atlantic Richfield, the public, and the regulatory agencies occurred during the effort to define suitable responses to these concerns. This culminated in the EPA issuing an Interim Record of Decision (ROD) (EPA, 1990) for the Active Area in September 1990. As subsequently modified, explained, and clarified, the Active Area ROD establishes the following:

- The technologies that will be used to treat surface water and to remediate tailings and associated soils within Pond 2;
- The extent to which the Pond 2 and 3 embankments must be raised and strengthened;
- Necessary institutional controls;
- Other necessary activities including monitoring; and
- The ARAR requirements and other performance standards.

The selected remedy for the Active Area (specified by the ROD and confirmed in Exhibit 2 of the UAO) is summarized as follows (EPA, 1990; EPA, 1991a):

1. Allow the WSP to remain in place. Ponds 2 and 3 will continue to function as treatment ponds until upstream sources of contamination are cleaned up.
2. Raise and strengthen pond berms according to specified criteria, which will protect against dam failure in the event of major earthquakes or floods and increase the storage capacity of Pond 3 to receive and treat flows up to the 100-year flood.
3. Construct new inlet and hydraulic structures to prevent debris from plugging the Pond 3 inlet and to safely route flows in excess of the 100-year flood around the WSP.
4. Comprehensively upgrade the treatment capability of Ponds 2 and 3 to fully treat all flows up to 3,300 cubic feet per second (cfs) (100-year peak discharge) and construct spillways for routing excess flood water into the Mill-Willow Bypass channel.
5. Remove all remaining tailings and contaminated soils from the Mill-Willow Bypass, consolidate them over existing dry tailings and contaminated soils within the Pond 1 and/or Pond 3 berms, and provide adequate cover material, which will be revegetated.
6. Reconstruct the Mill-Willow Bypass channel and armor the north-south berms of all ponds to safely route flows up to 70,000 cfs (one-half of the estimated probable maximum flood or PMF).
7. Flood (wet close) all dry portions of Pond 2, or, if not wet closed, dry close and revegetate contaminated portions.
8. Establish surface and groundwater quality monitoring systems and perform all other activities necessary to assure compliance with all performance standards.

9. Implement institutional controls and other measures to prevent future residential development.
10. Defer, until upstream cleanup is accomplished and incoming water quality is known, the decision on routing water into the treatment ponds and the final disposition of the WSPs.

Two legal mechanisms have been used to implement the Active Area remedy. The first, an Administrative Order on Consent (or Consent Order), applied to much of the work on Mill-Willow Bypass and strengthening of the pond embankments. The second, a UAO, was employed for implementing other portions of the remedy.

A similar sequence of study and dialogue involving Atlantic Richfield, the public, and the regulatory agencies occurred to address concerns relative to the Inactive Area. This resulted in EPA issuing an Interim ROD (EPA, 1992) (specific to the Inactive Area) in June 1992. The list below identifies the specific remediation goals and objectives addressed by the ROD:

- Prevent release of pond bottom sediments during earthquakes and major floods;
- Prevent ingestion of surface water above the standards specified by the Montana Public Water Supply Act through institutional controls and operation of the interception and pumpback system;
- Substantially reduce the potential for direct contact, inhalation, and ingestion of tailings and associated soils; and
- Prevent off-site migration of groundwater with constituent concentrations exceeding Montana groundwater maximum contaminant levels (MCLs).

Based on a comparison of alternatives, the ROD established:

- The technologies that will be used to treat and contain the contaminated groundwater and surface water and contaminated tailings, sediments, and soils present, as well as the necessary measures for monitoring effectiveness of the remedy;
- The extent to which the pond berms must be raised, extended, and strengthened;
- Institutional controls that are necessary for the Inactive Area;
- Other necessary activities; and
- The ARAR requirements and other performance standards.

The selected remedy for the Inactive Area, as set forth in Part I of the ROD and confirmed in Exhibit 2 of the UAO, is summarized as follows (EPA, 1993):

1. Remove all contaminated soils from the adjacent portion of the bypass channel and from the area below Pond 1 not planned for wet closure. Consolidate the wastes over existing dry tailings within the western portion of Pond 1.

2. Modify, or enlarge if necessary, the adjacent portion of the bypass channel to safely route flood flows up to 70,000 cfs, which is one-half the estimated PMF for the combined flows of Silver Bow, Willow, and Mill creeks. Soils and gravels that have copper concentrations

below 500 milligrams per kilogram (mg/kg) and meet geotechnical requirements will be used for raising and strengthening the existing berms and constructing new berms.

3. Raise, strengthen, and armor the north-south aspect of the Pond 1 berm. In accordance with specified state safety standards for high-hazard dams and for the protection of human health and the environment, the reconstructed berm must withstand the estimated maximum credible earthquake (MCE) for this area. The reinforced berm must also be constructed to withstand flood flows up to 70,000 cfs (0.5 PMF) in the enlarged bypass channel.

4. Stabilize the east-west aspect of the Pond 1 berm. The reconstructed berm must withstand the MCE for this area; thus protecting against the movement of contaminated pond bottom sediments or tailings into the uncontaminated or wet closed areas below Pond 1, according to specified site dam safety standards, and for the protection of human health and the environment.

5. Extend and armor the north-south aspect of the Pond 1 berm approximately 2,400 feet in a north-northeasterly direction. This extended berm will be constructed to provide MCE protection and the ability to withstand one-half the estimated PMF (70,000 cfs) in the adjacent bypass channel.

6. Relocate the lowermost portion of the bypass channel and convert the present channel into a Groundwater Interception Trench. The relatively straight reach of the bypass channel, from the apex of the existing Pond 1 berm to the historic Silver Bow Creek channel, will be relocated north of the extended berm. The entire reach of the bypass channel that is adjacent to the Inactive Area will be reconstructed, reclaimed, and restored to a more natural, meandering condition. Other excavated areas will be reclaimed and restored to their natural condition.

7. The converted Groundwater Interception Trench will be deepened and pumps installed to allow for a Pumpback System. Intercepted water that fails to meet specified standards will be pumped back to the Active Area for treatment. While the Pumpback System is in place, a hydraulic gradient standard will be attained. The Pumpback System is meant to be a temporary system to contain contaminated groundwater for a limited time until the chemical fixation described below addresses the groundwater contamination through source control. The Pumpback System may be shut off if appropriate performance standards are met. Monitoring wells and surface water quality monitoring stations will be placed at strategic locations. Surface water performance standards will be met.

8. Construct wet closure berms to enclose the submerged and partially submerged tailings and contaminated soils. Within the eastern portion of Pond 1 and along the historic Silver Bow Creek channel below Pond 1, these smaller berms will create a series of cells, which when flooded will vary in depth from a minimum of one foot to a maximum of six feet.

9. Chemically fix (immobilize) the tailings and contaminated soils, now enclosed by smaller berms, by incorporating lime and lime slurry onto or into them. The combination of chemical fixation and wet closure of contaminated soils and tailings is intended to be the

primary component of the remedy. It is expected that groundwater will be intercepted and pumped back to the Active Area for treatment until such time as the combination of chemical fixation and wet closure demonstrates its effectiveness in terms of preventing the continued mobilization of metals from their sources into the groundwater.

10. Flood the wet closure cells with water adjusted to a pH greater than 8.5 and maintain proper water surface elevations in the wet closure cells.

11. Cover the dry tailings and contaminated soils within the western portion of Pond 1 with 2 inches of limestone, 12 inches of fill, and 6 inches of a suitable soil cap. This dry closed area will be contoured to control runoff and seeded with native vegetation.

12. Construct a runoff collection and outflow system within Pond 1. This system will allow floods originating in the eastern hills to flow into Pond 1, but not compromise the integrity of the wet and dry closures. It will be designed to receive one-half the PMF, which is estimated to be 8,500 cfs at its peak.

13. Install toe drains along the armored berm and construct a collection manifold for both the Active and Inactive Area north of Station 164, as determined in the RD. The water collected will be pumped to either Pond 2 or Pond 3 for treatment if it exceeds final point source discharge standards specified in Attachment 5 to the WSP Active Area UAO, as determined by EPA as per the RD documents.

14. Implement long term ecological monitoring. Using an unbiased set of measurements, this monitoring effort will concentrate on the effects of biological systems living in contact with metals in the water and substrate of ponds and wetlands environments. The results will validate or invalidate the decision to chemically fix, wet close, and contain in place the exposed and submerged tailings and contaminated soils.

15. Implement institutional controls to prevent residential development, domestic well construction, disruption of dry closure caps, and swimming.

The above summary of the remedy for the Inactive Area describes only the major actions required. A complete description of all the remedy requirements is contained in the Record of Decision (EPA, 1992).

This O&M Manual, prepared in response to the UAOs for the Active and Inactive Areas, addresses the on-going site activities required for the long-term effectiveness of both remedies.

1.3 Owner and Contact Information

Atlantic Richfield Company (Atlantic Richfield) is a Potentially Responsible Party (PRP) of the WSP water treatment system. Operation and maintenance of the system is the responsibility of the PRP. Duties associated with proper O&M may be tasked to a contractor, or owner's representative.

1.3.1 Key Contacts / Emergency Information

BP Incident Notification Center 1-800-831-8642

BP (Atlantic Richfield)	**Office (406)**	**Mobile (406)**	**Home (406)**
Dave Griffis	723-1820	490-4210	
Josh Bryson	723-1834	565-7164	
Jenni Harris	723-1823	491-2552	
Jim Chatham	214-505-3992	714-228-6547	
Pioneer Technical			
Brad Archibald	497-8019	490-3032	494-6549
Casey Briggs	723-1943	491-5720	
Mike Browne	723-1917	498-3372	
Steve Lubick	490-7680	782-1702	
Brian Kremer		490-3086	
Tara Schleeman	497-8026	490-8272	533-0913
EPA			
Allie Archer		457-5021	
Montana DEQ			
Daryl Reed		841-5041	

1.3.2 Additional Emergency Contact Agencies

Emergency Response	911
Disaster-Emergency	(406) 497-6295
NorthWestern Energy	
Emergency	1-888-467-2427
Electrical Emergency	1-888-467-2353

1.3.3 Non-Emergency Services

Ambulance	911 or (406) 682-4222
Police	911 or (406) 563-5241
Fire Department	911 or (406) 563-2164
Hazmat Response Unit	911
Water Company	(406) 563-7111
Anaconda-Deer Lodge Co.	(406) 563-6932

NorthWestern Energy

Connect and Repair	1-888-467-2669
Century Link Repair Services	1-877-769-5939
MT. Highway Patrol	(406) 494-3233
MT Department of Highways	(406) 494-9600
Department of State Lands	(406) 563-6078
Community Hospital of Anaconda	(406) 563-8500
National Oceanic and Atmospheric Administration (NOAA)	(406) 329-4840

Local Resources-company names, contact name, phone numbers, description of resources

Jordan Contracting, Inc.
Ed McCarthy (406) 691-0103
Wasley Excavating
Brent Wasley (406) 491-1525

Oil Spill Response Contractors (OSROs)
Stantec Consulting (406) 723-7980

1.4 Organization and Use of this Manual

This O&M Manual contains several different types of information. First, it provides (for the operator) the necessary background and overview of the WSP system, how the system should function, and what is required for the system to function correctly. Then, this manual also provides detailed information and instructions to establish the necessary procedures for both normal operations and operations under special circumstances. Specifically, the sections provide the following.

Section 2.0 System Overview (Description and Capabilities). This section contains two levels of detail. An initial overview describes each major system component and its function. The remainder of the section provides substantial detail on the design basis and the technical features and capabilities of each facility. This section serves as an initial reference when the operator needs information on how a particular part of the system is intended to fit into and contribute to the entire system.

Section 3.0 Performance Standards. This section is organized and presented so that the operator can clearly understand the performance requirements and how to address the requirements on a day-to-day basis. The section describes the O&M requirements relevant to dam safety, water quality, and other issues. It describes the gradual staging that progressed through the Active Area Shakedown Period to more stringent water quality standards, describes the function of Inactive Area Phase I and II water quality standards, and details the manner in which some water quality standards are adjusted based on hardness. Operators should use this section in combination with Section 8.0, Routine Monitoring and Laboratory Testing, and Section 9.0, Operation Reporting and Recordkeeping.

Section 4.0 Process Control. Section 4 provides an overview of how the facilities can be used to adjust the treatment processes, identifies the actions an operator might take to adjust the processes, and lists the reasons/conditions to justify such actions.

Section 5.0 Normal Operations. This section first provides a structure for the operator's day in the form of routine tasks required for system monitoring and oversight, then provides details on what the normal settings are for the various facilities, and finally lists the procedures to establish, verify, and change those settings.

Section 6.0 Safe Operating Limits. This section describes the operating limits of the system components to prevent damage or failure of the system, which could potentially impact worker safety or the environment. This system provides safe operating water levels, pressure, temperature, and electrical limits as applicable to system components.

Section 7.0 Operations During Upsets. This section identifies various types of unusual conditions that could occur, especially in the WSP treatment system, and provides alternative response/ mitigation measures, approaches to identifying the cause of the problem, and sources of additional information and assistance.

Section 8.0 Routine Monitoring and Laboratory Testing. This section defines the full spectrum of measurement and observation reporting activities required for the site. This includes monitoring activities for operation and process control, and monitoring activities required by regulatory agencies. The section outlines an approach for the operator to use to summarize the data, detect trends, and respond with appropriate changes in operation. Operators must review the monitoring data for compliance with regulatory performance requirements (see Section 3.0) and submit the required monitoring reports (Section 9.0).

Section 9.0 Operations Reporting and Recordkeeping. Reporting and recordkeeping are extremely important aspects of daily operations. This section outlines the regulatory requirements for recordkeeping and reporting that operators must meet. Operating records provide a valuable source of data for improving system understanding and appropriate refinement of operations.

Section 10.0 Routine Inspection and Maintenance Guidelines. This section lists the routine inspections and maintenance required for all treatment and earthwork facilities. The section outlines the computerized scheduling and maintenance mechanism for the process equipment that allows scheduled activities to automatically become part of the operator's agenda at the appropriate time. The section also provides specific procedures for inspecting and maintaining the earthwork facilities.

Section 11.0 Emergency Procedures. This section lists the emergency procedures for response to various alarm conditions and, via reference to the most current Dam Safety Emergency Action Plan provided separately, dam safety emergencies as well as how to use emergency/ redundant equipment.

Section 12.0 Site Safety and Health Plan. This section identifies (via reference to the most current Site-Specific Safety and Health Plan developed for operations and maintenance of the WSP) specific site, equipment, and chemical hazards that the operator must recognize. It also stipulates appropriate precautions operators must follow.

Section 13.0 Management and Staffing Plan. Section 13 identifies the responsibilities for both the management (Atlantic Richfield's Authorized Representative) and the facility operator; and describes staffing and subcontractor support requirements.

Section 14.0 Future Revisions/Updates to the Manual. This manual serves as a *living* document that requires updates and revisions. This section establishes the mechanism for periodic review and issuance of such revisions on a controlled and properly documented basis.

Section 15.0. References. The last section lists full details on the documents reference throughout this manual.

The Biomonitoring Plan for the WSP operable units is administered separately from this O&M Manual.

1.5 Future Revisions

The subject of future revisions deserves special mention in this version of the WSP O&M Manual. The remedy being implemented, particularly the treatment effectiveness of the WSP system to remove metals, involves substantial uncertainties. Accordingly, the initial phase of operations was defined as the "Shakedown Period." Less stringent performance standards were established for this period (see Section 3.0); the more stringent final standards apply now that the project has had the advantage of analyzing and improving operations throughout and since the Shakedown Period. This information and refinement of operation has been incorporated into this version of the O&M Manual.

Appendix A details the revisions to the original O&M Manual.

2.0 SYSTEM OVERVIEW

The primary objective of the WSP system is to treat the incoming water so that water leaving the system meets established water quality standards. This objective is accomplished through integrated operation of the full system that includes Pond 3, Pond 2 (including the wet closure facilities), the facilities to bypass around Pond 2, the Pond 1 wet closure facilities, the three wet closure cells below Pond 1, and the Groundwater Interception and Pumpback System.

Operation of the WSP treatment facility and hydraulic structures are coordinated to optimize water quality for flow ranges up to the peak of 100-year flood inflow, with the objective of consistent compliance with final discharge standards. Pond 3 is the primary treatment pond, with Pond 2 serving to enhance performance under normal flow conditions. Lime is added to the inflow upstream of Pond 3 to control the pH within the WSP system at an optimal level for metals precipitation. Inflows of up to 3,300 cfs (100-year inflow) are treated and routed through the WSP system. Flows in excess of the 100-year event are routed around the WSP via the Mill-Willow Bypass. Flow entering Pond 2 from Pond 3 is controlled and limited to no more than 300 cfs. Flows into Pond 3 in excess of the maximum outflow to Pond 2 are accommodated by flood storage in Pond 3 and/or discharge to the Mill-Willow Bypass. Although the primary purpose of the wet closure cells within Pond 2 is to inundate exposed tailings and thereby prevent direct contact or release, secondary benefits to water quality are anticipated. The major hydraulic structures have been designed such that pond levels, discharge locations, and discharge flow rates can be varied as necessary to optimize treatment operation of the WSP system. The sections below contain a detailed description of the facilities within the WSP system. Figure 2-1 illustrates the facilities at WSP and Appendix G contains a Piping and Instrumentation Diagram (P&ID) of the facilities.

2.1 Description of Facilities

2.1.1 Mill-Willow/Silver Bow Creek Divider Dike

The Mill-Willow/Silver Bow Creek divider dike is located upstream of the WSP near the town of Opportunity, Montana, as shown in Figure 2-2. The purpose of the divider dike is to prevent flood waters in the Silver Bow Creek watershed from entering the Mill and Willow Creek drainages, and thereby the Mill-Willow Bypass during and up to the 100-year flood event. As a secondary function, the divider dike keeps relatively clean Mill-Willow flood waters out of the WSP system.

The alignment of the divider dike follows the divide between Mill and Willow Creeks and Silver Bow Creek. The dike commences at the bridge at I-90 and continues approximately 6,500 feet south to the ridge south of Stewart Street, and from Highway 1 approximately 5,600 feet south to connect to an existing agricultural embankment.

2.1.2 Mill-Willow Bypass

The Mill-Willow Bypass functions as the primary floodway for the WSP. Figure 2-2 shows the location of the Mill-Willow Bypass, which was designed and constructed to divert waters around the WSP including:

- All flows from Mill and Willow Creeks;
- The flows from Silver Bow Creek in excess of the Pond 3 inlet capacity; and
- Flood flows from the Silver Bow, Mill and Willow Creek drainages exceeding the 100-year flood (3,300 cfs), up to 70,000 (the Design Flood) cfs.

The Mill-Willow Bypass was modified to provide the necessary flood channel capacity. The WSP system dikes' side slopes adjoining the Mill-Willow Bypass were faced with soil-cement to protect the dikes from erosion during flood flows within the Bypass. Perforated pipe toe drains have been installed behind the soil-cement slope protection to maintain the stability of the soil-cement armored dikes. The toe drains relieve seepage pressures that could potentially build within the dikes behind the relatively impervious soil-cement. Outfall pipes convey the seepage flow through the soil-cement facing. Outfall pipes along the upper end of the Mill-Willow Bypass (along the Pond 3 Dike) discharge into the Bypass. Outfall pipes along the Pond 2 Dike discharge into a collection pipe called the Soil-Cement Toe Drain Manifold. The Toe Drain Manifold conveys the collected seepage water below grade, and discharges into the Groundwater Interception Trench.

Upon completion of the remedial measures at the WSP, the Bypass was reconstructed and reclaimed so that it currently consists of three major components: the design flood floodplain, low-flow channel for routing normal flows from Mill and Willow Creeks, and shallow ponds (see Figure 2-3). Most of the Mill-Willow Bypass is a floodplain composed of low growing grasses and a few small shrubs. The low-flow channel meanders through the floodplain and has grasses and willows planted locally along its edge to stabilize banks and enhance fish habitat. The shallow ponds have gradually sloping shores and small islands vegetated with emergent wetland plant species. Growth within the Mill-Willow Bypass must be limited to maintain the required flood discharge capacity.

2.1.3 Pond 3 Facilities

Pond 3 provides primary settling and metals removal for Silver Bow Creek flows that enter the WSP system. Pond 3 is impounded by approximately 21,000 linear feet of earth embankments, includes an inlet area for control and treatment of flows into the system, and includes several flow outlets for discharge during normal and emergency operations. Also, Pond 3 contains two dry closure areas that enclose tailings and other contaminated soils removed from the Mill-Willow Bypass during remediation of the WSP. Figure 2-1 shows the major components of the facilities at Pond 3, and Figure 2-4 shows the area/capacity relationship for Pond 3.

Earth embankments separate Pond 3 from the Mill-Willow Bypass to the west and from Pond 2 and/or the Wildlife Ponds to the north. Embankment sections along the Mill-Willow Bypass are referred to as dikes, and the sections separating the ponds are called dams. Natural high ground contains the impoundment on the eastern side. Soil-cement slope protection has been placed on the western (downstream) side of the Pond 3 Dikes to reduce scour and erosion potential during flood flows down the Mill-Willow Bypass. Dimensions and technical data for the Pond 3 Dike and Dam are detailed in Section 11.3.

The Pond 3 inlet area conveys Silver Bow Creek flows into the WSP system. The inlet area consists of an approach channel, the Inlet Structure, and the channel to Pond 3 downstream of the Inlet Structure (see Figure 2-5). The approach channel incorporates approximately 1,900 feet of dike on each side of Silver Bow Creek, a soil-cement overflow section, and a fuse plug section described in Section 2.2.7. The purpose of the channel is to convey normal flows and flood flows up to the 100-year flood into the Inlet Structure, and to route flood flows in excess of the 100-year flood around the WSP system and into the Mill-Willow Bypass. The Inlet Structure design limits the quantity of flow into Pond 3 and prevents debris and other unsuitable materials from entering the system and/or plugging the inlet gates, **providing that accumulated debris is removed in a timely manner**. Water treatment facilities are located at the Inlet Structure and use the channel downstream of the structure to mix lime additives with the inflowing water. The treatment facilities are described in detail in Section 2.1.15. Inflow to the WSP system is measured at a weir located at the downstream apron of the Inlet Structure.

There are four major outlet points for flows exiting Pond 3 as shown on Figure 2-1. The East and West Outlet Works route normal flows from Pond 3 into Pond 2 and the Pond 2 wet closure cells. A controlled overflow outlet discharges directly into the Mill-Willow Bypass. This overflow section is referred to by various descriptive names including *Pond 3 Service Spillway*, *Pond 3 Bypass Spillway,* and simply *Bypass Spillway*. The name used in this Manual is *Bypass Spillway* because the section's key characteristic is that it allows flows to bypass Pond 2. The fourth Pond 3 outlet is an Emergency Spillway, which has a higher crest elevation and much longer crest length than the Bypass Spillway. The Bypass Spillway and Pond 3 Emergency Spillway are used to discharge Pond 3 flows into the Mill-Willow Bypass during periods when higher flood flows cannot be directed into Pond 2, or when it is necessary to discharge water from Pond 3 rather than Pond 2. The Bypass Spillway is located at the northwest corner of Pond 3 and the Emergency Spillway is on the west side of Pond 3 approximately 4,500 feet south of the Bypass Spillway. In addition to the four major outlet points, small polyethylene (PE) siphons are used to feed the Wildlife Ponds from Pond 3 (see Figure 2-1).

Two dry closure areas are located within the Pond 3 impoundment (see Figure 2-1). These areas are disposal sites for tailings and contaminated soils. Both are located along the east side of the Pond 3 Dike. The larger dry closure area is located approximately 3,500 feet downstream of the Pond 3 inlet area, and the smaller site is located approximately 500 feet downstream of the inlet. The dry closure areas are covered with topsoil and grasses to maintain the integrity of the dry closure cap materials, and to prevent direct contact with or dispersion of the contaminant metals.

2.1.4 Facilities for the Pond 2 Wet Closure Cells

The base flow from the East and West Outlet Works of Pond 3 is routed into the Pond 2 wet closure cells to maintain inundation of tailings deposits. These cells also provide benefits as part of Pond 2 water treatment *polishing*. The two cells are impounded by approximately 7,500 linear feet of dike. The cells are fed by one common Inlet Structure, which allows splitting flow between the two wet closures. Several outlet structures serve each cell. Flows from the cells are discharged into Pond 2 for further treatment before being released into the Mill-Willow Bypass. The general location of the Pond 2 wet closure cells is shown in Figure 2-1 with a more detailed plan presented in Figure 2-6. Area/capacity relationships for the East and West Cells are shown in Figure 2-7 and Figure 2-8, respectively.

The Flow Measurement Weir, shown in Figure 2-6, routes a portion of the flows from the East and West Outlet Works of Pond 3 (via the Pond 2 inlet channel) into each of the wet closure cells. The weir structure construction allows for adjustable quantities of flow to enter each cell and allows excess flow to bypass the cells and directly enter Pond 2. The water level entering the east and west wet closures and passing directly to Pond 2 is measured at this sample station (SS) location by level transmitters LT-SS4-2303, LT-SS4-2304, and LT-SS4-2302, respectively, and calculated to flow rate.

The west wet closure cell inundates an area of approximately 78 acres. An inlet channel and dike conveys flow from the Flow Measurement Weir into the wet closure cell. Three outlet structures are equally spaced across the northern dike. These concrete box structures contain stoplogs to allow manual adjustment of the pool level for maintenance or other reasons. The wet closure cells will be held at a level to ensure that the tailings within the cells remain covered.

The east wet closure cell inundates an area of approximately 62 acres. An inlet channel and dike convey flow from the Flow Measurement Weir into the cell near the historic Rainbow Bridge. Two outlet structures, which are identical to those in the west cell, are evenly spaced across the northern dike. A four-acre, dry closure area is situated along the southern edge of the east cell at the toe of the Pond 3 Dam. This dry closure area was constructed to cover tailings and contaminated soils located above the east wet closure cell water surface.

Flow leaving Pond 3 in excess of the inflow capacities of the wet closure cells will spill over the Flow Measurement Weir, into the Pond 2 main channel, and thereby directly into Pond 2. This channel is located between the east and west wet closure cells as seen in Figure 2-6. A box culvert has been placed approximately half way down the channel to provide access across the main channel.

2.1.5 Wildlife Ponds

The Wildlife Ponds are three small ponds located just north of the northwest side of Pond 3 (see Figure 2-1). A small quantity of flow from Pond 3 maintains these wildlife areas and receives additional treatment as it passes through the Wildlife Ponds before being discharged into Pond 2. The water is routed into the Wildlife Ponds by siphoned flow from Pond 3. Discharge from the two western ponds enters directly into Pond 2 at its southwestern edge. The eastern pond discharges into the Pond 2 inlet channel upstream of the Flow Measurement Weir and subsequently into Pond 2. The discharge structure for each pond contains a vertically oriented, corrugated-metal overflow pipe and a smaller diameter, horizontally oriented, corrugated-metal outfall pipe. The eastern pond also contains a two-acre dry closure area at the southeastern edge of the pond along the toe of the Pond 3 Dam.

2.1.6 Pond 2 Facilities

Pond 2 is the final step in the surface water treatment system. Flow from the pond is returned to the Mill-Willow Bypass. This facility encompasses an area of 400 acres and includes approximately 8,800 feet of embankments, a service spillway, and an Emergency Spillway. The Pond 2 facilities are shown in Figure 2-1, and the area/capacity relationship is shown in Figure 2-9.

The Pond 2 Dam separates Pond 2 (Active Area) from Pond 1 (Inactive Area) to the north, and the Pond 2 Dike separates Pond 2 from the Mill-Willow Bypass to the west. The Pond 2 Dike has a soil-cement facing adjacent to the channel to minimize scour potential during flood flows within the Mill-Willow Bypass. A complete summary of the characteristics of the Pond 2 Dike and Dam is referenced in Section 11.3.

Water enters Pond 2 from Pond 3 by way of the Pond 2 wet closures, the main inlet channel, and the Wildlife Ponds. Pond 2 also receives the groundwater pumpback flows from the toe-ditches and Groundwater Interception Trench. Some flow also enters Pond 2 from runoff within the Whitcraft Gulch drainage located in the hills adjacent to the east side of Pond 2 (both sides of the Great Blue Heron Rookery). Discharge points from Pond 2 consist of a service spillway and Emergency Spillway. The service spillway is located at the northwest corner of Pond 2 (see Figure 2-10). Just downstream of the service spillway are the Pond 2 outlet channel and drop structures. The drop structure dissipates the energy of the Pond 2 outflow and conveys the treated water into the Mill-Willow Bypass. The water level is measured just upstream of the drop structure by level transmitter LT-PD2-3202 and calculated to get the flow rate discharged from Pond 2. The Emergency Spillway is a soil-cement-lined overflow section located on the Pond 2 Dike approximately 850 feet south of the northwest corner of Pond 2. The Emergency Spillway is designed to operate only during flood inflows from Whitcraft Gulch or in the event the service spillway becomes plugged.

A boat ramp was installed on the Pond 2 dike in 2014 and on the Pond 3 dike in 2016 to launch boats, rescue skiffs, and SolarBees.

2.1.7 Pond 1 Facilities

At the time of remediation, Pond 1, the original settling pond in the WSP system, was no longer functional as a settling pond. It had been previously removed from the flow sequence and has not been involved in the active treatment of water from Silver Bow Creek. This inactive pond and the area below Pond 1 are isolated from the active treatment portion of the Pond system. The relatively small volume of water contained within and flowing through the Inactive Area was due to seepage from the upgradient ponds and from local runoff. Thus, the Pond 1 remediation facilities are oriented toward interception and management of this water and containment of the tailings materials located within the pond. A Pumpback System manages the water; it intercepts and returns all Pond 1 outflows to Pond 2 for treatment prior to discharge to the Mill-Willow Bypass. Tailings deposits are contained by a combination of wet and dry closures (Figure 2-1).

A small diversion of flow from Pond 2 into Pond 1 helps maintain the wet closures. Although the new facilities represent a departure from the totally passive approach that existed prior to remediation, it does not constitute an active treatment system. The active water treatment system is still confined to Ponds 2 and 3.

Pond 1 facilities include the following features, as illustrated in Figure 2-1:

- Earth embankments separate Pond 1 from the Mill-Willow Bypass on the west (extending downstream from Pond 2) and from the area below Pond 1 (the historic Silver Bow Creek channel and floodplain). These embankments have been raised and strengthened, as necessary, to meet remediation requirements. The westerly slope of the 2,000 feet of dike bordering Mill-Willow Bypass is protected with soil-cement. This reduces the potential for dike scour and erosion during flood flows down the Bypass. A toe berm was necessary to strengthen the easterly 1,800 feet of the 5,000-foot dam separating Pond 1 from the downstream area.
- A Pond 2 outlet/Pond 1 Inlet Structure transfers flows, typically in the range of 1 to 4 cfs, from Pond 2 into the wet closure area of Pond 1. The Pond 1 inlet is a concrete box with a throttling slide gate (KG-PD1-3204) and weir for normal flow control.
- Pond 1 has a normal water surface at elevation 4,816.0 feet and an area of 141 acres (including 43 acres of naturally ponded area at the southern end of Pond 1 and located above elevation 4,816.0 feet). The area/capacity relationship for Pond 1 is shown in Figure 2-11.
- The Pond 1 dry closure area covers approximately 120 acres in the western portion of Pond 1. The southern portion of the Pond 1 dry closure area, comprising an additional 34 acres, was not dry closed because the area did not contain significant exposed tailings deposits. The existing vegetation in this area was left largely undisturbed.
- A spur dike isolates the wet and dry closure areas from each other, except in the case of a major runoff event from the Cook Creek East Hills drainage. At such time, the dike would serve as an overflow weir (elevation 4,818) allowing excess water from the wet closure area to spill into the dry area for temporary flood storage.
- The primary Pond 1 outlet (OS-PD1-3205) connects the wet closure area to the south wet closure cell through a concrete outlet box with a typical flow of 1 to 6 cfs. The pond level is controlled using adjustable stoplogs with maximum discharge controlled by an orifice on the downstream pipe.
- A second Pond 1 outlet (a 12-inch outlet pipe) discharges from the dry closure area to the Pumpback System for moderate floods (a 12-inch outlet pipe).
- A Pond 1 emergency outlet (two 66-inch diameter pipes) discharges to the Mill-Willow Bypass during an extreme flood.

2.1.8 Wet Closure Cells Below Pond 1 (Lower Wet Closures)

The wet closure areas below Pond 1 consisted of marsh and wet meadow, with local areas of ponded water and exposed tailings prior to remediation. To meet wet closure criteria, water levels were raised to inundate exposed tailings to a nominal 1-foot depth. Three wet closure cells were created to accomplish this by installing a system of dikes as shown in Figure 2-1.

Inlet and outlet facilities provide flow from the Pond 1 wet closure to the lower wet closures (south, middle, and north wet closures [SWC, MWC, and NWC, respectively]). Flow is from the Pond 1 wet closure to the south cell (through OS-PD1-3205) to the middle cell (through OS-SWC-3208) to the north cell (through OS-MWC-3209) and then to the Groundwater Interception Trench (through OS-NWC-3210) and the Pump Station for return to Pond 2. Each outlet consists of a concrete box with adjustable stoplogs. Maximum flows are limited by the pipe diameters, lengths, and differential heads to the downstream outlets.

2.1.9 Pond 2 Toe Ditch

A ditch at the toe of the western portion of the dam separates Pond 2 and Pond 1 (Figure 2-13). The purpose of this ditch is to intercept seepage originating in Pond 2, thereby controlling the groundwater table throughout the western dry closure area of Pond 1. The ditch is 7 to 10 feet deep, approximately 2,200 feet long, with bottom at elevation 4,810. The ditch is offset from the toe of the Pond 2 Dam by at least 20 feet. Normal water discharge is from the west end of the ditch through an outlet structure (OS-TD-3207) and gravity flow pipe, which conveys the water to the Soil-Cement Toe Drain Manifold and the pumpback facilities located at the northern end of the site. Outlet structure OS-TD-3207 is controlled by stoplogs, which allow selection of the desired water elevation in the ditch.

The level setting in the Pond 2 Toe Ditch can have an impact on the following:

- The hydraulic gradient beneath the Pond 1 Dry Closure;
- The piezometric pressures within the Pond 2 Dam; and
- The toe drain flows in the north end of Pond 2 along the Mill-Willow Bypass.

The setting was adjusted during initial operation to identify optimal operating levels that minimize required pumpback and do not adversely impact the issues identified above.

2.1.10 Flood Extension Dike

The Flood Extension Dike runs from the northwest corner of Pond 1 as an extension of the Mill-Willow Bypass east bank. It proceeds approximately 2,550 feet to the east-northeast, tying into the East Hills. The dike protects the lower wet closures from Mill-Willow Bypass floods and also provides secondary containment for the contents of the lower wet closures. The dike extends approximately 450 feet up the East Hills to exclude local runoff from the site.

2.1.11 Soil-Cement Toe Drain Manifold

The soil-cement erosion protection on the east bank of the Mill-Willow Bypass is relatively impermeable. It is therefore drained by a series of 4-inch diameter, perforated collection pipes that pass through the soil-cement and convey water from within the dikes to the Mill-Willow Bypass. Drain discharges are located at 100-foot intervals. The flow from drains between Stations 165 and 193 (approximately the length of the Pond 2 Dike) is collected in the Toe Drain Manifold (a sewer-like system of pipes and manholes buried within the Mill-Willow Bypass and slightly offset from the toe of the soil-cement facing (Figure 2-1 and Figure 2-12).

Lateral pipes connect each of the soil-cement toe drains to the manifold pipe in the manifold reach. To protect the pipes from freezing, they are buried below groundwater levels with special pipe insulation on the laterals above groundwater. Access to each toe drain is at a cross fitting on the lateral and to the manifold pipe at manholes. As described above, the manifold system collects the drainage from the Pond 2 Toe Ditch and the overall system, then drains to the upper end of the Groundwater Interception Trench. The combined flow is pumped back to Pond 2 for treatment prior to release to the Mill-Willow Bypass.

2.1.12 Pond 1 Toe Ditch

The western portion of the Pond 1 Toe Ditch, at the toe of the Pond 1 Dam west of the lower wet closure cells (Figure 2-13), connects to the north wet closure cell by a ditch system. The connecting ditch, assisted by subsurface flow that drains directly to the Groundwater Interception Trench, is designed to lower the toe ditch water level and the groundwater level beneath Pond 1. This induces movement of groundwater away from the Mill-Willow Bypass adjacent to Pond 1.

2.1.13 Groundwater Interception Trench

Consistent with the overall objective of preventing off-site migration of groundwater that might have constituents at concentrations exceeding MCLs, the Groundwater Interception Trench has been installed at the northern (downgradient) end of the site, immediately inside the Flood Extension Dike (Figure 2-1). The Groundwater Interception Trench together with the Pond 2 Toe Ditch and the Pond 1 Toe Ditch were designed to establish groundwater flow paths as indicated in Figure 2-13. The flow paths in Figure 2-13 are based on groundwater modeling conducted during remedial design and indicate that the trench combination should achieve the design flow paths and capture.

The trench typically provides 30 to 40 percent penetration of the upper aquifer, with penetration in the eastern portion and sump area in excess of 70 percent. The trench is approximately 2,300-feet long and varies from approximately 5 to 20 feet in depth. The trench is designed with a 20-foot bottom width and 2H:1V (horizontal:vertical) cut slopes to achieve long-term stability. The bottom of the trench slopes continuously to the east-northeast to maintain the penetration of the upper aquifer. The easternmost 200 feet of the trench are excavated deeper to form a sump for the Pumpback System inlet.

2.1.14 Pumpback System

The Pumpback System for the Inactive Area is designed to:

- maintain the necessary drawdown level in the Groundwater Interception Trench to achieve hydraulic capture; and
- return flows collected from the groundwater trench, Pond 1 Toe Ditch, Pond 2 Toe Ditch, the Active Area Toe Drain Manifold, and the Inactive Area wet closures to Pond 2 for treatment prior to release to the Mill-Willow Bypass.

The Pumpback System will also accommodate surface water entering the wet and dry closures from the East Hills. The Pumpback System consists of two major elements: the Pump Station Facilities and the Pumpback Effluent Pipe (Figure 2-1).

The Pumpback System design provides a minimum firm pumping capacity of 18 cfs. A total of four pumps are installed; any three together are capable of pumping the design flow of 18 cfs. A maximum discharge of approximately 22 cfs is available with all four installed pumps operating. The fourth pump provides an installed, regularly exercised backup to the three pumps required to meet the design capacity. The system contains a provision to install a fifth pump if necessary in the future. The fifth pump would increase the total system capacity to approximately 27 cfs with all pumps running at maximum output; all the Pump Station Facilities, including the traveling screen, and the Pumpback Effluent Pipe can accommodate expansion to a maximum flow of 27 cfs. Operations experience shows that the average flow attained in the Pumpback System is approximately 7 cfs; easily accommodated with two pumps.

Pumps P-PB-1 and P-PB-2 were removed and rebuilt during the 2007 construction season, and P-PB-3 and P-PB-4 were removed and rebuilt in 2011. In 2018, upgrades were performed that included replacing the P-PB-4 motor, the existing P-PB-4 motor controls with a variable frequency drive (VFD), and the pump control valve with a swing check valve.

It should be noted that runoff and direct precipitation during flood events are not specifically included in the design flow for the Pumpback System. Maintaining full design drawdown of the Groundwater Interception Trench during extreme flood events was not a design criterion. However, the substantial safety factor in the design pumping capacity of the system provides significant, real capacity to maintain normal operating levels in the wet closures and trench during moderate floods and allows relatively rapid recovery from more significant events. During extreme flood events, up to the 0.5 PMF, it may take several weeks or more to fully return the system to normal operating levels. Recovery of the Groundwater Interception Trench pumping level after an extreme flood event could be expedited by cutting off inflow from Pond 2 and the Pond 2 Toe Ditch until equilibrium is restored.

The Pump Station Facilities include a trash-rack-protected pipe inlet at the Groundwater Interception Trench sump; an automatic traveling screen (SCR-PB-4003) between the pipe inlet and the pumps; inlet and manifold piping; four vertical turbine can pumps (P-PB-1, P-PB-2, P-PB-3, and P-PB-4) with piping for a fifth; and a Pump Station building to house the pump motors and electrical controls and the pipe clean-out access (i.e., pig launcher). There are controls to start and stop pumps in sequence based on ditch level, which will automatically accommodate changes in inflow to the Pumpback System. The Pumpback Effluent Pipe consists of a 30-inch steel discharge pipe that connects to a 32-inch high density polyethylene (HDPE) line (28.24-inch ID [inside diameter]) approximately 7,600 feet in length. The static pumping head for the system is approximately 65 feet with a total dynamic head of 81 feet at the 18 cfs design flow.

2.1.15 Description of Treatment Facilities

The water treatment facilities at WSP are oriented toward removal of metals from Silver Bow Creek upstream of the Clark Fork River. The treatment approach is to cause precipitation and settling of the metals. Facilities provided for this purpose include the following:

- Chemical addition facilities
- Mixing facilities
- Settling facilities
- Hydraulic control facilities
- Groundwater interception and pumpback facilities

The chemical addition facilities are located at the Inlet Structure of Pond 3. The primary purpose of chemical addition is to precipitate metals during those times when settling and biological activity alone will not meet discharge standards (see Section 5.0 for more discussion and Figure 5-1 through Figure 5-4 for typical seasonal chemical addition requirements). This is accomplished by adding sufficient lime to raise the pH of the influent water to approximately 8.0 to 8.3. The facilities can accommodate raising the pH to at least 9.0 even during a 100-year flood event.

The site designers also considered the possibility of adding other chemical treatment facilities in the future. Such facilities could be located below the Pond 3 Inlet Structure or within the flow path between Pond 3 and Pond 2. Appropriate flocculation baffling within the inlet channel to Pond 2 and the inlet to the wet closures exists to enable such a future addition.

The mixing facilities ensure that chemicals added are adequately dispersed throughout the influent stream. These are provided as an integral part of the hydraulic flow structure at the Pond 3 inlet facility in the form of mixing baffles and deflection walls and dikes.

The settling facilities are the WSP themselves, which consist of Pond 3, the east and west wet closures in Pond 2, and Pond 2. Biological activity within the WSP system generally enhances metals removal during warmer seasons. Consideration of these biological processes was integral to the design of the project improvements.

The hydraulic control facilities design enhances precipitation and settlement by establishing suitable retention times and appropriately distributing flows under the wide variety of flow conditions. Additional benefits come from maintaining inundation and circulation through the wet closure areas.

The pumpback facilities ensure that groundwater that would otherwise leave the site is intercepted and subjected to treatment until applicable performance standards are met.

2.1.16 Description of Monitoring Facilities

The purpose of the monitoring facilities is to provide the following information:

- Elevation (for both surface water and groundwater), water flow, and quality variables that are the basis for process and hydraulic control.
- External factors that are believed to affect pond treatment results.
- The results achieved by the treatment and groundwater interception systems particularly in relation to the performance standards.
- Video recording of the major dams and dikes.

To accomplish this, the monitoring facilities perform the following:

- Monitor and record various environmental factors at Pond 3 and Pond 2.
- Measure and record flow rates at the Pond 3 inlet, Pond 2 and wet closure inlets, pumpback flow, and the Pond 2 outlet. Flow rates can also be measured at the confluence of Mill and Willow Creeks and on the Mill-Willow Bypass below Pond 2 discharge at a location upstream of the confluence with Warm Springs Creek.
- Sample, analyze and record water quality data at the Pond 3 inlet, Pond 3 outlet, Pond 2 outlet, north wet closure outlet, pumpback flow, and at three locations along the Mill-Willow Bypass.
- Establish supplementary monitoring points for obtaining other data as needed.
- Capture and record video of dams and dikes to investigate potential dam failures.

Monitoring facilities include various automatic sampling and sensing devices at different locations that feed data into the data logging/retrieval system. The automated system is supplemented by manual measurements (e.g., staff gages and piezometers) that are less subject to variations and less critical to day-to-day control. Section 2.6 provides a complete discussion of the monitoring system capabilities.

2.1.17 Warm Springs Ponds Survey Control

Survey control for the dam deformation survey monuments is described in IMP-7 and shown on Figure IMP7-1 (Appendix C). Master control for these monuments is based on the National Geodetic Survey (NGS) Warm Springs S Base, located north of the site. The horizontal survey datum is North American Datum (NAD) 83 state plane coordinates, with elevations based on North American Vertical Datum (NAVD) 88.

Survey control for the as-built construction drawings and piezometers is based on a different coordinate system, which appears to be similar to NAD 27 state plane coordinates. However, there are no known horizontal control monuments at the site at the time of this writing/update (October 2013). Vertical control for the piezometers is based on the same vertical datum as the dam deformation survey control. The dam deformation control point GPS-04, a 2-inch brass cap in a concrete wall associated with the weir below Pond 3 with the elevation stamped on it, is typically used for vertical control when surveying piezometers.

2.1.18 Solar Mixing Units

Solar mixing units were added to Ponds 2 and 3 and the west wet closure in 2010 to facilitate better gas exchange and temperature management. Initially, five units were installed in Pond 3, two units in Pond 2, and 1 unit in the west wet closure. In 2012, one more unit was added in Pond 3 and one more in Pond 2. Units might be added or subtracted in the future at the discretion of the Atlantic Richfield Project Manager.

The units installed in 2010 are SolarBee™ SB10000 v18 units (two additional units were installed in August 2012 in an attempt to accelerate oxidative biomass). Details regarding installation are included in the Final Construction Completion Report for the 2010 Temperature Modification and Gas Exchange Program Hardware (Atlantic Richfield, 2010). Each assembled SolarBee unit is 16 feet in diameter and weighs 850 pounds. The unit consists of three, 80-watt solar panels. The frame is constructed of 316 stainless steel, the three pontoons are foam-filled HDPE, and the intake is thermoplastic rubber. Operation and installation of SolarBee units are discussed further in Section 5.5.

2.2 Description of System Hydraulic Operation

This section describes the flow paths within the WSP system. Each system component contains a number of hydraulic structures that function to convey and control inflow and outflow. Figure 2-14 through Figure 2-17 show the locations of the hydraulic structures and related flow paths.

2.2.1 Normal Flow Path

Normal flows are defined as those that range from a low flow of 19 cfs to the mean annual peak flow of 293 cfs. For the purpose of the operational presentation, three normal operating flows were selected: low flow, average annual flow, and the mean annual peak flow. Under normal conditions, the general flow path consists of the following:

- The flow in Silver Bow Creek is diverted to Pond 3.
- The flow is routed through Pond 3 for sediment trapping and treatment purposes.
- The majority of Pond 3 flow discharges through the east and west outlets to the Pond 2 inlet channel where the flow is then split between the east and west wet closure cells with excess flow entering Pond 2.
- A portion of Pond 3 flow (7.5 cfs) is siphoned into the Wildlife Ponds, of which 2.5 cfs is discharged from the East Wildlife Pond into the Pond 2 inlet channel. The remaining 5 cfs is discharged in series through the two West Wildlife Ponds and then directly to Pond 2.
- The flow entering the wet closure cells receives additional treatment through increased detention, enabling additional settling and potential biological treatment prior to discharge to Pond 2.

- A portion of the Pond 2 flow (approximately 1 to 4 cfs) is routed into the Pond 1 wet closure and then to the lower wet closure cells to maintain required water levels.
- Flows previously diverted through the Wildlife Ponds, the wet closure cells (including the Pond 2, Pond 1, and lower wet closure cells), and the intercepted groundwater are routed through Pond 2 for final treatment and released to the Mill-Willow Bypass.

2.2.2 Flood Flow Paths

Flood flows are those in excess of approximately 290 cfs on Silver Bow Creek. Although system "Design Floods" are precipitation related, lesser flood events are commonly associated with above normal snowpack conditions, which can result in high spring runoff.

The major difference in operation during flood conditions compared to normal flow conditions is in the use of the Pond 3 Bypass and Emergency Spillways. In normal operation, all Silver Bow Creek flows up to the 100-year event (3,300 cfs) enter Pond 3. The flows are detained in Pond 3 and subsequently discharged to Pond 2 or bypassed around Pond 2 to the Mill-Willow Bypass. When a large, prolonged inflow volume surpasses the combined capacity of available **differential** flood storage and **allowable** release to Pond 2, a portion of the inflow bypasses Pond 2 through the Bypass Spillway. When the flood event **approaches that of** a 50-100-year frequency, the Emergency Spillway in Pond 3 will operate in addition to the Bypass Spillway. The use of the Emergency Spillway will increase if the normal pool in Pond 3 is maintained above elevation 4,868.0 feet, and/or the Bypass Spillway weir crest is set above elevation 4,870.0 feet. Some flows in Silver Bow Creek that are in excess of 3,300 cfs might bypass Pond 3 via an automatic overflow spillway at the Pond 3 inlet approach channel.

The Pond 2 Emergency Spillway provides a way to safely discharge routed flows in excess of the capacity of the service spillway and temporary flood storage for inflow events from Whitcraft Gulch, which are greater than the 100-year flood. In the Pond 1 dry closure, an Emergency Spillway exists to discharge extreme flood flows originating in the Cook Creek Drainage to the Mill-Willow Bypass in order to prevent potential overtopping of the Pond 1 embankment.

2.2.3 System Hydraulic Operation Overview

The sections following describe how the WSP system operates to meet the full range of flow conditions. Figure 2-14 shows the locations of the hydraulic structures discussed in the sections. System hydraulic profiles are shown in Figure 2-18, Figure 2-19, and Figure 2-20. Operational scenarios discussed are based on design settings determined since installation of the WSP treatment facilities. Section 2.2.9 outlines system flexibility and possible future adjustments.

2.2.4 Normal Operation

The segments below describe the normal operation of each WSP system component. The WSP system data for normal operation are summarized in Table 2-1, Table 2-2, and Table 2-3.

Pond 3 Inlet
Under normal conditions, all flow in Silver Bow Creek is diverted through the Pond 3 inlet channel to the Inlet Structure. The gates at the Inlet Structure (KG-LP-1901, KG-LP-1902, KG-LP-1903, KG-LP-1904, KG-LP-1905, KG-LP-1906, KG-LP-1907, and KG-LP-1908) will remain fully open during all flow conditions unless approved maintenance on downstream structures requires diversion of the flow. Such diversion must be approved by EPA. The flow is measured at the Inlet Structure using a continuous recording gage (LT-SS1-5100) calibrated to the inlet gates for high flows greater than 2,000 cfs and to the downstream weir for low flows. When required, to meet water quality objectives, lime (calcium hydroxide) slurry is added downstream of the Inlet Structure gates to adjust the pH. Riprap baffles located in the first 300 feet of the channel downstream of the Inlet Structure facilitate mixing of the chemicals with the channel flow.

Pond 3
The flow passes down the inlet channel to Pond 3. The normal pool at Pond 3 is set by the stoplogs located at the East and West Outlet Works structures (OS-SS3E-2313 and OS-SS3W-2311, respectively). The normal pool elevation under the revised operating mode (post 2008 revision) at this setting is 4,870 feet, which provides adequate detention time for the average annual flow. The detention time is defined as the pond volume divided by the discharge flow rate.

The Pond 3 discharge is controlled by the East and West Outlet Works structures. The structures are located 2,800 feet apart to provide uniform flow through Pond 3. Operators can adjust the discharge rate through each outlet structure by adding/removing one or more of the stoplogs from each of the three openings. The objective of adjusting/balancing flow is to achieve uniform water quality at the outlets.

Wildlife Ponds
The siphons that feed the Wildlife Ponds have relatively small conduit diameters, and thus changes in discharge rates under normal variations in Pond 3 and Wildlife Pond water surface elevations are minimal. Approximately 2.5 cfs is discharged from Pond 3 to the East Wildlife Pond and then to the Pond 2 inlet channel upstream of the Flow Measurement Weir. The two West Wildlife Ponds flow in series, the first receiving approximately 5 cfs from Pond 3 and the second discharging this flow to the southwest part of Pond 2.

Pond 2 Inlet Channel
The Pond 3 outlet structures OS-SS3E-2313 and OS-SS3W-2311 discharge into the Pond 2 inlet channel. The flow travels in the channel to the Flow Measurement Weir where it is split between the two wet closure cells or passes directly to Pond 2. The backwater from the Flow Measurement Weir creates a head to permit gravity flow to the wet closure cells. The flow into each cell is controlled by an inlet orifice and gate at the Flow Measurement Weir. Flow to the east wet closure cell is controlled by OS-SS4-2318 and flow to the west wet closure cell is controlled by OS-SS4-2319. The flow rate into each cell is measured by the differential head across the orifice as indicated by level sensor LT-SS4-2303 for the east wet closure and LT-SS4-

2304 for the west wet closure. Flow entering each wet closure cell may be regulated by partially closing the respective gate and observing the associated flow rate.

Flows in excess of the capacity of the wet closure cells pass over the weir and into Pond 2 through the main inlet channel. The flow over the weir is measured by electronic level sensor LT-SS4-2302 located in a stilling well. All flow signals are transmitted to the Programmable Logic Controller (PLC) in the Pond 3 SS-3E sample station where flow rates are recorded. The Pond 2 inlet channel below the Flow Measurement Weir contains riprap baffles to aid in mixing and flocculation of chemical additives, if implemented.

Pond 2 Wet Closure Cells

Flow enters the Pond 2 wet closure cells through inlet channels that are 700 feet in length. The flow out of each cell generally matches the flow in through maintenance of constant stoplog elevations at each outlet. The east wet closure (EWC) outlets are controlled by OS-EWC-2320 and OS-EWC-2321, and the west wet closure (WWC) outlets are controlled by OS-WWC-2322, OS-WWC-2323, and OS-WWC-2324. The flow rate through each cell will be relatively uniform for the full range of flows into Pond 2. Operators can adjust flow rates to optimize water quality if necessary. The pool level in the wet closures is controlled by the stoplog setting at the outlet structures. The minimum pool elevation is set to maintain a nominal minimum water depth over the tailings and associated soils of one foot and will not be altered except for approved maintenance purposes.

The normal pool elevation for the **east** wet closure cell is approximately 4,838.7 feet, which allows for a detention time of about 6 days. The stoplog elevation to maintain these values is 4,838.3 feet. For the **west** wet closure cell the stoplog elevation of 4,837.78 feet is used to maintain a normal pool elevation of about 4,838.22 feet, with an estimated detention time of 4 days. Flow rates and water surface elevations for normal operations are listed in Table 2-1. The outlet structures are approximately equally spaced to encourage uniform flow rates through the cells. The outlet structures discharge directly to Pond 2.

Pond 2

During normal operation Pond 2 provides final polishing of treated water before discharge to the receiving stream. The flow enters Pond 2 from the Pond 2 inlet channel, the Wildlife Ponds, the wet closure cells, and the Pumpback System. The diversion of flow to the wet closure cells reduces the rate of Pond 3 flow that directly enters Pond 2 from 216 cfs to 166 cfs during the mean annual peak flow. This decreases the possibility of bottom scour in Pond 2 and distributes the flow into Pond 2 more uniformly to maximize utilization of available detention.

The normal pool in Pond 2 is controlled by the stoplog setting (OS-PD2-3203) at the Pond 2 Service Spillway. The initial setting of the stoplog crest elevation is 4,834.8 feet, which results in a normal pool elevation of 4,835.3 feet during the average annual Silver Bow Creek flow of 73 cfs. The volume of Pond 2 at the normal pool elevation of 4,835.3 feet is 1,630-acre feet, which provides 11 days of detention time. The typical Pond 2 water level during operation between July 2008 and May 2009 has averaged closer to elevation 4,835.2 as compared to a “normal pool” elevation of 4,835.3. This condition exists because of several factors:

- lower than historic flows (e.g., average flow less than 73 cfs at Pond 3 Inlet Structure);
- flow losses through the Pond system due to evaporation and seepage; and
- adjustments to some of the Pond 2 spillway stoplogs (and flow seepage between some of the stoplogs within the structure).

Therefore, the "normal pool" elevation of 4,835.3 feet used herein, although not exact for all operating conditions, can be considered hypothetical based on a stoplog crest setting elevation of 4,834.8 feet and a design average flow of 73 cfs.

Pond 2 discharges through the service spillway to the Pond 2 outlet channel. The water level is measured by LT-PD2-3202 at the culvert/drop structure located in the outlet channel, transmitted to the PLC in SS-5, and converted to flow rate. The outlet channel discharges to the Mill-Willow Bypass.

Pond 1

Water is transferred from Pond 2 to the Pond 1 wet closure through the Pond 2 outlet/Pond 1 Inlet Structure located near the east end of the Pond 2 Dam. Normal flow is controlled by a throttling slide gate (KG-PD1-3204) within the multi-chamber concrete structure. The initial setting of the slide gate is to establish a flow of approximately 2.5 cfs at the average Pond 2 water surface elevation of 4,835.2 feet. It is estimated that the gate setting at 40 percent open will provide that flow from October to June. The gate setting from July through September will be approximately 100% to provide that flow. Because of the unavoidable uncertainties and seasonal variations expected for seepage gains/losses and evaporation/evapotranspiration losses, the structure is designed to facilitate flow adjustment. The typical flow is expected to be in the range of 2 to 4 cfs in order to provide adequate amounts of high pH water for the Pond 1 and lower wet closure cells. However, higher flows can be provided by simply adjusting the KG-PD1-3204 gate opening as necessary. Flow increases during normal flood events will be modest with the higher water surface elevations in Pond 2 resulting in less than a 15 percent increase in flow for essentially all gate settings and typical yearly flood conditions. Flow can be measured by observing the water surface elevation in the inlet immediately upstream of the overflow weir (and downstream of the throttling slide gate).

The flow into the Pond 1 wet closure enters through a riprap-protected stilling basin. The Pond 1 wet closure water surface is to be maintained at elevation 4,816 feet or above in order to provide the required 1 foot of inundation for tailings areas. The water surface area at this elevation is 96.5 acres. The actual water volume contained by the Pond 1 wet closure, with water surface elevation of 4,816 feet, is unknown. However, based on an assumption of an average water depth of 2 feet, and a surface area of 96.5 acres, the detention time at a net of 4.1 cfs inflow rate would be approximately 24 days. This detention time assumes an estimated 1.6 cfs seepage through the Pond 2 Dam into the Pond 1 wet closure.

The Pond 1 wet closure water is discharged through the Pond 1 outlet structure OS-PD1-3205 to the south wet closure cell located immediately to the north of the eastern portion of the Pond 1 Dam. Outlet structure OS-PD1-3205 is a reinforced concrete box with an overflow sill at elevation 4,815 feet. Stoplogs are available to raise the discharge elevation and have been initially installed to elevation 4,816 feet. The annual average outflow expected through the structure was estimated during design to be approximately 4.1 cfs.

Lower Wet Closure Cells

The series of three wet closure cells (south, middle, and north) located below Pond 1 receive in series the outflow from Pond 1. Pond 1 flows into the south wet closure through OS-PD1-3205, which then flows to the middle wet closure through OS-SWC-3208, which then flows to the north wet closure through OS-MWC-3209, which then flows to the Groundwater Interception Trench through OS-NWC-3210. Although the net effect of seepage and evapotranspiration is uncertain, the design estimate was for a loss of approximately 0.5 cfs on average in the south cell, 0.2 cfs further loss in the middle cell and a 0.4 cfs gain in the north cell. The gain in the north cell would be partially due to inflow from the Pond 1 Toe Ditch. Average detention times in the various cells are approximately as follows:

- South wet closure - 19 days;
- Middle wet closure -7 days; and
- North wet closure -5 days.

The key design parameters for these cells and dikes are listed in Table 2-2. The outlets/inlets for conveying water from one cell to the next have a straightforward design consisting of a concrete box outlet, as described for the Pond 1 outlet, with an overflow sill adjustable by inserting/ removing stoplogs. The inlets consist of a riprap-protected stilling basin with submerged discharge to the wet closure area.

Groundwater Interception Trench

The various surface and groundwater flow paths for the northern portion of the site converge at the Groundwater Interception Trench. As shown by the estimate listings in Table 2-3, the sources of flow that eventually discharge into the trench are the Soil-Cement Toe Drain Manifold, Pond 2 toe ditch, the outlet from the north wet closure cell, and groundwater seepage. The numbers listed in Table 2-3 provide an estimate for the potential range of average annual flow. However, except for increases in dramatic flood events or evaporation losses, flows are expected to be relatively stable.

Pumpback Facilities

The Pump Station and Pumpback Effluent Pipe design maintains an average trench water surface elevation of 4,779 feet (17.5 feet lower than the north wet closure cell) by withdrawing water from the Groundwater Interception Trench and returning it to Pond 2. The design capacity is 18 cfs with three pumps running. A fourth initially installed pump provides standby backup, while piping for a fifth pump was included to provide more capacity (if required). Inlet and discharge piping was sized for 27 cfs, based on the assumption that five pumps might be operating.

2.2.5 Spring Runoff Events

The major difference in operation during the spring (snowmelt) runoff period from a dam safety standpoint is the potential use of the Bypass Spillway and the Pond 3 Emergency Spillway. (Note: Other operational changes related to optimizing water treatment are also made seasonally as described in Section 5.0). As during normal operation, all flows will still enter Pond 3. The flow must either be detained in Pond 3 with subsequent discharge to Pond 2 or bypassed around Pond 2 through the Mill-Willow Bypass. This type of flood flow typically extends from 15 to 60 days as illustrated in Figure 2-21. When a high, sustained inflow volume exceeds the combined capacity of the available flood storage and allowable release to Pond 2, a portion of the inflow will bypass Pond 2. Flow detention within Pond 3 still provides sediment trapping and primary treatment for the bypassed flow. The incremental treatment benefit from Pond 2 and the wet closure cells at lower flow rates is foregone for the bypassed portion of the flow to limit the potential resuspension of sludges and sediment within Pond 2 at higher flow rates. The peak flow entering Pond 2 from Pond 3 is 300 cfs. The minimum Pond 2 detention time is approximately 3 days.

Regulation of discharges from the Bypass Spillway structure is provided by two downward opening weir gates operated by screw lifts. The normal setting for the crest of the gates is at elevation 4,872.0 feet. This setting, with the orifice plates removed, limits bypass flows to a theoretical frequency of once every 3 to 5 years, and emergency spillway flows to a frequency of once every 50 to 100 years. Table 2-4 summarizes the bypass characteristics for snowmelt runoff events with return periods of 3 years to 25 years. This table is based on a normal pool elevation of 4,870 feet and the Bypass Spillway weir gates being set at elevation 4,872.0 feet. Increasing the Bypass Spillway setting will cause more total flow to enter Pond 2 prior to bypassing but will also result in more frequent use of the Emergency Spillway.

The discharge to Pond 2 during snowmelt runoff events with a frequency of 2 years to 50 years remains relatively constant at 220 to 290 cfs. The wet closure cells and Pond 2 continue to function as unregulated ponds. The WSP system data for snowmelt runoff with return periods of 2 years to 0.5 PMF years are summarized in Table 2-5. Local runoff from the East Hills during spring snowmelt does not have a significant impact on inflow for any of the ponds or wet closures.

The information on Table 2-4 regarding bypassing versus flow through Pond 2 is there to help operators evaluate alternative operations that could be employed to optimize total system performance during spring runoff. (See also Section 2.2.9 - System Flexibility and Adjustment).

Another issue related to runoff events is that experience has shown that the inlet facility trash rack becomes clogged quite frequently during increased flow events, even events significantly below the design flood conditions. Operators must account for this and coordinate efforts for cleaning with an approved contractor. During spring runoff, coordination should include having a properly sized excavator located on-site, an equipment operator on call 24 hours, and a plan for operations personnel to frequently monitor the water surface elevation behind the trash rack.

2.2.6 100-Year Flood

The WSP system will safely handle the 100-year rainfall flood without any operational intervention. The hydraulic operation of the system during the 100-year event is described in the sections below. The assumed 100-year flood hydrograph for Pond 3 is shown in Figure 2-22. This hydrograph is based on a **short-duration**, **high-intensity storm** as would result from heavy precipitation as opposed to the long-duration snowmelt runoff in spring flooding. The theoretical information presented in Table 2-5 shows the system function during this extreme event.

Pond 3

All flow from the 100-year flood on Silver Bow Creek will be diverted through the inlet channel and structure into Pond 3. The operational analysis presented below assumes that Pond 3 is at the normal pool elevation of 4,870 feet, the Bypass Spillway is set at elevation 4,872 feet and the 200 cfs control orifices are removed on the SS3E and SS3W outlets. The total flood volume entering Pond 3 is 13,500 acre-feet (from Silver Bow Creek and the East Hills). This total volume receives a theoretical minimum detention time of 3 days as it passes through the pond, which will provide sediment trapping and treatment. After passing through the pond, a portion of the total volume is released through the Bypass Spillway to the Mill-Willow Bypass. The total volume released through the Bypass Spillway is 6430 acre-feet. The peak flow rate through the Bypass Spillway is 995 cfs. The maximum flow depth in the Emergency Spillway is about eight inches, which results in a peak discharge of 976 cfs. The total volume discharged over the Emergency Spillway is 1185 acre-feet. The remaining volume of 5885 acre-feet is metered out at a peak flow of 300 cfs through the East and West Outlet Works structures to Pond 2 and the wet closure cells. The maximum water surface elevation in Pond 3 during the 100-year flood is 4877.26 feet under the settings described.

Pond 2 Inlet Channel

The peak flow discharged to the Pond 2 inlet channel under these conditions is about 300 cfs. The Flow Measurement Weir diverts 19 cfs to the east wet closure, 33 cfs to the west wet closure, and allows 248 cfs to directly enter Pond 2.

Wet Closure Cells

The conditions in the wet closure cells were evaluated for a worst-case 100-year thunderstorm event. The east wet closure cell reaches a maximum pool elevation of 4,839.08 feet and provides a minimum of 2.7 days of detention. The peak discharge from the east wet closure cell is 32 cfs, which includes the routed peak flow from the East Hills. The west wet closure cell has a maximum pool elevation of 4,838.45 feet and provides a minimum of 2.5 days detention. The peak discharge from the west wet closure cell, including direct precipitation, is 45 cfs.

Pond 2

The conditions in Pond 2 were evaluated for a 100-year general storm. The peak inflow to Pond 2 during the 100-year flood is 1,083 cfs. This flow includes 312 cfs that enters from the wet closure cells and the Pond 2 inlet channel, 193 cfs that falls directly on the pond surface, and 578 cfs that enters from Whitcraft Gulch (the East Hills). The flow from Whitcraft Gulch will enter Pond 2 across a large alluvial fan that will disperse the runoff into numerous, small-flow channels to help prevent scouring the bottom sediments in Pond 2.

The maximum 100-year water surface elevation in Pond 2 is 4,836.49 feet. The volume at the maximum pool is 2,096 acre-feet, which provides a minimum detention time of 2.9 days. The peak discharge from Pond 2 is 368 cfs, which flows through the outlet channel to the Mill-Willow Bypass.

Pond 1 Wet Closure and Below
The Pond 1 system is off stream from 100-year flows in Silver Bow Creek through the Active Area of the WSP. The increasing water level within Pond 2, from the normal pool elevation of 4,835.3 feet to the 100-year flood pool elevation of 4,836.49 feet, would increase the peak discharge from Pond 2 into Pond 1 by 1.1 cfs (from 4.0 to 5.1 cfs). A corresponding increase in discharge from Pond 1 to the south wet closure of 1.1 cfs would increase the Pond 1 outflow from 5.6 to 6.7 cfs (assuming a net gain of 1.6 cfs seepage through the Pond 2 Dam) and increase Pond 1 water level from elevation 4,816.0 feet to 4,816.6 feet. The Pond 1 outlet structure design limits the peak discharge to the lower wet closures through an orifice plate that begins to control Pond 1 levels at flows in excess of 6.0 cfs. Corresponding water level increases in the lower wet closures would be minimal and much less than in Pond 1 because wet closure stoplog settings would continue to regulate the respective pool level. Should the event be sustained, the eventual increase in pumping rates at the Pumpback Facility would be 1.1 cfs.

For the condition of a 100-year flood originating in the Cook Creek drainage basin of the East Hills, estimated runoff volumes entering the system, including direct precipitation, are 136 acre-feet to the Pond 1 wet closure, 10 acre-feet directly into the south and/or middle wet closure and 8 acre-feet falling directly on the Pond 1 dry closure. These volumes would result in increases in pool level elevations to 4,817.1 feet for the Pond 1 wet closure, 4,805.3 feet for the south wet closure, and 4,812.5 feet at the Pond 1 dry closure. Elevations shown above do not consider the reduction in volume that would result from increasing discharges as pool levels rise. The peak flow from the Pond 1 wet closure at elevation 4,817.1 feet would be 7.25 cfs. The peak flow entering the Pumpback System from the Pond 1 dry closure outlet at elevation 4,812.5 feet would be 5.8 cfs. The combined peak entering the Pumpback System from these two sources would be 13.0 cfs, which, with an estimated probable net additional flow from all other sources of 1.1 cfs, would result in peak pumping requirements of 14.1 cfs. This peak inflow rate is within the 18 cfs firm pumping capacity provided.

2.2.7 Flows Greater than the 100-Year Event

The WSP system can safely operate during flood flows that are greater than the 100-year event. The design flood is the one-half (0.5) PMF, which results in the required maximum design flow. Following is a description of operational considerations related to system components that could be affected by flows greater than the 100-year event. Although the probability of experiencing the extreme flow conditions for which the design flood is based is extremely remote, it is important that the integrity of design elements required to accommodate this condition be maintained.

Soil-cement armoring is provided on the west (Mill-Willow Bypass) side of the main dikes that separate the WSP and Mill-Willow Bypass. This soil-cement armoring prevents scour and erosion of the dikes during an extreme flood event. Operators must inspect this armor periodically to ensure that protection does not deteriorate.

The **Emergency** Spillways for Ponds 2 and 3 are designed to handle flood flows entering the WSP system in excess of the 100-year event. In the event of the **0.5 PMF** there is a **safety** or **relief valve** built into the system. This relief valve is the **inlet channel fuse plug**. When the

Pond 3 inlet channel overflow spillway capacity is exceeded, the fuse plug will erode causing an **intentional failure** of the inlet channel dike. This failure will divert the excess flows around the WSP system down the Mill-Willow Bypass. Because the primary function of the Mill-Willow Bypass is flood routing, it is important that vegetation growth in the Mill-Willow Bypass be controlled. The inspection procedure IMP-4 of Appendix C presents the Manning n factors and vegetation requirements associated with proper maintenance. Also, it is important that the fuse plug be maintained to insure proper failure.

Another item to be aware of is the proper maintenance of the **trash racks**. Operators periodically clean the trash racks on an as-needed basis using a backhoe or excavator. Debris is hauled off the site to the Opportunity Ponds waste management area. The inlet to the WSP system is designed to handle flows up to and including the 100-year peak (3,300 cfs), with the trash racks reasonably maintained (at least 50 percent free). A portion of inflows greater than the 100-year event will be released by way of the inlet channel overflow spillway and into the Mill-Willow Bypass. Should the total Silver Bow Creek flow reach approximately 27,000 cfs the fuse plug will erode causing an intentional failure of the inlet channel dike. Additional conditions that will probably exist as the total flow approaches 27,000 cfs include the failure of the divider dike between Silver Bow and Mill and Willow Creeks and overtopping of the highway. If the trash racks in any other part of the WSP system become clogged, the associated emergency spillway systems are designed to pass the excess flow.

As shown from the 0.5 PMF data presented in Table 2-5, the primary pond hydraulic features associated with the 0.5 PMF are listed below:

- Large inflows due to direct precipitation and local runoff. Runoff from Whitcraft Gulch into Pond 2 is estimated to have a peak inflow of 7,250 cfs, while the Pond 3 outlets restrict flows from Pond 3 into Pond 2 to slightly more than 300 cfs. Similarly, the Pond 1 area is estimated to receive a peak inflow of 5,240 cfs from the East Hills (primarily Cook Creek), while the flow from Pond 2 to Pond 1 is restricted to a maximum of approximately 7 cfs.
- Increases in pond and wet closure water levels.
- Automatic operation of emergency spillways in Ponds 1, 2, and 3 with attenuated discharges to the Mill-Willow Bypass.
- Increasing flows at pond outlets due to the higher water surface levels.
- Rising water levels in the Groundwater Interception Trench. Increased flows between wet closures, local runoff, and direct precipitation may exceed pumpback capacity during a 0.5 PMF event. Maintaining trench level during the 0.5 PMF was not a required design criterion when establishing pumping capacity. However, the Flood Extension Dike was designed to isolate all three lower wet closure cells and the Groundwater Interception Trench from Mill-Willow Bypass flows even under the 0.5 PMF condition. The crest elevation of 4,803 feet was selected to provide a maximum 2 feet of freeboard in addition to containing the relevant inflows.

2.2.8 Low Flow Operations

Operators must adjust the system for seasons of low flow entering the system and should monitor snowpack in the spring and adjust pond levels accordingly. Having adequate volume in Pond 3 will allow for enough water to maintain minimum water elevations in all ponds within the system. Observation of all elevations is critical during low flows to ensure the system meets UAO requirements. Low flows can also increase the frequency of cleaning debris and sedimentation from outlet structures to ensure flow is available. Additional means of moving water (i.e., siphons and pumps) might be required to ensure water is flowing through the system.

2.2.9 System Flexibility and Adjustment

Provisions exist to allow operators to adjust the WSP system to respond to varying conditions and optimize overall treatment performance. The possible adjustments are summarized below with a brief description of the purpose and effect of each adjustment.

Pond 3 Normal Pool Elevation

The Pond 3 normal pool level can be adjusted from elevation 4,870 feet (stoplog crest elevation is 4,869.3 feet) by raising or lowering stoplogs OS-SS3E-2313 and OS-SS3W-2311 at the East and West Outlet Works. The maximum pool that will meet dam safety criteria for freeboard during the 100-year flood is elevation 4,877.26 feet. The purpose of raising the normal pool would be to increase the detention time (and presumably the treatment effectiveness of the Pond). Raising the normal pool has two effects on the system operation. First, the higher pool increases the frequency of Bypass Spillway releases to the Mill-Willow Bypass. The increase in bypass frequency can be minimized by raising the Bypass Spillway crest elevation as explained below. Second, the greater normal pool level increases the frequency of releases from the Emergency Spillway, which has the possibility of disturbing bottom sediments near the spillway. Table 2-6 summarizes the effects of raising the normal pool.

Pond 3 Bypass Spillway Crest Elevation

The Bypass Spillway crest elevation can be adjusted from the normal setting of elevation 4,872 feet by raising the weir gates (KG-PD3-2310) at the structure. The purpose of raising the weir gates is to decrease the frequency of bypass. Raising the crest elevation of the Bypass Spillway results in increasing the frequency of discharge from the Emergency Spillway. Table 2-7 summarizes the effect of raising the weir gates.

A possible operational scenario involves maintaining a high weir gate setting to retain the largest volume possible during a flood event, then lowering the gates as the Pond 3 water surface begins to approach the Emergency Spillway to prevent continued increase in water level and minimize the volume released through the Emergency Spillway. The practicality of this operation would depend on the ability to judge the magnitude of a runoff event.

Pond 3 Outlet Discharge

The maximum discharge from the Pond 3 East and West Outlets Works is 300 cfs (since the orifice plates at the downstream end of the outlet pipes were removed). The purpose of increasing the discharge from Pond 3 is to increase the volume of flow treated by the wet closures and Pond 2; to reduce the bypass release frequency in Pond 3; and to reduce the frequency of Emergency Spillway releases. Increasing the discharge from Pond 3 into Pond 2 could increase the risk of disturbing bottom sediments in Pond 2 because of higher flow velocities near the inlet and outlet. *Note that operational problems in Pond 2 because of using the increased flow rate with the orifice plates removed has not been a problem during actual operation to date.* The risk of disturbing bottom sediments near the Pond 2 inlet is lessened by the diversion of flow through the wet closure cells. Table 2-8 summarizes the effect of increasing/reducing the discharge of the Pond 3 outlets.

Pond 2 Wet Closure Cells

The maximum pool elevation in the east wet closure is limited to 4,839.2 feet in order to sustain freeboard requirements for the dikes. Similarly, the maximum pool elevation in the west wet closure is limited to 4,838.5 feet. These restrictions limit pool raises to a maximum of one stoplog from the initial design settings (see Table 2-1). The pool elevation could be lowered for maintenance purposes; however, this results in possible temporary exposure of tailings and associated soils in the impoundment area. The rate of flow passing through the wet closures can be regulated by throttling the canal gates in the inlet boxes to each wet closure.

Pond 2 Normal Pool Elevation

The normal pool elevation (based on 73 cfs flow) in Pond 2 is limited to a maximum of 4,835.5 feet in order to meet dam safety requirements for freeboard during the 100-year flood (compared to the initial setting at elevation 4835.3 feet). The pool elevation could be lowered for maintenance purposes; however, this results in decreased detention time and possible temporary exposure of tailings and associated soils in the pool area. Therefore, there is limited occasion to adjust Pond 2 pool elevation.

Pond 2 Outlet to Pond 1

At the Pond 2 outlet/Pond 1 inlet, the throttling slide gate KG-PD1-3204 can be adjusted to establish a flow rate in the range zero (gate shut) 2.5 cfs (design/initial setting, gate 40 percent open) to a maximum of approximately 5 cfs (gate fully opened). Higher flows will introduce greater quantities of high pH water to the Pond 1 wet closure and result in increased flows through the Pumpback System.

The minimum practical flow will be that at which the slide gate (KG-PD1-3204) can be throttled without becoming plugged with debris. A trash rack with 1-inch clear bar spacing is provided upstream of the gate. At a 1-inch opening, it is estimated the gate will allow 0.6 cfs from Pond 2 to Pond 1 in addition to groundwater seepage.

Pond 1 and Lower Wet Closure Cells

The dike crests for the Pond 1 and lower wet closures have been established to achieve the pool elevations required for tailings inundation. Essentially no extra freeboard is available for increasing the normal pool levels. Therefore, during normal operations, the design pool elevations should be maintained.

2.3 Treatment Facility and Controls

2.3.1 Lime Feed Facilities System Criteria

The lime feed facilities located at the Pond 3 Inlet Structure are the primary mechanism for managing the water treatment process. A detailed schematic of the lime feed facilities is shown in Figure 2-23 and a P&ID is included in Appendix G. The lime feed facility design was based on two major requirements:

- Lime addition is to be sufficient to raise and maintain pH levels to a minimum of 9.0 at SS-2.
- Lime addition is to be effective at both normal flows and for flood flows up to the 100-year event.

Other factors important to the lime feed system include the following:

- Target pH of 9.3 was initially selected based on treatability studies and historic data on pond performance. Refer to Section 5.0 and Figure 5-1 through Figure 5-4 for typical seasonal chemical addition requirements. Target pH varies with turbidity and flow.
- Target pH has been set to 8.0 to 8.3 with a maximum dosage rate of 25 milligrams/Liter (mg/L) when the influent turbidity is greater than 25 Nephelometric Turbidity Units (NTU).
- The maximum lime feed capacity is based on the 100-year-flood hydrograph with a peak flow of 3,300 cfs and a 5-day volume of 13,000 acre-feet from Silver Bow Creek.
- The system has the capability of feeding lime at a rate sufficient to maintain a pH of 9.0 at the peak of the 100-year hydrograph. Lime storage facilities provide reserve capacity to maintain a minimum pH 8.6 throughout the 100-year hydrograph without additional lime deliveries and/or maintaining a pH of 9.0 based on regular delivery schedules.
- Sufficient system redundancy exists for continued lime feed with minimal downtime.
- The capability to maintain continued operation includes a backup power supply (emergency generator GEN-LP-1000) capable of running the entire lime feed system.
- Hydrated lime is the primary chemical for pH adjustment.
- Lime deliveries are anticipated at a normal frequency of 5 to 7 days after placement of orders. Deliveries are made in 24 to 30-ton trucks with pneumatic unloading.
- Two lime storage silos are provided to enable continued operation should either unit be out of service for maintenance. Silo No. 1 (flood stage silo) is sized primarily for flood storage/feed and transfer while Silo No. 2 (normal usage silo) is sized for normal conditions. This approach accommodates the extreme range of operating conditions required by the range of influent flow and pH.
- Where feasible, redundant facility components for the normal usage system are installed because it is needed in operation on a near-continuous basis.
- Normal deliveries are to the flood stage silo. Lime is then cycled through the flood stage silo (Silo No. 1) to the normal usage silo (Silo No. 2). This procedure aids in maintaining a fresh lime supply.

Facilities included at the lime feed system are located as shown on Figure 2-24 and Figure 2-25. The sections below describe the facility components.

2.3.2 General Description of Lime Feed Facilities

The lime feed facility contains two hydrated lime storage and handling systems. The larger of the two silos, Silo No. 1 (the flood stage silo) is the primary hydrated lime truck-receiving silo and is the main storage facility. During normal operation, lime is pneumatically transferred from Silo No. 1 to Silo No. 2 (the normal use silo) for eventual use in making lime slurry. Silo No. 2 has metering and mixing devices within its cone area and has a standby truck receiving system for use if Silo No. 1 facilities are inoperable. Silo No. 1 is equipped with jet slurry facilities to enable direct use of lime from Silo No. 1 during periods of high lime usage (flood conditions), or at times when Silo No. 2 is inoperable. Figure 2-26 and Figure 2-27 illustrate the facilities described in this section.

Auxiliary facilities including water supply for producing slurry, overall system controls, aeration and transfer blowers, and backup power supply are located remotely from the storage silos.

2.3.3 Description of Lime Feed Systems and Components

The lime storage and feed facilities include the following components:

Storage Silos
The two hydrated lime storage silos are 60-feet tall, constructed of welded steel, with a 60-degree cone-shaped bottom and an enclosed heated/ventilated equipment area at the base. Structural design for the silos is based on a lime density of 45 pounds per cubic foot; whereas, the storage capacity is based on the more common density of 30 pounds per cubic foot. In operation, the actual density will vary depending on such factors as the moisture content and the source of the lime. Moisture content will vary with the degree of aeration and the humidity because moisture will be drawn from the air to the lime within the silo. Theoretical capacities and sizes are as identified in Table 2-9.

Lime Feed Systems
The lime feed systems include the controlled removal of lime at the base of each silo and the mixing and transport of the lime with a water supply.

Lime Feed Facilities
Each silo is equipped with a pneumatic knife gate located directly beneath the cone opening. Connected to the bottom of the pneumatic knife gate is a reducer cone that reduces the lime flow orifice from 10 inches to 3.5 inches. Lime is fed into the lime feeder hopper, which weighs the lime in small batches and controls the opening and closing of the pneumatic knife gate. From the hopper, lime is fed by a variable speed helix that is used to regulate the rate of lime withdrawal and provide a uniform flow of lime from the silo. In *Silo No. 1*, the lime from the helix is, in turn, fed to a constant speed horizontal screw that augers the lime to its discharge point as described below.

The variable speed drives for the feeders can be regulated to control the removal rate to that required by the process control system. The horizontal screw conveyor in *Silo No.1* has a capacity of 10,000 pounds per hour, which is capable of transferring the maximum release from the feeder.

In *Silo No. 1*, feeder XE-LP-1730 discharges lime to the horizontal screw conveyor (SF-LP-1700), which is a reversible unit with a center feed and is capable of discharging from either end. Operation in one direction discharges the lime to a surge hopper above pneumatic rotary vane feeder RVF-LP-1410 described under the *fill and transfer system* below. The reverse direction discharges to the jet slurry mixer (MX-LP-2).

In *Silo No. 2*, feeder XE-LP-1830 discharges lime directly to the solution mix tank with mixer MX-LP-1.

Solution/Slurry Distribution

Each silo has an independent method to introduce lime to the Silver Bow Creek Channel.

Silo No. 1 is the flood stage system and is therefore used primarily to address periods of increased lime demand. The system includes a jet slurry mixer (MX-LP-2) and a water supply well pump (P-LP-3). Water piping connects the well to the mixer and slurry piping (which extends from the mixer to the creek channel). The jet mixer operates by use of a constant flow of water (50 gallons per minute [gpm]) entering the mixer at a high pressure (60 pounds per square inch [gauge] {psig}) and creating an eductive force that results in a suction pulling the hydrated lime from the hopper and into the flow stream. Slurry flow from the jet mixer moves by gravity through a 4-inch polyethylene pipe installed above grade to a point where it discharges above the low-flow channel. The slurry has a minimum water-to-lime ratio of 2.5:1. Water is pumped through the mix tank and discharge pipe for an extended period of time after lime feed has been stopped in order to flush the system clean. Because this system is rarely required to operate, the well pump is periodically operated, even when not required to transport lime to the creek, to exercise the pump and purge the well.

Silo No. 2 is the normal usage facility and is used the majority of the time. Lime is dropped from a helix in the feeder hopper through a discharge chute into the top of the solution mix tank. The solution mix tank is a 500-gallon, stainless steel tank with a constant speed mixer (MX-LP-1). Hydrated lime dropping into the tank is mixed with a constant flow of water (50 gpm), which is pumped to the tank by either P-LP-1 or P-LP-2. The water and lime form a dilute slurry (less than 5 percent) that is discharged through an overflow weir at the end of the tank opposite to where the lime is introduced. The lime solution/slurry then passes through a pipe system to its discharge into the Silver Bow Creek channel. The concentration of lime in the slurry and the subsequent amount introduced to the creek is regulated by the rate of lime withdrawal through XE-LP-1830 as described above. The slurry is conveyed via a slurry pipe trough, which distributes the slurry uniformly across the channel.

To aid in cleaning the system when not in continuous use, the water supply pump continues to operate for a limited duration after stopping lime feed. This operation flushes the lime solution/slurry from the system.

The system contains two normal usage well pumps (P-LP-1 and P-LP-2). Either unit can provide the necessary flow rate for the system to function; the other unit acts as the standby backup if the unit in service requires maintenance. The normal usage well pumps and the flood stage well pump operate at different pressures and are not interchangeable.

Inventory and Usage Metering Systems
The facility contains two monitoring systems to monitor short-term usage (instantaneous usage) and the overall inventory: the inventory system and the usage metering system.

> ***Inventory System*****:** The silos are supported by a series of legs, each of which sets on a load cell. Load cells XE-LP-1704 are installed in Silo #1 and load cells XE-LP-1804 are installed in Silo #2. The inventory system continuously weighs the silos and its contents and electronically records/transmits the data to the Human Machine Interface (HMI) at the Control Building. This measurement is not as accurate as the usage metering system described below and should only be used when operating the system in volumetric (hand) mode or to estimate lime inventory.
>
> ***Usage Metering System*****:** Each lime feeder hopper is equipped with load cells. The load cells continually weigh the lime in the hopper as each individual batch of lime is added, and the total weight of lime that is discharged is tracked. The usage metering system continuously records/transmits the data to the HMI in the Control Building, and the information is used to identify the instantaneous feed rate. The usage metering system is only operable when the feeder is running in gravimetric (auto) mode.

Aeration System: Each silo contains a series of air slides that inject air into the cone of the silos to loosen the lime so that it will flow to and out the opening at the bottom of the silos. Air supply to the aeration system is from blowers located in the Blower Building. The aeration system is intended to operate periodically for an interval of time sufficient to loosen the silo's contents. Blowers can be automatically started and stopped at adjustable time intervals as appropriate to keep the lime from bridging. See *blower equipment* below.

Vibrators: Manually controlled vibrator pads have been provided between the air slides on the hopper cone as a backup if the air slide system is unable to loosen the silo contents. The preferred method of loosening hydrated lime is by aeration. Vibrators can tend to pack hydrated lime further and should be used only momentarily and with discretion.

Fill and Transfer Systems: Each silo has a separate truck fill unit including a high-level switch and alarm. The high-level switch is a separate unit installed at the top of each silo and is independent of the inventory system. The truck fill line extends from the base of the silo, upward along the outside of the silo wall, and across the top of the silo to its termination in a turbulence box that breaks up the incoming lime/air mixture and distributes the lime to the silo.

The transfer system includes a blower in the Blower Building, the pneumatic transfer rotary vane feeder in Silo No. 1, and piping to carry air from the Blower Building to Silo No. 1 and lime from the base of Silo No. 1 to either Silo No. 2 or a truck. A pneumatic diverter valve that is operated from the HMI in the Control Building controls the flow of lime either to the turbulence box at the top of Silo No. 2 or to a truck. Refer to ***blower equipment*** below. Transfer operations also involve use of the Silo No. 1 lime feed system (feeder and horizontal screw) with the horizontal screw operating in reverse direction.

Dust Collection System: Separate dust collectors are located at the top of the silos to remove dust during truck unloading, during aeration of the silo contents, and during transfer of lime from Silo No. 1 to Silo No. 2. Each dust collector has the capability of accepting up to 1,400 actual cubic feet per minute (acfm) of air from delivery trucks. The dust collectors are automatically cleaned by a pulse jet system for which the common air supply is located in the Blower Building. The pulse jet air supply includes two separate compressors connected to a common air supply extending from the Blower Building outside and to the roof of the silos. An air dryer is installed on the air supply line in the Blower Building to remove moisture from the air that could otherwise create problems due to freezing in the winter/and or plugging of air release openings within the dust collectors.

Maintenance Access Facilities: Maintenance access to the roof of the silos is through a common, external caged ladder; internal access is through a man hatch (with an integral pressure/vacuum release valve) located at the top of the silo and an internal ladder that extends down the inside of the silo wall.

Blower Equipment: Four rotary vane, positive displacement type blowers are installed in the Blower Building.

Blowers B-LP-2 and B-LP-3 are each 15-horse power (hp) units, which provide a design air flow rate of 267 scfm (standard cubic feet per minute). These two blowers provide air to the aeration system in Silo No. 2. Either unit can provide the necessary air flow; the other unit acts as a standby backup if the unit in service requires maintenance.

Blowers B-LP-1 and B-LP-4 are each 25 hp units with a design air flow rate of 482 scfm. Blower B-LP-1 normally supplies air to the aeration system for Silo No. 1 with Blower B-LP-4 supplying air to the pneumatic transfer system. Both units are identical and contain piping and controls to enable either unit to assume the role of the other should one unit be out of service for maintenance. Blowers have inlet filters, inlet and discharge silencers, check valves, pressure gages (manometers), and pressure relief valves.

2.3.4 Electrical Power Distribution System

This section provides a general description of the electrical system at the inlet treatment facility including the electrical service, emergency power system, and the motor control center (MCC). A listing of process equipment power requirements is shown in Table 2-10. As discussed below, the facility contains a standby power system to enable continued operation of necessary components during power outages. Transfer to emergency power is through an automatic transfer system. The emergency generator and the MCC are housed in separate rooms within the Blower Building. The emergency generator uses diesel fuel with an integral fuel storage tank. Following is a more detailed description of these facilities.

Electrical Service

NorthWestern Energy provides the electrical services to the facilities. The WSP site is fed off an overhead distribution circuit operating at 12,500 volts. A three-phase bank of pole-mounted transformers rated at 300 kilovolt-amperes (kVA) provide the plant with an electric service operating at the 480\277 voltage level.

The pole-mounted transformers are protected on the primary side by a set of distribution fuse cutouts. These are sized to protect the transformer from internal transformer faults. The fuses can be operated manually by the utility company to isolate the transformer from the distribution circuit. They will melt in response to abnormal flow of current in the transformer coils.

A power outage condition should be reported to the electric utility for cases other than when the main plant service disconnect operates to interrupt service.

Plant Electrical Service Entrance Equipment

The service entrance conductors are underground from the utility transformer pole to the Blower Building MCC room. The conductors are terminated at the plant main circuit breaker located in the MCC line-up in the first vertical section (refer to the MCC electrical one-line diagram in Appendix I).

The main breaker is rated for 300 amps at 480 volts, three-phase. Operation of the main breaker will interrupt normal utility power to the plant. The position of the main breaker operating handle is clearly marked on the MCC panel. The breaker will be found in one of three operating positions: 1) ON, 2) OFF, or 3) TRIPPED.

A transient voltage surge suppressor is employed at the service entrance. This device is capable of switching transient voltage levels and dissipating their energy to ground thereby protecting the insulation systems of downstream electrical equipment. The surge suppressor must be inspected periodically to check its operation and check for potential failures.

Emergency Power System

A 150-kW, diesel standby generator provides electrical power to selected pieces of process equipment if normal utility electrical power is lost. An automatic transfer switch (ATS) automatically starts the generator if incoming utility power is lost, the voltage is too low, there is a phase reversal, or if there is a phase loss. When normal power is restored, the ATS will register that the voltage and frequency are sufficient and transfer to the utility position. The generator will continue to run for a selected time period at no load then shut down via a command by the ATS.

The standby generator can supply all the plant electrical load with only one of the 25-hp blowers running. A selector switch on the MCC determines which blower operates on the standby system. The generator is designed to operate on ASTM2D Number 2 diesel fuel with a minimum cetane rating of 40. A ventilated, skid-mounted fuel tank supplies fuel to the generator, and a fill stand pipe penetrates the exterior wall of the generator room to fill the fuel tank. The engine-mounted fuel pump is sufficient to supply the engine with fuel. The generator is operated and maintained according to the manufacturer's recommendations to minimize emissions.

The maintenance schedule of the generator system should be based on its running time. A maintenance schedule is included with the manufacturer's operation and maintenance manual in terms of daily, weekly, monthly, and annual requirements. All non-emergency operation including maintenance checks and testing will be held to less than 100 hours per year. Refer to Section 9.0 for maintenance scheduling.

The entire emergency generator system should be exercised on a monthly basis. During this time the system should be run for at least 30 minutes under not less than one-half rated load, and checked for unusual vibrations, noises, exhaust, and coolant and fuel leaks while running. Operators/inspectors must maintain records demonstrating compliance with the following:

- Change oil and filter every 500 hours of operation or annually, whichever comes first.
- Inspect air cleaner every 1,000 hours of operation or annually, whichever comes first.
- Inspect all hoses and belts every 500 hours of operation or annually, whichever comes first, and replace as necessary.

Regular generator exercise keeps the engine parts lubricated, improves starting reliability, prevents oxidation on electrical contacts, and consumes fuel at a rate such that the fuel will not deteriorate prior to use. A generator maintenance log can be found in Appendix K.

Motor Control Center
The MCC houses the motor overcurrent protection equipment, the motor running overload protection equipment, and the motor starting control circuitry for each process equipment motor. Each motor has an external operating handle to operate the motor overcurrent protection device. The handle can be padlocked in the OFF position. *When working on a motor for repair or maintenance the handle must be locked in the OFF position.*

The center also houses a 480-volt, three-phase power panel (Panel "P"), and a 208\120-volt, three-phase panel (Panel "L"). Panel schedules located in the door of these panels indicate the load served and the circuit breaker number supplying that load.

2.3.5 Process Control System

The facility contains a Schenck AccuRate Feeder® in each Silo to regulate the amount of lime added to the influent water stream. The system allows for fully automatic operation as well as for manual override. The control system can be set to use one or more of the following system monitoring variables as the basis for controlling the rate of lime feed:

- Constant dosage of lime based upon influent flow rate; and/or

- Constant motor speed of helix in hopper.

The operator adjusts the rate of lime feed and, when necessary, switches between the flood stage and normal usage feed systems depending on lime demand, and/or switches to backup control modes if the operating system control fails.

Lime Feed Control
During normal conditions, lime slurry is dispensed from the normal system as a solution/slurry flow discharging to the creek. Normal operation, in gravimetric mode, paces lime feed to maintain a lime dosage that meets downstream pH setpoint (target). The operator establishes the downstream pH target to obtain the target pH at the SS-2 monitoring location. Refer to Section 5.0 for target pH values. The flood stage system feeds lime to the creek through the use of the jet slurry system and has the same primary control mode.

Control Mode
Gravimetric Mode (Automatic)
While the AccuRate Feeder lime rate switch is in the Gravimetric (AUTO) position, the rate of lime addition is controlled automatically through PLC programming and algorithms within the controller. The HMI control screen allows the operator to enter the dosage value (mg/L) as needed to decrease or increase the lime rate. Once a value is set, the AccuRate Feeder motor speed determines the amount of lime that is fed into the system. Therefore, the amount of lime that enters the system is automatically increased or decreased in direct proportion to the influent flow rate.

Volumetric Mode (Manual)
While the AccuRate Feeder lime rate switch is in the Volumetric (HAND) or manual position, the operator manually adjusts the feed rate knob on the Lime Feeder System Control Panel to change the speed of the AccuRate Feeder motor. Feeder motor speed is displayed locally at the feeder controller and the main HMI control screen in the Control Building. While operating in Volumetric mode, the operator must monitor pH readings at SS-2 on a routine basis and adjust lime rate as necessary to maintain desired pH reading.

System Selection
The system in service, whether Silo No. 1 (flood stage) or Silo No. 2 (normal usage), is determined automatically based on lime usage requirements or is established manually by operator selection.

Under *automatic* control, the PLC determines the system in service based on lime demand as compared to system capacity. Adjustable setpoints are programmed to define the minimum and maximum capacities of the feed systems for each silo. If the lime demand is not within the range of the silo in operation (after a time delay), the system control switches between the silos. An alarm is sounded following any transfer between silos to alert the operator of the status. If demand is less than the minimum capability of Silo No. 2, an alarm initiates to indicate the need for operator intervention (implementation of Secondary Control C).

In *manual* control, the operator selects the silo system to operate. In this mode of operation, if demand is outside the range of the unit in operation, an alarm will initiate to alert the operator to the condition.

Well Pump System and Controls
Well pumps P-LP-1 and P-LP-2 provide the water supply to operate the normal usage system. Well pump P-LP-3 provides water to operate the flood stage system. All three pumps are rated at 50-gpm capacity. Pumps P-LP-1 and P-LP-2 are low pressure pumps designed to pump water into the solution tank. Pump P-LP-3 is a high-pressure pump that discharges to the jet mixer at 60 psig; the function of pumps P-LP-1 and P-LP-2 are interchangeable; however, because of the increased pressure requirement of pump P-LP-3 it is not interchangeable with the two other units.

Normal Usage System Pumps/Controls (P-LP-1 and P-LP-2)
The system contains two normal usage well pumps. One is on standby and the other is operational. A pump alternation switch located on the mimic panel is labeled *Well 1 - Auto - Well 2*. When in the *auto* position, the PLC alternates the use of the two pumps. Alternation is performed based on operator selection of an adjustable setpoint (in hours). If the control is set in *auto* and the pump selected fails, the PLC automatically starts the remaining pump. When the control switch is set to either Well 1 or Well 2 the respective pump runs and automatic alternation is inoperable; automatic backup operation of the other well is also not available.

The well system is interlocked with the operation of the normal usage lime feed system for Silo No. 2 such that when Silo No. 2 lime feed operations are called for, the well pump is started and a time delay activated. If, after the time delay, flow has not been established, as determined by a flow switch on the water line at the entrance to the solution tank, an alarm is initiated and the second pump is started. If the second pump fails to establish flow the entire lime feed system is shut down and an alarm is initiated.

Once flow is established, a second time delay begins, then the lime feed system is started (first the horizontal screw then the rotary vane feeder). The system shutdown sequence first stops operation of the rotary vane feeder, activates and waits a specified time delay, then stops the horizontal screw, activates and waits an additional time delay of several minutes, and then stops the well pump. This sequence of operation purges the lime from the system prior to complete shutdown.

Flood Stage System Pump/Controls (Well Pump P-LP-3)
The system contains one flood stage well pump. This unit provides water to the jet slurry mixer in Silo No. 1 for use in making lime slurry during periods of high demand or when Silo No. 2 is out of service. The unit contains a hand-off-automatic (HOA) selector switch on the MCC. When the switch is in the *auto* position the pump will start upon demand for lime slurry by the flood stage system. As with the normal usage system, operation of the well pump is interlocked with operation of the lime feed system. When the system is called on to start, the well pump starts operation and activates a time delay. If, after the time delay, flow has not been established at the flow control switch (located near the jet slurry mixer) an alarm is initiated and the pump stopped.

Once the pump is started and the flow confirmed by the flow switch, the system operates the reversible horizontal screw in the direction forcing lime to the jet mixer hopper and starts the rotary vane feeder. The system shutdown sequence first stops operation of the rotary vane feeder, activates and waits a specified time delay, stops the horizontal screw, activates and waits an additional time delay of several minutes, then stops the well pump. This sequence of operation purges the lime from the system prior to complete shutdown. If the flow switch senses loss of flow during the operation of Silo No. 1, automatic operation of the system is shut down and an alarm initiated to alert the operator.

Because of its infrequent use, well pump P-LP-3 has an exercise cycle to help maintain the unit. There is an adjustable time setting for *off* time (in days) and *on* time (in minutes). If necessary, the exercise schedule can be enabled or disabled from the interface HMI.

Plant Control Panel
The plant control system includes a mimic panel, located in the Blower Building, a PLC, and an HMI, both located in the Control Building. The plant mimic is duplicated on the HMI and shows all run, position, and alarm status. All plant alarms are displayed, logged, and printed at the HMI, and all pertinent system process data is logged and trended at the HMI. All operator-adjustable setpoints, times, and operations selections are available at the HMI if the security access level of the operator is appropriate. The plant mimic panel contains all the necessary selector switches for remote auto or hand operation of field devices. The mimic also contains status indicators to display the status of field devices.

Hydraulic Controls
Hydraulic controls relevant to surface water treatment are described in Section 5.0.

2.4 Pumpback Facility and Controls

2.4.1 Pumpback System Criteria

The Pumpback System, located at the downgradient (northerly) end of the site (Figure 2-1), is designed to deliver captured groundwater and surface water back to the Active Area so that it is treated, if necessary, to meet performance standards prior to leaving the site. The captured water is returned to Pond 2 where metals precipitation and settling occur prior to discharge. Under normal operation, the Pumpback Facilities must maintain an appropriately low water level in the Groundwater Interception Trench so that the groundwater gradient and flow is toward the trench from all directions (see Figure 2-13 and Figure 2-28).

The Pumpback System consists of two major elements, the Pump Station Facilities (Figure 2-29) and the Pumpback Effluent Pipe (Figure 2-30). A P&ID of the system can be found in Appendix G. The capacity of the Pumping Facilities and the Pumpback Effluent Pipe was a key consideration in system design. The following sources of flow were included in capacity selection:

- Intercepted groundwater as identified through groundwater modeling;

- Toe drain manifold flow with reserve for potential future expansion;
- Flow passed through the wet closures as appropriate to maintain normal pool levels; and
- Direct precipitation and East Hills runoff as routed through the wet closure system (pumping rates to accommodate runoff under the extremely remote 0.5 PMF maximum design event assume selecting a reasonable time period during which increased water levels are drawn down and equilibrium conditions are restored, and/or utilization of redundant pumping capacity).

The first three sources were estimated in terms of high, probable, and low values of average annual flow as presented in Table 2-3. An allowance for the fourth source was made by selecting a capacity (18 cfs with three pumps) that exceeds the high estimate (16.24 cfs) for the three sources while providing an extra pump for maintenance backup or flood water pumping. Other engineering design criteria identified for the Pumpback System design include the following:

- Six feet of cover for freeze protection.
- Automatic pump controls based on maintaining interception trench water level within an acceptable range.
- An appropriate factor of safety on estimated pumping requirements.
- Redundant pumping equipment.

2.4.2 Pump Station Facilities

The Pump Station Facilities include a trash-rack-protected pipe inlet at the Groundwater Interception Trench sump, an automatic traveling screen between the pipe inlet and the pumps, inlet and manifold piping, four vertical turbine can pumps (and piping for a fifth), a Pump Station Building to house the pump motors and electrical controls, and the pipe clean-out access (i.e., pig launcher). These facilities and components are described in the following paragraphs.

Inlet Piping
The inlet pipe invert at the Groundwater Interception Trench sump is set at elevation 4,774.0 feet to maintain an average operating water level elevation of 4,779 feet in the trench. The entrance of the 36-inch steel inlet pipe is protected by a bar-type trash rack accessible by a foot bridge.

Traveling Screen (SCR-PB-4003)
The inlet pipe enters a reinforced concrete tower housing an automatic traveling screen located approximately 160 feet from the sump (Figure 2-29). The traveling screen tower is located within the Flood Extension Dike fill. The top of the 33-foot-high structure is at the crest elevation of the Flood Extension Dike (i.e., elevation 4,803 feet). This location was selected so that, in the event of power loss to all pumps during a worst-case pool level, equipment would be protected and no water from the Inactive Area would flow off-site. The traveling screen motor and controls, backwash pump controls, sluice gate operator, and debris removal facilities are housed in a small building at the top of the screen tower (Figure 2-31 and Figure 2-32 show the major features of the traveling screen facility). Adequate area is provided at the widened crest to

provide access for equipment for debris removal and/or traveling screen maintenance. The traveling screen is designed to protect the pumps from debris and/or vegetation that is not caught by the coarser inlet trash rack. Debris caught by the traveling screen is conveyed to the top of the structure to the elevation of the crest of the Flood Extension Dike where it is accessible for periodic removal. If it is ever necessary to completely dewater part or all of the remainder of the traveling screen or Pump Station Facilities, the inlet to the traveling screen tower is fitted with a sluice gate operated from the top of the structure.

Manifold Piping and Suction Vessels

A continuation of the 36-inch steel inlet pipe described previously conveys inflows from the traveling screen structure to a header section, which manifolds the inlet pipe to five vertical pump suction vessels (Figure 2-29). These connections are made by 36-inch steel tees with reducers to an 18-inch steel inlet pipe for each vessel. A flexible Dresser-type coupling is provided at each end of the 30-foot-long connection pipes (Figure 2-33).

The suction vessels noted above are 24-inch diameter steel casings that house the vertical turbine can pumps. These approximately 30-foot-long vessels extend up through the floor of the Pump Station Building, which is set approximately two (2) feet above surrounding grade downstream of the Flood Extension Dike.

Pump Station Building

The vertical pump suction vessels extend to the surface where they penetrate the floor of the Pump Station Building. Heating and ventilation are provided to keep the pump motors within an appropriate operating temperature range. The building also includes a high-clearance, overhead door and roof hatches over each pump. The MCC is located within a separately enclosed space in the building.

Pump Operation and Appurtenances

Each of the four installed pumps is powered by a 75 hp motor. Motor controls provide level control start/stop operation, with level sensed by a transducer in the Groundwater Interception Trench sump. The sump levels are set to provide sufficient volume for a minimum of 30 minutes between starts. The pumping system is designed to maintain an average water level at elevation 4,779 feet in the sump. Pump P-PB-4 is the primary pump and is controlled by a VFD. A 4-20 mA signal from the level transmitter located at the Traveling Screen Building directs the VFD to vary the pump motor speed to maintain a setpoint. A secondary pump will be on standby status. If water level exceeds the high level setpoint, the secondary pump will initiate pumping until the water level in the GWIT sump is below an established level. Should the water level continue to increase, existing control logic will be activated to initiate additional pumping capacity using existing setpoints. Multiple pumps will be activated as necessary to accommodate rising water levels, and will drop offline as water levels are reduced. The static pumping head for the system is approximately 65 feet. The design basis total dynamic head (TDH) with three pumps running is 81 feet with 18 cfs delivered to Pond 2.

Each pump has a 14-inch discharge that contains a flexible, Dresser-type coupling; a combination air valve and vacuum relief/air inlet valve; an expansion joint with restraining rods; a pump control valve; and a knife gate valve. The Pump P-PB-4 discharge line has a swing check valve in place of the pump control valve. The Dresser-type coupling is intended to accommodate minor differences in alignment and/or settlement between the pump base and the building pad supporting the discharge header. The coupling also facilitates pump maintenance/ removal and installation. The harness helps prevent the coupling from separating due to line and/or surge pressure. The expansion joint is an additional precaution to accommodate potential unanticipated, differential settlements between the pump and the building pad. The restraining rods prevent the expansion joint from deforming beyond its safe range. The pump control valve reduces normal water hammer effects on the piping system by limiting the rate of change in flow during pump startup and shutdown. The swing check valve on the Pump P-PB-4 discharge line prevents backflush. The knife gate valve isolates each pump and its appurtenances from the Pumpback Effluent Pipe for repair or maintenance as needed.

The 14-inch pump discharge piping is manifolded into a 30-inch steel discharge line, which penetrates the Pump Station wall at the north end of the building where an insulated pipe section drops to provide a minimum 6 feet of cover outside the building. Two sets of air and vacuum valves are provided on the 30-inch discharge line inside the building. The 30-inch steel discharge line is also set up to launch a clean-out pig from within the Pump Station Building.

2.4.3 Pumpback Effluent Pipe

The 30-inch steel pump discharge line connects to the 32-inch HDPE Pumpback Effluent Pipe just outside the Pump Station Building. The final design alignment of the Pumpback Effluent Pipe, as shown on Figure 2-30, is approximately 7,600 feet long. The effluent pipe is buried a minimum of 6 feet to the top of the pipe for freeze protection. The effluent pipe discharges into Pond 2 via a shallow, 350-foot-long ditch that acts as an energy dissipater and provides a location to retrieve the pig when performing line maintenance. The ditch is armored with riprap at and just downstream of the pipe discharge.

Appurtenances on the effluent pipe include three air valve vaults, each containing a combination air valve and a vacuum relief/air inlet valve, and an ultrasonic-type flow meter (Figure 2-34). Two of the air valve vaults are installed on either side of a vertical sag in the profile where the effluent pipe crosses the Cook Creek drainage channel; the third air valve vault is located upgradient of the flow meter vault. The system design includes redundancy to enable operation with the loss of any single air valve. The flow meter is located in a vault just upstream of the East Hills wing dike, about 1,150 feet from the Pump Station. This location was selected so the meter could stay above groundwater and provide recommended flow distances from bends in the effluent pipe.

2.4.4 Electrical Power Distribution System

NorthWestern Energy provides electric power to the Pump Station Facilities. For answers to questions or problems regarding electrical service, contact the local utility office:

NorthWestern Energy
Butte, Montana
Telephone (888) 467-2353 (467-2669)

Power Distribution System

The electrical characteristics of the Pump Station's electrical service are 480/277 volts, three-phase. It is a 4-wire grounded wye system. The service entrance conductors from the NorthWestern Energy padmount transformer terminate at the main service disconnect circuit breaker mounted in the MCC. The service is rated for 800 amps at 480 volts. The main circuit breaker is an 800-amp frame device with a trip plug rating set for 700 amps of continuous current.

Transient voltage surge suppression is provided on each phase of the main service. High energy, parallel suppression circuitry provides both Normal Mode and Common Mode protection. Status lamps on the suppression device indicate either a normal power situation or operation of the device under a power surge. A resettable event counter on the face of the suppression device indicates the number of successful operations.

Power is distributed to the Pumpback System motors, process equipment, mechanical equipment, miscellaneous electrical load, and the Traveling Screen Building through the MCC. The Electrical One-Line Diagram found in Appendix I indicates the schematic layout of the power distribution system.

The MCC is operated at 480 volts. Equipment motors served from the MCC each contain a solid state, combination, circuit breaker type motor starter that provides motor running overload and overcurrent protection.

The Pump Station uses a 15-kVA dry-type transformer to step the 480-volt station voltage down to 208/120 volts for receptacle loads and miscellaneous equipment requiring 120 volts. Panel "P" contains the overcurrent protection for the miscellaneous 120-volt power and lighting circuits at the Pump Station.

The motor circuit breakers, with handles accessible from the front of the MCC, can be padlocked in the "OFF" position. *When working on a motor for repair or maintenance its MCC circuit breaker should be locked in the OFF position* and tagged indicating the time the equipment was taken off-line, the reason for de-energizing the circuit, and who should be contacted regarding questions on the status of the equipment.

A 480-volt feeder circuit originating in the Pump Station MCC supplies power to the traveling screen building. A main distribution panel (MDP) located in the screen building contains the 480 volt circuit breakers that supply the building electrical heating equipment, screen drive motor, screen backwash pump, and the transformer for 120 volt power.

A 15-kVA dry-type transformer is used at the traveling screen building to step the 480 volts down to 208/120 volts for receptacle loads and miscellaneous equipment requiring 120 volts. Panel "S" contains overcurrent protection for the miscellaneous power circuits at the traveling screen building.

2.4.5 Pumpback System Controls

A PLC controls the pumpback motors when they are placed in the automatic mode. The PLC communicates with pump motor starters, the pump control valve control panels (Pump Director Panels), and the trench level monitoring equipment through input/output (I/O) modules. Each I/O module is specified to communicate with field devices such as the level meter and motor starter contacts. The I/O modules plug into card slots in the PLC rack. Depending on the type of communication signal, digital or analog, three types of I/O cards are applied in the Pump Station PLC system (listed below).

1. Digital Input Module: Receives digital signal from status indicating device such as switch or electrical contact action.
2. Digital Output Module: Transmits digital signal for electrical switch action.
3. Analog Input Module: Receives 4-20 mA (milliampere) analog data signal from meter devices.

The PLC is programmed in standard relay ladder logic using RS Logix 500 software. The program instructions are loaded into the PLC's memory.

Operator Interface
An operator interface panel (OIP) is mounted on the main instrument control panel. This device is a CRT touch screen electronic operator station that integrates with the PLC to display operating data and permit the operator to control various processes by accessing predefined aspects of the PLC program from the touch screen.

Control Modes
The Pump Station motors operate automatically in response to water level in the Groundwater Interception Trench. Individual sets of start and stop water level setpoints from the trench are assigned and programmed in the PLC to establish four pumping positions: first on, second on, and third on.

Pump P-PB-4 is the primary pump and is controlled by a VFD. A 4-20 mA signal from the level transmitter located at the Traveling Screen Building directs the VFD to vary the pump motor speed to maintain a setpoint. If Pump P-PB-4 is running at maximum speed for 15 minutes and the level rises more than 1 foot over the setpoint, Pump P-PB-1 will turn on and Pump P-PB-4 will adjust speed. If Pump P-PB-4 and Pump P-PB-1 are both running at maximum speed and the level continues to rise, Pump P-PB-2 will turn on and so on until all pumps are running.

The pump motors can be assigned to a pumping position using two methods. The first method is to manually assign which pump occupies which pumping position: from the OIP, access the PLC program and input the desired pump and pumping position schedule.

The second method involves selecting the automatic pump position alternator sequence, which is programmed in the PLC to rotate the pumps into a different pumping position every 24 hours. From the OIP, access the PLC program and select the option for automatically timed alternation of pumps.

2.5 Hydraulic Controls

Most hydraulic controls at the site are manually operated. These include the following:

- Slide gates at the Inlet Structures (KG-LP-1901, KG-LP-1902, KG-LP-1903, KG-LP-1904, KG-LP-1905, KG-LP-1906, KG-LP-1907, and KG-LP-1908).
- Weir gates (downward opening slide gates) at the Pond 3 Bypass Spillway (KG-PD3-2310).
- Slide gates at the Pond 3 Outlet Works (KG-SS3E-2314 and KG-SS3W-2312).
- Stoplogs at the Pond 3 Outlet Works (OS-SS3E-2313 and OS-SS3W-2311).
- Canal gates to adjust inflow to the east and west wet closure cells at Pond 2 (OS-SS4-2303 and OS-SS4-2319).
- Sluice gate at the Flow Measurement Weir below Pond 3 (KG-SS4-2325).
- Stoplogs at the Pond 2 Service Spillway outlet (OS-PD2-3203).
- Slide gate at the Pond 2 outlet/Pond 1 inlet (KG-PD1-3204).
- Stoplogs at the Pond 2 Toe Ditch (OS-TD-3207).
- Stoplogs at the lower wet closure outlets (OS-SWC-3208, OS-MWC-3209, and OS-NWC-3210).

The operator records the status and any adjustments made to the hydraulic control gates as part of the system operating records.

2.6 Monitoring Systems

2.6.1 System Overview

The WSP facilities include an extensive and varied information collection system, which is integral to the overall successful operation and compliance with regulatory requirements. Monitoring facilities include the following:

- Pond water level monitoring gages are installed for Pond 2 (LT-PD2-3201) and Pond 3 (LT-PD3-2301). Water flow rates are monitored at the inlets to Pond 3, Pond 2, and the wet closures, and at the Pond 2 Service Spillway. Flow measurement installations are also in place below the Mill and Willow Creek confluence and on the Mill-Willow Bypass above the Warm Springs Creek confluence.
- Water quality monitoring/sampling facilities are located at the Pond 3 inlet (upstream and downstream of lime feed facilities), Pond 3 East and West Outlet Works, and the Pond 2 Service Spillway. Additional monitoring/sampling is periodically completed at three locations on the Mill-Willow Bypass at the Toe Drain Manifold outlet: at the south wet closure outlet, at an access port in the Pumpback Pipe inside the Pumpback building, and at selected soil-cement toe drains that discharge directly to the Mill-Willow Bypass.
- Groundwater gradient and quality monitoring occurs at various points in the Inactive Area (Pond 1 and below). As initially designed, the monitoring program includes water level

monitoring at 15 piezometers and 8 staff gages, and groundwater quality monitoring from 9 of the piezometers. The monitoring program is described in the piezometer manual.
- Lime feed system equipment/process status monitoring is completed at the Pond 3 inlet treatment facility.

Information collected from the above monitoring systems is used in a variety of ways:

- As input for automatic control of the lime feed system;
- To trigger alarms to notify the operator of conditions that require attention and/or action;
- In informational displays that provide the operator with an instantaneous overview of system status;
- As supplemental information that the operator can access to troubleshoot a problem or examine an aspect of system status in more depth;
- In a database to track system loading, environmental factors, operations, and treatment effectiveness that can be analyzed to understand major factors that influence effluent water quality, and based on such understanding, help optimize system performance; and
- As a record that documents system performance relative to applicable performance standards.

The sections following describe the monitoring system facilities in terms of their measurement technologies and the nature and availability of the data produced, from a broad scale to a more complex scale based on water level and flow rate monitoring, water quality monitoring, and equipment/process status monitoring. Other chapters address how the system and operators use the data. The locations of the monitoring facilities, relative to the flow/treatment system schematic, are shown in Figure 2-35. Figure 2-36 shows a weather station monitor.

2.6.2 Water Level and Flow Rate Monitoring

The system monitors the pond levels and flow rates at a number of locations on the site. Flow rate and pond level are significant factors that can impact the effectiveness of the water treatment system. In several locations, particularly relative to Ponds 2 and 3, electronic pressure sensors measure water surface elevation. Level measurements are then translated to flow measurements by the system software using theoretical formulas or rating curves. In other locations, particularly relative to wet closures in the Inactive Area and the Inactive Area Hydraulic Gradient, designated personnel obtain measurements manually from staff gages and piezometers. The established measurement stations are detailed below.

Mill-Willow Bypass above the WSP System
This measurement station is located below the confluence of Mill and Willow Creeks and is designated as Mill-Willow Bypass 1 (MWB-1). Designated personnel read and record the staff gage. A rating curve for this gaging station is in Table 2-11.

Pond 3 Inlet Flow Measurement
The measurement station (SS-1) is located at the Inlet Structure adjacent to the lime feed facility. Flow into Pond 3 is measured by an in-channel weir and stream gage (LT-SS1-5100). During flood events greater than the 100-year flood, a portion of the flood flow from the Silver Bow Creek diverts to the Mill-Willow Bypass and is not measured by the gage. Also, note that flows from Mill and Willow Creeks were diverted into Pond 3 during the multi-year remedial action construction period resulting in higher than normal inflows.

The primary gage point, for low to moderate flows, measures the head (water depth) above the measurement weir at a location 8 feet upstream of the weir. This water level is transferred by a sensing line extending from the weir backwater to a stilling well in the northern portion of the gage house (see Figure 2-25 and Figure 2-37).

The level sensing device and transmitter located at the stilling well sends a 4-20 mA signal proportional to level to the PLC, where stream flow is calculated and displayed, and to the HMI where flow is recorded in the database. A flood stage alarm is activated at a high flow condition. The flood stage alarm setting is field adjustable. The 4-20 mA signal is also used by the controller for the lime feed systems as a control input.

Flows up to approximately 500 cfs are monitored by the primary gage point located in the north side of the gage house stilling well. Flow values for this range are taken from a table based on field-verified, stage-discharge values for the weir.

Flows above 500 cfs are monitored via level measurements at the secondary gage point (LT-SS1-5101) on the south side of the stilling well, which reflect the water level upstream of the inlet gates (see Figure 2-25 and Figure 2-37). Flow calculations for this secondary gage point are based on orifice equations for flow through the 8 inlet gate openings (assuming all gates are in their normal fully open positions).

The SS-1 stage-discharge relationship is listed in **Table 2-12**. For head conditions at or below 1 foot (4,881.8) the discharge equation in millions of gallons per day (MGD) is $\mathbf{Q = 0.646*76\ H^{2.5}}$ and for heads greater than 1 foot but less than 2.5 feet (4883.3) the discharge equation is $\mathbf{Q = 0.646*76\ H^{2.06}}$. These equations were calibrated to field measurements conducted in 2010. The SS-01 weir can become submerged at flows approximately above 100 cfs, transferring the hydraulic control to the downstream channel. The rating table flow estimates should be updated approximately once every 6 weeks, or when significant changes to the channel occur, to account for updated stream gaging data and seasonal shifts and to minimize the flow measurement error. Therefore, field verification through stream gaging under actual operating conditions is required at this measurement station. Flow measurement equipment at the Pond 3 inlet can measure within a 5 to 3,300 cfs range.

Pond 3 Water Surface Elevation
To measure water surface elevation at Pond 3, the sensor is located near the East Outlet Works of Pond 3 in conjunction with Station SS-3E. The pond water surface elevation is measured by an electronic pressure transducer (LT-PD3-2301) installed in a 12-inch diameter, half-round stilling basin fastened to the outside wall of the outlet structure. The stilling basin minimizes the effect of wave action and ice formation on the pond. Data are logged into the Station SS-3E data acquisition unit on an adjustable interval initially set at 1 hour. Pond 3 water surface measurements can be used to determine Pond 3 volume and to calculate flow rates (if any) through the Bypass Spillway and the Emergency Spillway.

Pond 3 Outlet Structure Flow
The flow leaving Pond 3 through the East and/or West Structure can be estimated using the data in Figure 2-38. The figure shows the combined flow from the two structures; the flow from each structure will be 50 percent of the total. At higher flows, the outlet box and stoplog (weir) will become flooded with the flow by pipe control, which is not affected by stoplog setting. The figure assumes a stoplog setting of 4,869.3 feet for weir control.

Pond 3 Bypass Spillway Flow
Flow from Pond 3 to the Mill-Willow Bypass is estimated using the head measurement as determined by the Pond 3 pond level relative to the crest of the Bypass Spillway. The Pond 3 level measurement can be taken from the staff gage/electronic recorder at the Pond 3 monitoring building. Table 2-13 lists a rating table for this weir.

Pond 2 Inlet Flow
The stage sensor (LT-SS4-2302) is located upstream of the Flow Measurement Weir structure downstream from the Pond 3 East Outlet. The sensor and Cipolletti weir measure combined flows from the Pond 3 East and West Outlets. Plan and section views of the measurement weir structure are provided in Figure 2-39. The water level sensor is installed in the stilling well located on the right (east) abutment of the measurement weir. The level sensing signal is transmitted by instrument cable to the Pond 3 (SS-3E) monitoring building where it is logged by the data acquisition unit. Table 2-14A shows the normal flow distribution for different water surface elevations at the Flow Measurement Weir. The discharge table for flow into the Pond 2 inlet channel is shown in Table 2-14B.

Pond 2 West Wet Closure Inlet
The upstream water surface sensor location is at the Flow Measurement Weir discussed under Pond 2 Inlet Flow. A water level sensor (LT-SS4-2304) is installed in a stilling well located within the pipe inlet box on the left (west) abutment of the measurement weir (see Figure 2-38). The water surface elevation within the box is compared with the water surface elevation upstream from the measurement weir (level signal for Pond 2 inlet flow as described above) and the head differential across the orifice is used to calculate the flow through the orifice plate that feeds the inlet box and, eventually, flows into the west wet closure. Stage is logged by the data acquisition unit on an adjustable recording interval initially set at 15 minutes. The rating table used to calculate flow from the differential head across the orifice plate is based on an orifice

equation and is listed in Table 2-14C. The flow equation is: **Flow (MGD) = 2.37 (64.4 x H_w (ft))$^{1/2}$,** where H_w is the head differential across the WWC orifice.

Pond 2 East Wet Closure Inlet
The east wet closure inlet sensor location is at the Flow Measurement Weir downstream from the Pond 3 East Outlet. A water level sensor (LT-SS4-2303) is installed in a stilling well located within the pipe inlet box on the right (east) abutment of the measurement weir (see Figure 2-38). The sensor installation, function, and derivation of east wet closure inflow is analogous to the west wet closure inflow just described. The flow rating table is listed in Table 2-14C. The flow equation is as follows: **Flow (MGD) = 1.38 (64.4 x H_e (ft))$^{1/2}$,** where H_e is the head differential across the EWC orifice. The gate for the EWC should remain less than 50% open during normal operating conditions. If the gate is opened beyond 50%, the downstream channel hydraulics controls the flow, which invalidates the orifice calculations.

Pond 2 Water Surface Elevation
The Pond 2 sensor is located in a stilling well attached to the access bridge just upstream of the stoplogs at the Pond 2 Service Spillway in conjunction with Station SS-5. Similar to the installation at Pond 3, the electronic pressure transducer (LT-PD2-3201) provides a signal that is translated to water surface elevation and is transmitted to the data acquisition unit in the Pond 2 (SS-5) monitoring building. The data are logged at an adjustable recording interval initially set at 1 hour. Pond 2 water surface measurements can be used to determine Pond 2 volumes and to calculate flow rates (if any) through the Pond 2 Emergency Spillway.

Pumpback System Flow
An ultrasonic, clamp-on type flow meter (FIT-PB-4704) is installed on the Pumpback Effluent Pipe in a vault about 1,150 feet from the Pump Station. The flow reading is transmitted to the Pump Station control room where it is indicated and totalized. The flow totalizer is to be read and recorded daily for use in monitoring return loading to Pond 2.

Pond 2 Outlet Flow
The Pond 2 outlet flow sensor (FA-PD2-3202) is installed within an 18-inch diameter, corrugated-metal pipe stilling well located adjacent to and in hydraulic connection with the Service Spillway outlet channel. The stilling basin is immediately upstream from the twin box culvert drop structure, the entrance of which serves as a hydraulic control section. Water level is transmitted to the Pond 2 (SS-5) data acquisition unit where it is converted to flow and logged at an adjustable recording interval initially set at 15 minutes. The rating table for translating water surface elevation to outflow rate is provided in Table 2-15. Operators must conduct periodic field flow measurements (minimum 1 every 6 weeks) to determine if shifting of the rating table is required for accurate flow measurement; a shift is required if the difference between measured flow and rating table flow is greater than 10%. The base stage-discharge relationship, in MGD, is **$Q = 24 H^{3/2}$**.

Pond 1 Inlet Flow
Flow from Pond 2 to Pond 1 is measured at a weir located within the Pond 1 Inlet Structure. A 2-foot wide Cipolletti weir with a staff gage is installed on the downstream side of the structure

below the control gate (KG-PD1-3204). The formula for flow in MGD is **4.352 $H^{3/2}$**. Table 2-16 lists a rating table for this weir.

Wet Closure Water Surface Elevations
Each of the six wet closures (Pond 2 East and West, Pond 1, and lower south, middle, and north wet closures) is equipped with a staff gage installed near its outlet. The staff gages provide a ready reference for the operator during routine site inspections. The staff gages are to be read and recorded on a stipulated frequency (monthly) to document compliance with performance standards.

Inactive Area Groundwater Gradients
To demonstrate compliance with the hydraulic gradient performance standard for the Inactive Area, systematic water level monitoring is required in:

- piezometers constructed both north and south of the interception trench and along the Pond 1 Dike;
- the Groundwater Interception Trench; and
- the reconstructed Mill-Willow Bypass channel.

The designed gradient monitoring network, as referenced in Section 8.0, includes the following stations:

- 9 piezometers along the Groundwater Interception Trench (4 along the south side, 4 along the north side and 1 at the east end);
- 4 staff gages along the bottom of the interception trench;
- 1 staff gage at the west end of the Pond 1 Toe Ditch;
- 3 staff gages along the relocated Mill-Willow Bypass channel; and
- 6 piezometers along the west side of Pond 1 (3 along the Pond 1 Dike and 3 within the dry closure 400 feet east of the dike).

Water level monitoring for all the above gradient stations was initiated when construction of the monitoring wells, interception trench, and Pumpback System was completed and is to continue as long as the trench and Pumpback System operate. During an initial 24-month startup period, these water level measurements were collected monthly. Since then, these water level measurements are taken semi-annually.

Although not required for hydraulic gradient performance standard monitoring, the Pond 2 Toe Ditch staff gage and piezometers, AH1-A13 and AH1-A42, must be read at the same time as the above stations.

Mill-Willow Bypass Below WSP System
This monitoring point is located in the Mill-Willow Bypass upstream from the confluence of Warm Springs Creek and downstream of the Pond 2 discharge.

2.6.3 Water Quality Monitoring

Various approaches to water quality monitoring are used depending on the purpose of the data. The approach taken ranges from regular collection and analysis of grab samples to continuous online monitoring for process control. The measurement stations and facilities established and the parameters to be measured are described below. Section 8.0 contains detailed sampling and analysis procedures.

Mill-Willow Bypass

The system monitors water quality in Mill-Willow Bypass to provide baseline information as flow passes through the project area. The locations of the monitoring stations are shown in Figure 2-40. Monitoring Station 1 (MWB-1) is located upstream of the Ponds system and monitors the combined flows of Mill and Willow Creeks. This station is located just upstream of the point where Mill and Willow Creeks were temporarily diverted during remedial action construction. Data from MWB-1 provides background information regarding water quality characteristics of the combined flows from Mill and Willow Creeks, upstream of influences from the Ponds system. Monitoring Station 2 (MWB-2) is on the Mill-Willow Bypass at a location immediately upstream of the Pond 2 discharge. During periods of construction, when Mill and Willow Creeks were being diverted into the Ponds system, MWB-2 provided data on the water quality characteristics of seepage that entered the Mill-Willow Bypass from the reach extending from above Pond 3 downstream to the Pond 2 discharge. With Mill and Willow Creeks rediverted to the Mill-Willow Bypass, comparison of MWB-1 and MWB-2 could show the impacts of seepage. Monitoring Station 3 (MWB-3) is located upstream of the confluence with Warm Springs Creek and below the Pond 2 discharge. This is the ambient water quality compliance point identified by regulatory requirements.

Selected personnel collect grab samples monthly. Parameters monitored by the stations include those identified in Exhibit 4 of the Active Area UAO (Appendix E) as well as additional, selected metals and other parameters:

Arsenic	Mercury	Dissolved Oxygen
Cadmium	Selenium	Turbidity
Copper	Silver	Temperature
Iron	Zinc	Color
Lead	pH	Hardness

Soil-Cement Toe Drains

These drains do not discharge directly to Mill-Willow Bypass. The non-manifolded toe drains (south of Station 164+00) monitored include numbers 67, 84, 87, 90, 91, 99, 104, 152, 157, 160, and 161. The monitoring includes only the dissolved concentrations of the parameters specified above.

The subset as selected comprises 11 drains out of the 40 to 45 non-manifolded flowing drains. The drains were selected to provide a representative sampling relative to location, flow, concentration, and seasonal trend of parameter. The following procedure was followed to identify appropriate drains:

- Flows for all available stations for all prior sampling events were tabulated.
- Those stations with measured flow for 4 consecutive sampling periods, during 6/93 - 10/94, were selected for further evaluation. Selecting 4 sampling periods provided the greatest practical number of drains with comparable data. Thirty-three drains were included in the remaining data set.
- The percent coefficient of variation (CV) for individual toe drains was calculated for flow to determine flow consistency as compared to the sum of all flowing drains. A low coefficient indicated a good correlation. The relative impact of an individual drain on the total measured flow was examined by dividing the flow at the individual drain by the calculated CV for the drain. Thus, a large number identified a drain with a significant flow and/or that consistently represented the total flow trend from all drains and was considered to be a good candidate for future sampling.
- Similar procedures were performed for zinc (Zn) and arsenic (As) loading measured for the selected toe drains.
- Values obtained for the ratio of total metal loading/CV and total flow/CV were normalized to equal 93, which was the maximum ratio obtained for zinc loading/CV.
- Composite scores of each station were obtained by summing the normalized values for total zinc loading/CV, total arsenic loading/CV, and total flow/CV. Composite values were ranked by decreasing order.
- A geographical sample of the drains that provided the greatest composite representation of the entire system was selected.
- The validity of the subset was verified by plotting the calculated composite values for flow, arsenic, and zinc loading for each sampling date for the selected subset as compared to the entire toe drain system.
- The subset of 11 drains was reviewed to verify that it provided a reasonable representation of the range in flow and concentrations as exhibited by the entire toe drain system.

Toe drains require annual maintenance to remove excessive vegetation and sediment that builds up at the outfall of the drain pipe.

Pond 3 Inlet
Located at the Inlet Structure adjacent to the lime feed facility, the monitoring equipment at the Pond 3 inlet (Station SS-1) consists of electronic water quality monitoring devices as well as an automatic composite water sampler.

A sample pump (P-SS1-1), a turbidimeter (UIT-SS1-5110), a pH meter (AIT-SS1-5106), a temperature sensor (TIT-SS1-5107), and an automatic sampler are installed in the gage house located at the Inlet Structure. Silver Bow Creek water is continuously pumped from a location just downstream of the Inlet Structure, at the discharge of one of the slide gates near the center of the channel and upstream of the lime injection location. The sample inlet facility contains a removable screen. Sample flow is pulled through the inlet screen and into a sample line that terminates at the gage house. Sample flow passes through the gage house and through the west wall of the gage house to the Inlet Structure. The sample pump is a small, self-priming centrifugal unit that runs continuously.

Sensors measure influent water quality and monitor the results of lime addition. Data obtained by the sensors are stored in the server system located in the control room. The automatic sampler collects a 24-hour composite sample that is time based. The composite samples are retrieved twice per week and analyzed for a full range of metals and other water quality parameters as defined in Section 8.0. This sampling station provides influent loading data and complies with monitoring requirements included in Exhibit 5 of the Active Area UAO (Appendix E).

Pond 3 Inlet Downstream of Lime Addition
The monitoring facility is located approximately 300 feet downstream of the Inlet Structure. Grab samples are collected from this location on a daily basis during active lime treatment to assure the target pH is being met.

Pond 3 Discharge
The station is located at the East Outlet Works. It contains a water quality monitoring facility similar to that at the Pond 3 inlet to characterize Pond 3 discharge (Station SS-3E). The monitoring facility includes a sampling intake line with an intake screen, a sample pump (P-SS3E-1), an automatic sampler, and in-line probes located in the building. Flow is continuously circulated from the intake, located at the East Outlet Works, through the building, and returned to Pond 3. Data collected from electronic sensors aids in the evaluation and analysis of Pond 3 treatment effectiveness. The electronic sensors monitor the following parameters:

- pH (AIT-SS3E-5307);
- water temperature (TIT-SS3E-5309);
- turbidity (UIT-SS3E-5314); and
- specific conductance (AIT-SS3E-5308).

The data acquisition unit logs the data from the sensors. Composite samples are collected for twice weekly retrieval and analysis of metals and other water quality parameters as detailed in Section 8.0.

Pond 2 Discharge
The monitoring facility is located at the Pond 2 Service Spillway, the normal outlet for the pond. The monitoring facility includes a sampling intake line with intake screen, a sample pump (P-SS5-1), an automatic sampler, and in-line probes located in the building. Data collected at SS-5 are used to evaluate Pond 2 performance as well as comply with the monitoring requirements of Exhibit 5 of the Active Area UAO. The flow sample at this installation is continuously pumped from a location on the west side of the Pond 2 Service Spillway, just upstream of the spillway crest. Electronic sensors monitor the following parameters:

- pH (AIT-SS5-5510);
- water temperature (TIT-SS5-5508);
- turbidity (UIT-SS5-5511); and
- specific conductance (AIT-SS5-5507).

The data acquisition unit logs the data from the sensors. Composite samples are collected for twice weekly retrieval and analysis of metals and other water quality parameters as detailed in Section 8.0.

Inactive Area Groundwater Quality Monitoring
Performance standards are established for groundwater quality in terms of dissolved concentrations for 6 parameters: arsenic, cadmium, chromium, lead, mercury, and nitrate nitrogen (NO_3-N). Currently, the pertinent sampling stations are the 9 piezometers located along the Groundwater Interception Trench and Piezometer P-14. In addition to the parameters required by the performance standards, the following general water quality parameters must also be measured: pH, electrical conductivity, temperature, total dissolved solids, copper, zinc, and sulfate. Samples must be collected semi-annually.

Groundwater quality compliance monitoring was initiated immediately north of the interception trench (4 piezometers) upon startup and is to continue during operation of the Trench/Pumpback System. In addition to the compliance monitoring north of the Groundwater Interception Trench, sampling and analysis south and east of the interception trench is also to be completed during operation of the Trench/Pumpback System. The compliance monitoring and additional sampling and analysis will continue until Atlantic Richfield demonstrates, and EPA concurs, consistent compliance with groundwater quality standards immediately south of the interception trench for 24 months. Groundwater quality compliance monitoring will be continued immediately south of the interception trench as part of the Inactive Area Phase II O&M.

Inactive Area Surface-Water Quality Monitoring
The only specific performance standard directly applicable to monitoring of surface waters within the Inactive Area relates to monitoring of Ambient Standards at MWB-3 under Phase II O&M as discussed in Section 3.0. The Inactive Area UAO further requires Atlantic Richfield to "*flood the wet closure cells with water adjusted to a pH greater than 8.5 and maintain proper water surface elevations in the wet closure cells*."

The intended purpose requiring introduction of high pH water into the wet closure system is to prevent re-solubilization of the metals within the wet closures. The most favorable condition to immobilize metals is believed to be under reducing conditions with low dissolved oxygen levels near the water-sediment interface and a pH within a range of 6.5 to 8.5 at the interface. The immobilization of metals is important relative to groundwater beneath the site and relative to potential impacts on water quality discharged from Pond 2. To begin assessing impacts on surface water quality, monitoring stations were initially established as follows:

- Monitoring Station IA-1: At an access port in the 36-inch Pumpback Pipe in the Pumpback Building.

- Monitoring Station IA-2: At the north wet closure outlet structure.
- Monitoring Station IA-3: At manhole D on the Soil-Cement Toe Drain Manifold, the last manhole immediately prior to discharge to the Groundwater Interception Trench.

Monitoring Station IA-1 identifies total loading from the Inactive Area facilities on Pond 2. If excessive metals loading is registered, measures will be taken to further identify source(s), assess impacts, and, if appropriate, assess potential remedies. Monitoring Station IA-2 provides information on pH and metals in surface water leaving the combined wet closure system. If water quality problems are observed at this location, supplemental sampling at each wet closure outlet will be undertaken. Monitoring Station IA-3 provides water quality information on the combined flow from the Pond 2 Toe Ditch and the Soil-Cement Toe Drain Manifold.

Monitoring data from these three locations plus data from the groundwater monitoring wells south of the Groundwater Interception Trench allow assessment of the various sources on the total loading from the Inactive Area. Initially, monitoring will be monthly with analysis for the parameters required at Pond 2 discharge (SS-5).

There have been no impacts from the Inactive Area water quality affecting the Active Area water quality. This is mostly likely due to the lower flows that are pumped from the Inactive Area to the Active Area and the size of Pond 2. The pH of water entering Pond 1 from the Pond 1 Inlet Structure is assumed to be the same as that at the Pond 2 Service Spillway (monitoring station SS-5). This condition/correlation will be periodically verified and documented.

2.6.4 Lime Feed System/Equipment Status

Following is a brief description of the specific data available and monitoring equipment at the Pond 3 inlet treatment facilities.

Influent High Water Level (LT-LP-1909)
There is an ultrasonic level probe upstream of the trash rack at the Pond 3 Inlet Structure. A high water level reading from the probe indicates a possible trash rack blockage or flooding conditions and activates an alarm.

Inlet Structure Remote Camera
A remote camera located upstream of the trash rack at the Pond 3 Inlet Structure transmits pictures to an internet site. Accessing the internet site, operations personnel can visually inspect the condition of the trash rack remotely.

Lime Silo Load Cells (XE-LP-1704 and XE-LP-1804)
Load cells are located beneath the legs of each lime storage silo to facilitate control of lime inventory and usage. Load cells XE-LP-1704 are installed in Silo No. 1 and load cells XE-LP-1804 are installed in Silo No. 2. The system monitors weight values for each silo and adjustable high and low setpoints are available for control and to activate alarms. The weight values are also used to provide inventory information on actual delivery weights, amount transferred between silos, and daily/monthly usage. Load cells are typically calibrated at the beginning of the lime season.

Lime Silo High Level (LE-LP-1701 and LE-LP-1801)
An independent level switch sensor is mounted at the top of each silo to indicate high level and a danger of imminent overfilling. Level switch LE-LP-1701 is installed in Silo No. 1 and level switch LE-LP-1801 is installed in Silo No. 2. In addition to activating an alarm, the high level switch will discontinue fill operations.

Lime Feed Water Pumps
The water supply lines that feed the respective lime feed systems are equipped with flow detection switches (PT-LP-1707 and PT-LP-1807) to verify that flow is occurring when it is supposed to be. If flow is not detected the alternate pump is activated (in the case of the normal usage system). If both normal usage pumps fail or if the flood system pump has failed the respective lime feed system is shut down automatically and an alarm is activated.

Lime Transfer Air Flow
The pneumatic system for transferring lime from the large (No. 1) silo to the normal usage (No. 2) silo is supplied with an air-flow detection sensor (FIT-LP-1406) that verifies sufficient flow to transport the lime. If air flow is not sufficient, an alarm is activated and the transfer operation is stopped.

The facility contains various additional equipment sensors to detect such occurrences as open equipment access doors, over torque or jamming of screw feeders, or other abnormal conditions. These conditions initiate the appropriate alarms in the system.

2.7 Protective System Devices

Protective System Devices (PSDs) play a critical role in protecting people, systems, and their surroundings by reacting when unsafe or near unsafe conditions occur. The PSDs must be tested and maintained according to the requirements specified in the Section 5.4, Protective System Devices, of *RM Site Technical Practice REMED-GP-35-0001* (BP, 2011). The following requirements for PSDs are identified in BP's Engineering Integrity Manual (BP, 2009):

- System PSDs will be identified and listed separately in the O&M Manual as specified in *Section 22. Operation and Maintenance Manual Requirements*;
- PSDs will be tested quarterly as specified in subsection *17.9. Protective System Device Inspection* of the Engineering Integrity Manual;
- PSDs will be inspected and tested according to the requirements specified in subsection *17.9. Protective System Device Inspection* of the Engineering Integrity Manual.

The PSD register, SAFE Chart, and PSD Inspection and Maintenance plan can be found in Appendix H of this manual.

2.7.1 List of Protective System Devices

A list of PSDs for WSP is provided below:

DEVICE ID	FUNCTIONAL DESCRIPTION	SETPOINT	UNITS
PRV-LP-1001A	Air Compressor (AC-LP-1001) Pressure Relief Valve (Head)	325	PSI
PRV-LP-1001B	Air Compressor (AC-LP-1001) Pressure Relief Valve (Tank)	200	PSI
PRV-LP-1001C	Air Compressor (AC-LP-1001) Pressure Relief Valve (Line)	80	PSI
PRV-LP-1002A	Air Compressor (AC-LP-1002) Pressure Relief Valve (Head)	325	PSI
PRV-LP-1002B	Air Compressor (AC-LP-1002) Pressure Relief Valve (Tank)	200	PSI
PRV-LP-1002C	Air Compressor (AC-LP-1002) Pressure Relief Valve (Line)	80	PSI
PRV-LP-1102	Air Blower (B-LP-1) Pressure Relief Valve	NA	NA
PRV-LP-1202	Air Blower (B-LP-2) Pressure Relief Valve	NA	NA
PRV-LP-1302	Air Blower (B-LP-3) Pressure Relief Valve	NA	NA
PRV-LP-1402	Air Blower (B-LP-4) Pressure Relief Valve	NA	NA
ZI-LP-1721	Screw Feeder (SF-LP-1700) Zero Speed	NA	NA
ZS-LP-1013	ATS in Emergency Position	Fault	NA
LT-PD3-2301	Pond 3 Level Hi / Hi Hi / Dike Failure	4871 / 4871.5 / NA	FT
ZA-SS3E-2325	SS-3E Power Failure	Fault	NA
LT-PD2-3201	Pond 2 Level Hi / Hi Hi / Dike Failure	4835.35 / 4835.5 / NA	FT
ZA-SS5-3220	SS-5 Power Failure	Fault	NA
LT-PB-4001	Groundwater Interception Trench Level; Activates pumps at setpoints	11 / 11.5 / 11.8 / 12 / 14	FT
ZA-PB-4101	Pump Station #1 Pump #1 Failure	Fault	NA
ZA-PB-4201	Pump Station #1 Pump #2 Failure	Fault	NA
ZA-PB-4301	Pump Station #1 Pump #3 Failure	Fault	NA
ZA-PB-4401	Pump Station #1 Pump #4 Failure	Fault	NA
ZA-PB-4003	Pump Station #1 Power Failure	Fault	NA
ZT-PB-4109	Plug Valve Limit Switch	NA	NA
ZT-PB-4209	Plug Valve Limit Switch	NA	NA
ZT-PB-4309	Plug Valve Limit Switch	NA	NA
EX-CRS-01	Shop Fire Extinguisher #1	NA	NA
EX-CRS-02	Shop Fire Extinguisher #2	NA	NA
EX-CR-01	Control Room Fire Extinguisher	NA	NA
EX-CRSP-01	Sample Prep Fire Extinguisher	NA	NA
EX-SS1-01	SS-1 Fire Extinguisher	NA	NA
EX-LP-01	Silo #1 Fire Extinguisher	NA	NA
EX-LP-02	Silo #2 Fire Extinguisher	NA	NA
EX-BB-01	MCC Room Fire Extinguisher	NA	NA
EX-BB-02	Emergency Generator Room Fire Extinguisher	NA	NA
EX-BB-03	Blower Room Fire Extinguisher	NA	NA
EX-SS2-01	SS-2 Fire Extinguisher	NA	NA
EX-SS3E-01	SS-3E Fire Extinguisher	NA	NA
EX-SS5-01	SS-5 Fire Extinguisher	NA	NA
EX-TS-01	Traveling Screen Fire Extinguisher	NA	NA

DEVICE ID	FUNCTIONAL DESCRIPTION	SETPOINT	UNITS
EX-PB-01	Pump Station #1 Fire Extinguisher #1	NA	NA
EX-PB-02	Pump Station #2 Fire Extinguisher #2	NA	NA
ESS-LP-1014	Silo #1 Emergency Stop Button	NA	NA
ESS-LP-1015	Silo #2 Emergency Stop Button	NA	NA
LS-PD1-3211	Pond 1 Dry Closure Flood Level Float Switch	NA	NA

2.8 Dam Mitigation Equipment

In an effort to monitor the dams and dikes and mitigate any potential failures, three Canon VB-H41 cameras, two American Signal EC-Series electronic sirens, and a solar-powered level switch were installed in 2015. The cameras were installed at the following locations:

- Remedial Design Unit (RDU) 8, on the west side of I-90;
- Pond 3 Dam, below dam near the SS-04 weir; and
- Pond 2 Dam, below dam near SS-5.

The sirens were installed at the following locations:

- RDU-8, on the west side of I-90; and
- Pumpback station, east side of Traveling Screen building.

The cameras are located in such a way that all major dams and dikes around Pond 2 and Pond 3 are visible. The footage is viewed from a monitor in the Control Building. The sirens are located so that the tone and voice command is used to notify WSP visitors and recreationists to evacuate the WSP area in the event of an embankment breach. See Figure 2-41 for locations of cameras and sirens and approximate siren coverage areas.

The level switch was installed near the overflow outlet culverts in the Pond 1 dry closure. If there is water in the Pond 1 dry closure, the level switch is activated and an alarm is relayed to the HMI notifying the operators of a potential dam breach or flood situation.

3.0 PERFORMANCE STANDARDS

The respective UAOs for both the WSP Active and Inactive Areas detail a wide variety of performance standards including the following:

- Air standards
- Well construction and maintenance standards
- Surface water point source discharge standards
- Receiving water (ambient) standards
- Groundwater gradient and contamination standards
- Contaminated soil and mining waste remediation standards
- Performance standards under various resource management, conservation, and protection acts and/or programs
- Action-specific performance standards related to design and remediation construction
- Action-specific performance standards related to ongoing operation and maintenance and monitoring of site conditions and facilities

Appendix E contains these performance standards for information and reference. Appendix E consists of Exhibits 4 and 5 of the Active Area UAO and Exhibit 4 of the Inactive Area UAO.

Many of the performance standards were primarily pertinent as design criteria for the required remedial construction. Appropriate responses to these requirements have been implemented in remedial action. The remaining applicability of the performance standards will be satisfied by implementing the O&M procedures detailed throughout this manual, which are intended to maintain the effectiveness of the remedies. Other standards were applicable during the construction period to protect worker safety and public/environmental health from construction impacts. While many of these standards are still technically in force during project O&M, they will only occasionally merit specific attention from site O&M personnel. The key to compliance with these standards is for site personnel to remember that these safety and health standards exist and to refer to them while planning any extraordinary activity on the site, such as drilling or rehabilitating a well, grading an area as part of some minor improvement, or restoring an area after damaging flood flows (e.g., in Mill-Willow Bypass or where East Hills drainage enters the Ponds).

The performance standards that are particularly relevant to ongoing O&M activities can be grouped in a few major categories such as dam safety, point source discharge, groundwater, and ambient standards. The items below highlight specific points within these categories (refer to the numbered subsections within this chapter for details on the specific standards).

Dam safety requirements

These requirements are of overriding importance from a public safety perspective. Because dam safety functions might demand only a very small portion of site personnel's efforts (perhaps 5 percent or less), dam safety might seem less important than addressing other O&M

requirements. However, dam safety is a paramount responsibility of all personnel. ***Accordingly, all O&M personnel must be aware that their most important responsibilities are as follows:***

- ***To recognize and alert Atlantic Richfield's Authorized Representative immediately about any unusual situation regarding dam safety, such as seepage through or in the toe vicinity of embankments, erosion of embankments, undercutting of embankment toes or degradation of slope protection. Rapid involvement of Atlantic Richfield's Authorized Representative and dam engineers could allow time for mitigative actions so that an emergency is avoided.***
- ***To be prepared to respond appropriately if a dam safety emergency occurs. This requires advance study and periodic review of the emergency procedures detailed in the latest version of the Emergency Action Plan provided under separate cover.***

Because dam safety is important, Section 3.1 details the specific performance standards and references specific procedures presented throughout the remainder of the O&M Manual that are designed to proactively comply with these standards.

Surface and groundwater quality standards
Surface and groundwater standards are complex and demanding. Compliance requires the majority of O&M personnel's attention. Section 3.3 contains detailed information on groundwater standards.

Monitoring and reporting
The UAO requirements for monitoring and reporting are designed primarily to confirm proper operation of site facilities and to detect noncompliance with the surface and groundwater quality standards. Refer to Section 8.0 for details on the monitoring system and Section 9.0 for reporting requirements.

Occupation health and safety standards
The health and safety of site personnel and visitors must be protected by maintaining safety awareness, completing periodic safety reviews/audits and refresher training, maintaining safety equipment, and implementing all applicable safety plans and practices. Section 12.0 addresses the safety and health requirements. Also, refer to the latest version of the Site Specific Health and Safety Plan provided under separate cover.

3.1 Dam Safety O&M Requirements

As required by the UAOs, the dams and dikes of the WSP system were designed and constructed in compliance with the Montana Dam Safety Act. Appendix F contains the Montana Dam Safety Act and implementing regulations. Specific design criteria were also set and implemented relative to floods and earthquakes.

The Active Area UAO further requires that the structural integrity of the Ponds be maintained, and that the Ponds be operated in compliance with specific EPA regulations applicable to surface impoundments including prevention of overtopping or massive failure. Consequently, routine monitoring and inspection is required on at least a weekly basis and after storms to detect evidence of the following:

- Deterioration, malfunctions, or improper operation of overtopping control systems;
- Sudden drops in the Pond water levels; or
- Severe erosion or other signs of deterioration (e.g., seepage) in the dams or dikes.

These requirements are also incorporated by reference to State of Montana regulations.

The Inactive Area UAO specifically recognizes the dams and dikes as high hazard structures. Under the Montana Dam Safety Act, such embankments must be operated and maintained in compliance with ARM ξ 36.14, Subchapter 4, and subjected to periodic inspections as required by Subchapter 6 (see Appendix F). Requirements for emergency procedures are set forth in Subchapter 7. These requirements have been implemented for the WSP system through the O&M activities listed in this manual, particularly in Sections 6.0, 10.0, and 11.0.

3.2 Point Source Discharge Requirements

Per EPA, interim discharge water quality standards were complied with for 6 years starting with the effective date of the Active Area UAO (i.e., commencing October 25, 1991). This section delineates the discharge standards that are required by the UAO for the ongoing interim operating period. Current operations are required to comply with Phase I O&M requirements (EPA, 1991a).

During the Shakedown Period, compliance with interim standards was monitored. The system was also evaluated for potential compliance with final standards. This progress evaluation and further refinement of system operation aided in complying with final Active Area standards. Operation of Pond 3 hydraulics includes establishing 1) the base operating level; 2) the Bypass Spillway crest setting; 3) the discharge rate released to Pond 2; and 4) balancing the flow between the East and West Outlet Structures from Pond 3 to Pond 2. These operational factors can affect the rate and quality of water leaving the system at the various discharge points identified subsequently. The purpose of the Ponds system operation is to optimize the control variables to discharge the best combined water quality that is consistent with safe operation.

The subsections that follow list the limitations that apply as defined by the interim and final standards for the points of compliance (discharge points). Most of these details are based on Exhibit 5 of the Active Area UAO.

3.2.1 Description of Discharge Points

Authorization to discharge is limited to those locations identified below as discharge locations, which are the points of compliance for the discharge standards.

Outfall Serial Number	Description of Discharge
002	Pond 2 controlled discharge to the Mill-Willow Bypass (Pond 2 Service Spillway).

003	Pond 3 controlled discharge to the Mill-Willow Bypass (Bypass Spillway).
004	Pond 2 Emergency Spillway discharge.
005	Pond 3 Emergency Spillway discharge.
006	Drains from the North-South Dike adjacent to the Mill-Willow Bypass.

3.2.2 Discharge Conditions

3.2.2.1 Discharge 002: Pond 2 Controlled Discharge

a. ***Final Standards (Pond 2)***
The following limitations became effective on October 25, 1997, six years after the effective date of the UAO and after two years of Tier II Interim Standards. They remain in effect.

Parameters	Daily Max. (mg/L)***	Monthly Avg. (mg/L)***
Arsenic*	0.02	0.02
Cadmium*	**0.0039**	**0.0011**
Copper*	**0.018**	**0.012**
Iron*	1.5	1.0
Lead*	**0.082**	**0.0032**
Mercury*	0.0002	0.0002
Selenium□*	0.26	0.035
Silver□*	**0.0041**	0.00012
Zinc*	**0.12**	**0.11**
TSS	45.0	30.0
pH	6.5-9.5 Units	

TSS Total Suspended Solids
* Total Recoverable Analysis
*** The limitations for cadmium, copper, lead, silver, and zinc are the Chronic (Monthly Average) and Acute (Daily Maximum) Ambient Water Quality Criteria assuming a hardness of 100 mg/L. Adjustments to the limitations based on measured hardness at the discharge will be made for cadmium, copper, lead, silver (except no adjustment is allowed in the monthly average limitation for silver), and zinc. Note: Values to be adjusted in the above table are highlighted.
□ Four years after the effective date of the UAO, EPA will reevaluate the frequency of monitoring and the necessity of retaining the numeric limitations for silver and selenium. If changes are appropriate, EPA may modify Exhibit 5 and the UAO.

Note: Operations experience has shown that exceedances in total arsenic and pH occur. These exceedances result from natural biological activity in the Ponds and are therefore more pronounced in the spring, summer, and fall. Typically, the operator notifies Atlantic Richfield's

Authorized Representative, the EPA, and Montana DEQ via an e-mail within 24 hours of the time the operator becomes aware of the exceedance (in accordance with the notification requirements contained in the UAO).

Table 3-1 is an example showing the calculation of the *adjusted* limit for Daily Max Criteria for each parameter according to the measured hardness of water at the time of sample. This is merely an example. The equations following the table should be used to obtain the hardness-based limit, which is then compared to each individual parameter concentration sampled.

Table 3-2 is an example showing the calculation of the *adjusted* Monthly Average Criteria for each parameter according to the measured hardness of water at the time of sample. This is merely an example. The equations following the table should be used to obtain the hardness-based limit for the hardness associated with each sample. The monthly average standard for each parameter is determined as the average of the individual limits calculated for each sample taken.

3.2.2.2 Discharge 003: Pond 3 Controlled Discharge to Mill-Willow Bypass

Final discharge standards for discharges from the Bypass Spillway became effective October 25, 1997, and are identical to Pond 2 discharge standards.

a. ***Final Standards (Pond 3)***
   The following limitations became effective on October 25, 1997, six years after the effective date of the UAO.

Parameters	Daily Max. (mg/L)***	Monthly Avg. (mg/L)***
Arsenic*	0.02	0.02
Cadmium*	**0.0039**	**0.0011**
Copper*	**0.018**	**0.012**
Iron*	1.5	1.0
Lead*	**0.082**	**0.0032**
Mercury*	0.0002	0.0002
Selenium□*	0.26	0.035
Silver□*	**0.0041**	0.00012
Zinc*	**0.12**	**0.11**
TSS	45.0	30.0
pH	6.5-9.5 Units	

* Total Recoverable Analysis

*** The limitations for cadmium, copper, lead, silver, and zinc are based on Acute and Chronic Ambient Water Quality Criteria and assume a hardness of 100 mg/L. Adjustments to the limitations based on measured hardness at the discharge will be made for cadmium, copper, lead, silver (except no adjustment is allowed in the monthly average limitation for silver), and zinc. Note: Values to be adjusted in the above table are highlighted.

□* Four years after the effective date of the UAO, EPA will reevaluate the frequency of monitoring and the necessity of retaining the numeric limitations for silver and selenium. If changes are appropriate, EPA may modify Exhibit 5 and the UAO.

The adjustment calculations shown in Table 3-1 and Table 3-2 apply to both Pond 2 and Pond 3.

3.2.2.3 Discharges 004 and 005: Emergency Spillway Discharges from Ponds 2 and 3

Discharges from the Emergency Spillways in Pond 2 and Pond 3 will occur any time that the water level in the respective pond rises above the elevation of the spillway. The quality of these discharges will not be regulated. Monitoring and reporting of the spillway discharge is required as specified in Sections 8.0 and 9.0. Discharges 004 and 005 cannot be used solely to avoid compliance with the discharge limitations applied to discharges 002 and 003.

3.2.2.4 Discharge 006: Toe Drains from North-South Dikes Adjacent to Mill-Willow Bypass

To the extent that the toe drains create point source discharges, some of those discharges are collected (via the Soil-Cement Toe Drain Manifold) and pumped back into the Active Area for treatment. This complies with water quality discharge standards identified in the original Warm Springs Ponds ROD (EPA, 1990) and Explanation of Significant Difference (ESD) (EPA, 1991b). Some discharges will not be collected. These discharges either do not violate point source discharge standards or their collection and treatment is waived. Monitoring of such drains is discussed in Sections 2.0 and 8.0.

3.3 Groundwater Standards

The Inactive Area UAO specifically identifies the standards that must be met by groundwater that flows off-site toward the Mill-Willow Bypass and eventually enters the Clark Fork River (EPA, 1992). Accordingly, the UAO establishes specific maximum contaminant levels for groundwater that are indicative of groundwater quality. As an interim step, a hydraulic gradient requirement was established to capture essentially all groundwater and pump it back to the Active Area for treatment. When acceptable groundwater quality is achieved, the Pumpback System will be discontinued.

3.3.1 Maximum Contaminant Levels

The Inactive Area UAO (Exhibit 4) (Appendix E) establishes maximum contaminant levels and non-zero maximum contaminant limit goals for constituents of concern at the site. The specific regulatory authorities for these standards are cited in the UAO. The list below shows the specific levels. Note that all limits shown, except nitrate, are for dissolved analysis.

Arsenic	0.050 mg/L
Cadmium	0.010 mg/L
Chromium	0.050 mg/L
Lead	0.050 mg/L
Mercury	0.002 mg/L
Nitrate (as N)	10.000 mg/L

Both the time and point of compliance for these standards are influenced by the presence of the temporary Pumpback System. While the Groundwater Interception Trench and Pumpback System are operating, the standards musts be met immediately north of the interception trench. For a 24-month period prior to shutting down the interception trench and Pumpback System (and thereafter), these standards must be met immediately south of the interception trench (see Figure 3-1).

3.3.2 Hydraulic Gradient Performance Standards

The Pond 2 Toe Ditch, the Pond 1 Toe Ditch, the Groundwater Interception Trench, and the Pumpback System maintain a controlled hydraulic gradient. This controlled hydraulic gradient was designed and constructed so that essentially all groundwater flow in the affected aquifer or aquifers is toward the interception trench from all directions. All the controlled hydraulic gradient system components must be monitored to ensure effectiveness. Also, the hydraulic gradient standard is a temporary standard intended to temporarily supplement, not supplant, metals immobilization by chemical fixation and wet and dry closures.

The controlled hydraulic gradient performance standard was initiated during remedial action activities after construction of the interception trench and Pumpback System. It will function as long as the interception trench and Pumpback System operate. And, the interception trench and Pumpback System cannot be terminated until Atlantic Richfield demonstrates, and EPA concurs, that a) the system complied with groundwater performance standards (identified previously) consistently for a period of at least 24 months at a point or points immediately south of the interception trench, and b) after the Pumpback System is discontinued, groundwater flow from the operable unit will not adversely affect surface water quality in the lower Mill-Willow Bypass or the Clark Fork River.

Compliance with this performance standard is determined based on monitoring water levels in a) piezometers constructed both north and south of the Groundwater Interception Trench and along the Pond 1 Dike, b) the Groundwater Interception Trench itself, and c) the lower (relocated) Mill-Willow Bypass channel.

3.3.3 Non-Degradation Standard

Compliance with the maximum contaminant levels and the hydraulic gradient standards identified in Sections 3.3.1 and 3.3.2 will also achieve compliance with the State of Montana non-degradation standard for groundwater (ARM ξ 16.20.1011).

3.3.4 Groundwater Well Construction Standards

Additional contamination of groundwater through construction of groundwater wells is prohibited. Groundwater wells must be constructed and maintained to prevent waste, contamination, or pollution of groundwater. Activities cannot result in the degradation of groundwater, in accordance with ARM ξ 16.20.203, .204, .206, .207, .1002, .1003, and .1011. To the extent these regulations identify numeric limits for contaminants in the groundwater other than those substances listed in Section 3.3.1, numeric limits for other substances are not performance standards for the site. This performance standard must be met during construction or maintenance of any groundwater well, both during the remedial action and once it is complete.

3.4 Numeric Limitations for the Receiving Water of the Point Source Discharges (Ambient Standards)

This section defines the ambient standards, which are those limits imposed on the receiving waters approximately at the downstream boundary of the site (identified as MWB-3, located just below the lower drop structure). The relevant parameters and their associated limits were monitored during Phase I O&M, but the standards will only become effective upon completion of both the Active Area and Inactive Area remedial actions. As shown on Figure 3-1, completion of remedial action for the Active Area requires demonstrating consistent compliance with final discharge standards for a 24-month period, while completion of remedial action for the Inactive Area requires demonstrating consistent compliance with groundwater standards south of the intercept trench for a 24-month period. As of May 2009, compliance has not yet been demonstrated; therefore, the site is still in Phase I O&M. The ambient water quality standards as established in the Inactive Area UAO (EPA, 1993) are assumed to govern where there are slight differences between the requirements of the two UAOs. The Inactive Area UAO is EPA's latest statement of the requirements.

During Phase II operation, State of Montana surface water quality standards and federal water quality criteria, or appropriate replacement values for those standards and criteria that are waived, must be met for instream ambient water at or near the site (that is, water within the reconstructed, lower Mill-Willow Bypass and the water entering the Clark Fork River). The specific authority for these standards is cited in the UAO (EPA, 1993). The specific limits are listed below:

	Acute***	Chronic***
Arsenic (III)	0.36 mg/L	0.19 mg/L
Arsenic (V)	0.85 mg/L	0.048 mg/L
Arsenic (Total)*	-	0.02 mg/L□
Cadmium*	**0.0039 mg/L****	**0.0011 mg/L****
Copper*	**0.018 mg/L****	**0.012 mg/L****
Iron*	-	1.0 mg/L
Lead*	**0.082 mg/L****	**0.0032 mg/L****
Mercury*	-	0.2 □g/L*
Zinc*	**0.12 mg/L****	**0.11 mg/L****

□ Indicates that the standard is a replacement standard for a standard that is waived, pursuant to section 121 (d) (4) (A) and (C) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Refer to the WSP Active Area ROD (EPA, 1990).

* Total Recoverable Analysis.

** Indicates that the value is based on an assumed hardness of 100 mg/L. If average hardness can be demonstrated to occur at different levels at monitoring points or at the compliance point, the standards will be adjusted appropriately. Note: Values to be adjusted have been highlighted. Adjustments are to be calculated as in the examples given in Table 3-4 and Table 3-5 for the final discharge standards.

*** Acute and chronic are interpreted to be consistent with discharge standards where acute means the daily maximum and chronic means the monthly average.

Dissolved Oxygen
Dissolved oxygen concentration may not be reduced below 7.0 mg/L.

pH
Induced variation of pH within the range of 6.5 to 9.5 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0.

Turbidity
The maximum allowable increase above naturally occurring turbidity is 5 NTUs except for short-term construction or hydraulic projects, game fish population restoration, or as allowed in ARM ξ 16.20.633.

Temperature
A 1 degree Fahrenheit (F) maximum increase above naturally occurring water temperature is allowed within the range of 32 degrees to 66 degrees F; no discharge is allowed that will cause the water temperature to exceed 67 degrees F. Where the naturally occurring water temperature is 66.5 degrees F or greater, the maximum allowable increase in water temperature is 0.5 degrees F. A *2-degrees F per hour* maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55 degrees F, and a *2-degrees F maximum* decrease below naturally occurring water temperature is allowed within the range of 55 degrees F to 32 degrees F.

Sediment, etc.
No increases are allowed above naturally occurring concentrations of sediment, settleable solids, oils, or floating solids that will or are likely to create a nuisance or render the water harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, or other wildlife.

Color
True color must not be increased more than 5 units above naturally occurring color.

These standards must be met at the point of compliance, which is within the reconstructed Mill-Willow Bypass channel immediately upstream of the confluence with Warm Springs Creek (i.e., MWB-3). These standards must be met at the conclusion of the Inactive Area remedial action implementation, or at the conclusion of the Active Area remediation including the Shakedown Period, whichever comes later.

Instream monitoring is to be conducted to measure instream values as set forth in Section 8.0. When evaluating compliance for the above standards, the bases for calculating induced variation are measured background concentrations in the flow in the Mill-Willow Bypass above the Pond 2 discharge (i.e., MWB-2).

If Atlantic Richfield can demonstrate that exceedances of the instream standards are caused by conditions that are unrelated to the site, these ARARs and performance standards will not be considered to be violated. Compliance with these standards constitutes compliance with the State of Montana's non-degradation standards.

4.0 PROCESS CONTROL

This section provides an overview of how the facilities described in Section 2.0 can be operated to comply with the performance standards identified in Section 3.0. The basic processes involved in the WSP treatment system are two-fold: adding lime and removing metal precipitates:

- Lime is added to the influent stream (Silver Bow Creek) to raise the pH to the target level initially set at pH 9.3, and cause the precipitation of metals, such as copper and zinc, as metal hydroxides.
- During periods of high flow and high turbidity (e.g., runoff or precipitation events), lime is added at higher dosages to act as a flocculent for fine suspended sediments. Section 5.0 and Figure 5-1 through Figure 5-4 describe the basis for variation in lime dosage.
- The ponds are used as settling facilities for metal precipitates, thus removing them from the water prior to its discharge back into the natural stream system.
- The opportunities to control these processes are limited and involve two basic thrusts:
  - The quantity of lime added to the influent stream (and the resultant pH) can be adjusted; and
  - Hydraulic controls can be altered so that the water surface elevations and volumes of Ponds 3 and 2 are raised or lowered, or so that water flows are routed differently between or around the Ponds and/or the wet closures.

The following sections describe the process mechanisms involved and provide more detail on how operators can specifically take action to control the process. During and since the Shakedown Period of project operation, substantial efforts were devoted to refinement of operating approaches and the results are reflected in the procedures and control targets listed below. They are based on operating experience to date but can be adjusted as further experience dictates.

The elements of the Inactive Area are by definition out of the Active Area treatment flow path. However, process control of Inactive Area components is relevant in that flow from the Inactive Area enters Pond 2 and can therefore impose a load or impact on Pond 2 discharge.

The site is currently operating under the *WSP Lime Rate Optimization Pilot Study Work Plan* (Atlantic Richfield, 2013). The study implements a 50% reduction from the pre-study lime addition rate, targeting a pH range of 8.0 to 8.3 at sample location SS-2 in an attempt to improve water quality. This section describes the operating strategy before implementation of the pilot study.

4.1 Treatment Mechanisms

Lime treatment for metal precipitation is based on the fact that many metal hydroxides precipitate at elevated pH (generally in the range of pH 9 to 11), with a corresponding decrease in dissolved metal ions in the water. A visual representation of the chemistry involved is provided by a solubility diagram, a general example of which is provided in Figure 4-1. The low point of the curve represents the pH at which the solubility of the metal, the dissolved phase metal concentration in micrograms per Liter (µg/L), is least and the amount of the metal converted to a solid precipitate is greatest. In an ideal world, assuming pure solutions and only one metal was of concern, a precipitation treatment facility could be operated to maintain the pH exactly at the low point on the curve, thereby maximizing precipitation of the metal.

Lime treatment to remove metals that have already precipitated to their solid form is based on the fact that lime added to a high turbidity stream acts as a flocculent, thus increasing the removal efficiency of fine, suspended sediments. Increased lime dosage to act as a flocculent is typically used when incoming turbidity is greater than 25 NTU.

The WSP treatment system must meet performance requirements for seven metals and two other parameters. These metals do not have coinciding low points on the pH/solubility curves. Figure 4-2 provides a composite of solubility curves for six of the seven relevant metals. Based on this set of curves, it can be seen that some compromise pH is required based on the several metals present. In the case of WSP, the primary concerns for metal removal are for copper and zinc for which historic performance data illustrate the poorest compliance with the performance standards. Fortunately, both these metals have solubility curve low points in the vicinity of pH 9.0. However, it must be emphasized that these curves are theoretical curves, based on pure solutions of the respective metals under ideal conditions.

Even trying to duplicate the theoretical curves in a controlled laboratory situation, researchers find significant deviation from the theoretical curves. Data on experimental values for metals are shown in Figure 4-3. They differ somewhat from the theoretical values in Figure 4-2, including generally having higher solubilities at a given pH. Again, these curves were developed on an individual basis (simple systems) for pure compounds in an idealized laboratory setting. Solubilities for mixed systems as a function of pH are not generally available.

There are several reasons that the WSP treatment system cannot always be precisely controlled at a given, optimum pH. A few of the most important reasons are listed below:

- Operation of the treatment system must consider removal of multiple metals.
- The Pond system is chemically complex, containing many dissolved and colloidal chemical species that can affect the solubility of a given metal.
- The Pond system is subject to a large number of environmental factors such as changing air and inflow temperatures, sunlight, winds, storm water inflows, and biological dynamics, which can combine to alter the particular chemical balance of interest.
- The Pond system is large, with typical retention times in the range of 20 to 50 days. The treatment system adds lime only at the inlet to the Pond system. Thus the natural, environmental factors can affect the water during its relatively long period of residence and the effects from those factors are relatively difficult to anticipate.
- Discharges from the treatment system are required to have a pH of between 6.5 and 9.5. There is strong incentive to avoid generating high pH in the Pond system, which can cause an exceedance of the upper limit at the discharge point.

Fortunately, both copper and zinc have solubility curve low points slightly above pH 9.0. Based primarily on this fact, but also recognizing the 9.5 discharge limit and the impossibility of precise control of pH for the total period of water residence in the Pond system, the target pH for lime addition is set at 9.3. This target pH is waived during periods of high-turbidity inflow. During these periods, a pH range of 9.8 to 10.0 with a maximum dosage rate of 50 mg/L has proven to be effective in removing fine suspended sediments without resulting in pH exceedances.

The preceding was an overview, a simplified presentation of the concept of solution chemistry as it relates to pH and the relevant metals. It should be noted that the real world contains complexities that create a much more intricate, involved chemical system and cause deviations from the sharp curves shown in Figure 4-2 or even Figure 4-3. To illustrate these complexities, review Figure 4-4 (developed for copper). It indicates that copper occurs in various dissolved forms depending on pH. Furthermore, the solid phase (precipitate) present can influence the pH required for optimal metal removal. Comparing Figure 4-2 to Figure 4-4 one can see that optimal removal for copper occurs at approximately pH 8.9 when copper hydroxide [$Cu(OH)_2$] is the solid phase, while the optimal pH is approximately 9.8 when copper oxide (CuO) is the solid phase. At high pH values, pH greater than 10, copper becomes soluble in the form of complex copper-hydroxyl ions, $Cu(OH)^+$ and $Cu_2(OH)^{2+}{}_2$. At lower pH values, pH less than 6, the copper ion (Cu^{+2}) becomes prevalent, but the soluble phase also includes the complex copper carbonate $Cu(CO_3)^0$, which is the predominant dissolved copper form in the pH range 6.0 - 9.3, and copper hydroxyl ions $Cu_2(OH)^{+2}{}_2$ and $Cu(OH)^+$.

The complexity is not only limited to the dissolved phase. The solid phase also consists of different chemical compounds. In the case of WSP, where lime is added to form precipitates, the immediately relevant solid phase is copper hydroxide ($Cu(OH)_2$). However, another solid (tenorite or CuO) is also a player and, if ultimate equilibrium were reached, would be the dominant solid phase. This is important because the envelope curve developed in a solubility diagram is dependent on the particular solid species assumed. Solubility curves that are derived for various solid forms will have low points occurring at a different pH.

The solution chemistry is further complicated by the presence of other ions. Increases in anion concentration, such as carbonate, can result in a shift towards higher required pH for optimal metal removal, and an increase in the solubility of the dominant solid form as shown in Figure 4-5. The presence of other cations, such as dissolved iron (Fe^{3+}), can result in the co-precipitation of copper and a downward shift in the pH required for optimal metal removal.

Thus, the relatively sharp concentration versus pH lines shown on the solubility curves are approximate, because they can shift upward or downward depending on the chemical composition of the inflow water. Natural water systems are typically very complex because of the many chemical species present and the ability of metals to form complexes with natural water constituents.

Beyond the addition of lime for pH elevation and metal precipitation, the mechanisms involved in the WSP treatment system include the following:

- Mixing to evenly distribute the lime throughout the inflow stream thereby achieving the pH adjustment and precipitation reaction in all the water. This is facilitated by the system of mixing baffles installed in the inlet channel and by the more natural meandering stream channel that flows into Pond 3. The mixing then continues in Pond 3 itself.
- Building of the precipitate into settleable-sized particles. This begins immediately and is facilitated by the mixing described above. In conventional water treatment for municipal supply, this building process is often enhanced through designed coagulation and flocculation processes. In the case of the WSP system, the large scale and variable flows make conventional approaches difficult, but coagulation enhancements could be considered if necessary to meet performance requirements. Also evaluated during Shakedown were the interactions between the Ponds' biological system, and the metal precipitates and complex metal ions. These interactions in the large, open Ponds system have been found to be both beneficial and detrimental to the building of settleable particles.
- Settling of the particles begins upon entry of the flow into Pond 3. The wet closures and Pond 2 provide additional "polishing" sedimentation. Under ideal conditions settling would depend simply on particle size, weight, and the upflow velocity (flow rate divided by surface area) of the settling pond. Again, however, the conditions in the Ponds system are not ideal. The Ponds do not have simple geometry that lead to a uniform distribution of flow. The best that can be done is to create hydraulic barriers and flow patterns that eliminate obvious short circuiting. Such actions have been taken and were monitored during Shakedown. Similarly, the Ponds do not always (or even typically) have quiescent settling conditions. They are subject to winds and seasonal turnovers that are obviously disruptive to particle settling.
- Natural biological activity within the ponds. The ponds contained within the WSP system are highly biologically productive during the spring, summer, and fall timeframes. During these times, the naturally occurring biological activity results in increased pH in the ponds through the removal of dissolved carbon dioxide (CO_2) by photosynthesis. Additionally, the natural lifecycle of pelagic plant and animal life results in increased removal efficiency of fine suspended sediments through a flocculation process.

During the Shakedown Period of operation, opportunities to understand the effectiveness of the ponds for settling were available. The new lime addition facility provides the ability to control pond pH much more effectively than was previously possible. With this variable under control, it is more feasible to evaluate pond settling performance and relate that performance to the factors that influence it.

The Groundwater Interception Trench and Pumpback System is designed to piggyback on the same treatment mechanisms described above. The relatively small inflow of the Pumpback System (5 to 16 cfs compared to Pond 2 throughflow of 20 to 200 cfs) is intended to mix with the high pH Pond 2 water causing metal precipitation and settling prior to discharge through the Pond 2 Service Spillway.

4.2 Control Mechanisms

4.2.1 Amount of Lime Added

As described in Section 2.0, the lime feed facility is designed to automatically feed the quantity of lime necessary to maintain a constant dosage to an operator-controlled dosage setpoint. Initially, this dosage setpoint resulted in the target pH for the Ponds system, which was established as 9.3. Under the current lime reduction pilot study, the target pH is 8.0 to 8.3.

The primary automatic control system is set to add a constant dosage of lime to the influent stream. This dosage rate is initially set by the operator, and then pH at SS-2 is monitored and dosage rate is adjusted to assure the target pH is achieved.

There are alternative automatic control modes as well, which were described in Section 2.0. These alternative control modes can be selected by the operator but, initially, the system is to be operated in gravimetric mode unless there is an obvious breakdown. In such case, the operator is to switch to volumetric mode, resolve the breakdown problem, and return to gravimetric mode as soon as possible.

As described in Section 8.0, the operator must regularly monitor pH at various locations in the Ponds system in order to maintain an overview on how pH is changing as the water flows from the inlet (SS-1 and SS-2) to the Pond 3 outlet (SS-3), and then to the Pond 2 outlet (SS-5). An overview of seasonal and recent trends in pH can be obtained by plotting representative pH values for each of these monitoring stations on a daily basis (see Section 8.3.3). When observing these data the operator must go the next step by evaluating whether some trend or change in the condition of the Ponds is becoming apparent. To do so, he or she must consider not only the pH measurements, but also the lag time for flow through Pond 3, the additional lag time for flow through Pond 2, and whether recent adjustments to the pH feed system might have already compensated for the observed trends or changes. After making this evaluation (on a daily basis), the operator must decide whether a slight change in operation is warranted.

The mechanism available to the operator to change the lime feed operation (and thus the resultant pH at the Pond 3 and Pond 2 outlets) is to either raise or lower the dosage setpoint in the lime feeder. For example (before lime reduction pilot study), in May and June, the pH at the Pond 3 outlet might have been consistently measured at 9.2 and 9.3 with no adjustment of operations necessary. In early July the operator detects an increasing trend; after a full week of pH 9.3, the last three days have shown pH 9.4 readings. This might be taken to indicate that with warmer weather biological activity in the ponds is increasing and causing the rise in pH. If a similar pattern had been seen in previous years and, if a similar pattern is occurring now in Pond 2, it would be logical for the operator to decrease the pH setpoint to 9.2 or 9.1, thereby avoiding possible violation of the pH discharge standard at the Pond 2 outlet (not greater than 9.5), maintaining the Ponds system closer to its target pH (9.3), and saving lime.

Experience shows that natural biological activity, occurring from late spring to early fall, provides sufficient increase in pH and removal efficiency for fine suspended sediments that continuous lime addition is not required. In the spring, the determination as to when to cease continuous lime addition is typically made when the pH in Pond 2 shows a sustained, increasing trend with no corresponding trend evident in Pond 3. In the fall, the determination as to when to initiate continuous lime addition is typically made when the pH in Pond 2 shows a sustained, decreasing trend with no corresponding trend in Pond 3. Several other factors enter into the decision to initiate or cease continuous lime addition including watershed snowpack, forecasted weather, runoff volume to date, and visual evidence of biological activity within the ponds system.

During times when continuous lime addition is not occurring, operations personnel will initiate lime addition in response to a high-turbidity flow event. Lime addition will cease upon return to normal influent turbidity. See Section 5.0 for detailed operations flowcharts.

The decision to change the pH setpoint is one that the operator will think about every day; but a change will only rarely be needed. The Ponds system has lots of inertia, like a big ship and an easy mistake would be to oversteer. Thus, once a change seems warranted, the change needs to be small and the operator needs to allow plenty of time for the effects of the change to become apparent. All this essentially depends on good judgment; operator experience is vital for further development of guidance on what specific circumstances warrant adjustments to the pH setpoint and how large such adjustments should be. Section 5.0 summarizes the seasonal changes to the amount of lime addition.

4.2.2 Hydraulic Controls

As described in Section 2.0, the hydraulic controls in the normal operation of the WSP system are manually (not automatically) set. They have one "normal operation" setting that is not to be changed by the operator except after consultation with Atlantic Richfield's Authorized Representative. One objective of the Shakedown Period was to evaluate the hydraulic control settings and optimize them for best metal precipitate settling performance. Based on these evaluations, Atlantic Richfield's operating experience, and additional evaluations recently completed by the design engineers (see Technical Memorandum for Warm Springs Ponds Operations Support, by Short Elliot Hendrickson Inc. (Hendrickson, 2007), the hydraulic flow settings could be altered during specified seasons or flow conditions as outlined in this section. The hydraulic controls available for operation of the WSP system are listed below:

- **Pond 3**
  - *East Outlet Works:* Pond level and outlet discharge rate to Pond 2 at low flows are controlled by stoplogs installed on three sides of a rectangular box outlet structure (OS-SS3E-2312). Under normal conditions, the tops of all three stoplogs are to be set identically at slightly below the desired pond surface elevation. The normal pond surface elevation is set at 4,870 feet. Stoplogs can be adjusted from a minimum elevation of 4,866 up to a maximum of approximately 4,871.7 feet. Actual pond level above the stoplogs varies with flow; at normal flows, it will be 0.6 feet above the stoplog setting. Such adjustments in pond surface elevation could be desirable to increase or decrease pond volume and, thereby, retention time. Under high flow conditions (storm inflows), the pond will rise, increasing the discharge rate. Under very high flows, the outlet

structure will fill, transferring hydraulic control to the outlet pipe, which limits flow through the East Outlet Works to a maximum of 150 cfs. The operator can raise or lower the normal pond operating level, thereby changing pond volume and retention time, by adding or removing stoplogs.

- *West Outlet Works:* This structure (OS-SS3W-2311) is identical to the East Outlet structure and also discharges water to Pond 2 at a variable rate up to 150 cfs maximum.
- *Bypass Spillway for Direct Discharge to Mill-Willow Bypass (bypassing Pond 2):* Discharge through the Bypass Spillway is controlled by two adjustable weir gates (KG-PD3-2310 and KG-PD3-2309). These gates can be individually adjusted through a range of 6 feet; the setting is 4,872.0 feet, two feet above the anticipated normal pond operating elevation of 4870.0 feet.
- *Pond 3 Operating Limits:* Table 4-1 summarizes acceptable operating limits for Pond 3. Operating conditions highlighted in black meet all necessary flood routing criteria.

- **Pond 3 Flow Measurement Weir**
  - *West Wet Closure Canal Gate (OS-SS4-2319):* The gate located at the west (left) abutment of the measurement weir allows control of the quantity of Pond 3 discharge water diverted to the west wet closure. It can be operated fully open, fully closed, or partially closed to throttle flow over a continuous range.
  - *East Wet Closure Canal Gate (OS-SS4-2318*): This gate is located at the east (right) abutment of the measurement weir and allows control of Pond 3 discharge water diversions to the east wet closure. It is similar to the gate described above.

- **Wet Closure Outlets for Discharge to Pond 2**
  - *West Wet Closure Outlets:* Three rectangular outlet structures (OS-WWC-2322, OS-WWC-2323, and OS-WWC-2324) are in the west wet closure to allow overflow discharge to Pond 2. Stoplog slots are on one side of the structures and are adjustable through approximately a 5-foot range. However, system design requires that tailings be continuously flooded and that wet closure level be maintained without change except under special circumstances. The normal setting is near the top of the range with a pond water surface elevation of approximately 4,838.2 feet.
  - *East Wet Closure Outlets:* Two rectangular outlet structures (OS-EWC-2320 and OS-EWC-2321) are in the east wet closure with function and design identical to those described above. The normal setting results in a pond water surface elevation of approximately 4,838.7 feet.

- **Pond 2**
  - *Service Spillway for Discharge to Mill-Willow Bypass:* This is the primary normal outlet of Pond 2. It is controlled by a stoplog weir structure (OS-PD2-3203) that serves as the spillway crest. The structure consists of 13 stoplog slots, which are adjustable through a 9-foot range. These stoplogs are to be set at elevation 4,834.8 feet to control the normal Pond 2 surface elevation at 4,835.2 feet. By adding stoplogs the pond surface elevation can be raised as much as 1.5 feet; by removing stoplogs the pond surface can be lowered

to a minimum setting (no stoplogs) of 4,827.8 feet. Although this wide operating range is available, it should not be used except under extreme circumstances. If the Pond 2 Dam integrity is threatened but the dam is not in danger of imminent failure, the stoplog elevation can be lowered after receiving approval from Atlantic Richfield's Authorized Representative. If the dam is in danger of imminent failure, the stoplogs can be lowered first, and Atlantic Richfield's Authorized Representative then immediately notified. Other usual conditions, such as Pond 2 upset, could warrant minor raising or lowering of the stoplog elevation (one or two stoplogs). These conditions should be discussed with Atlantic Richfield's Authorized Representative and changes made only after receiving approval from Atlantic Richfield's Authorized Representative.

  - *Outlet to Pond 1 Wet Closure:* A throttling slide gate (KG-PD1-3204) in the Pond 2 outlet/Pond 1 Inlet Structure controls the quantity of high pH water diverted to the Pond 1 and Inactive Area wet closures. The ideal flow will be the minimum necessary to maintain adequate pH in the wet closures and/or limit problems from ice formation at outlet structures during the winter. The outlet/inlet is capable of flows from 0 to 5 cfs but flows in the 2 to 4 cfs range are typical.

- **Pond 2 Toe Ditch Discharge to the Soil-Cement Toe Drain Manifold Pipe**
  - A rectangular outlet structure (OS-TD-3207) at the west end of the Pond 2 Toe Ditch allows overflow discharge into the Toe Drain Manifold pipe with subsequent discharge to the Groundwater Interception Trench and Pumpback System. Stoplogs are on one side of the outlet structure and are adjustable through a 7.5-foot range from elevation 4,810 to 4,817.5 feet.

- **Pond 1 Wet Closure Discharge to the South Cell of the Lower Wet Closure Area**
  - A rectangular outlet structure (OS-PD1-3205) in the Pond 1 wet closure allows overflow discharge to the south cell. Stoplogs are on one side of the outlet structure and are adjustable through a 6-foot range from elevation 4,815 to 4,821 feet. Stoplogs should not be placed above elevation 4,817 feet except in unusual conditions to maintain appropriate freeboard. The Pond 1 wet closure must be maintained at water surface elevation 4,816 feet to achieve the required inundation of tailings deposits; the stoplogs are initially set for this elevation.

- **Lower Wet Closure Outlets**
  - Each of the three lower wet closure cells is equipped with a rectangular outlet structure allowing overflow discharge to the next lower cell in the series and ultimately to the Groundwater Interception Trench. Stoplogs are on one side of each outlet structure and are designed to provide the following range of settings:

Elevation (feet)

Cell	Normal	Low	High
South Cell (OS-SWC-3208)	4,805	4,798	4,806.7
Middle Cell (OS-MWC-3209)	4,800	4,795	4,801.7
North Cell (OS-NWC-3210)	4,796.5	4,794.5	4,797.8

The cell water surface elevations must be maintained to the indicated normal elevation to achieve the required inundation of tailings deposits. Higher settings will subtract from flood freeboard. Thus the stoplogs are to be set for the normal elevations except during unusual conditions.

- **Pumpback System**
  - o The level switches to start and stop pumps can be adjusted as indicated in the earlier discussion of Pumpback System controls (Section 2.4.5).

As described in Section 8.0, on a daily basis the operator must monitor Ponds 2 and 3 water surface elevations, retention time, and other hydraulic parameters such as inflow and outflow. He or she must also monitor settling performance, as represented by metal concentrations in the discharge from the Ponds system. Based on these regular reviews and the increasing understanding of the behavior of the Ponds, the operator is expected to recognize potential problems in settling behavior or the beginnings of upset conditions. Based on these recognitions and experience gained to date, the operator might decide to make adjustments in the hydraulic operations of the Ponds. Seasonal adjustments are summarized in Section 5.0.

An assessment of the wet closures is performed quarterly to recognize whether those systems are performing acceptably. The most significant indicators/variables are quantity of outflow, retention time, pH, turbidity, or TSS in outflow.

The following is a listing of different hydraulic control actions that the operator might implement:

- **Discharge Pond 3 Water Directly to Mill-Willow Bypass.** To implement this action the operator would lower one or both of the weir gates (KG-PD3-2309 and KG-PD3-2310) located in the Bypass Spillway. Depending on the extent of the bypass desired, it might also be appropriate to restrict flow into Pond 2 by closing (or throttling) slide gate KG-SS3E-2314 or KG-SS3W-2312 at the Pond 3 East and West Outlets Works. This action might be taken during upset conditions in Pond 2 to achieve the best possible quality of combined system discharge. Such discharges also would occur during large runoff events when the operator might lower or raise the weir gates to control the quantity or timing of such discharges. Refer to Section 9.4 for special reporting/notification requirements associated with using the Bypass Spillway.
- **Raise or Lower the Pond 3 Water Surface Elevation.** This action would be implemented by adding or removing stoplogs from OS-SS3E-2313 and OS-SS3W-2311 at the East and West Outlet Works. The reasons for taking such action could include increasing pond volume to increase detention time and improve settling or increasing pond volume to capture and better treat water from a storm runoff event.

- **Change the Proportions of Pond 3 Outflow in the East versus West Outlet Works.** This action would be implemented by adding or removing one or more stoplogs in one outlet structure but not in the other. Such an action might be necessary to decrease the amount of short circuiting and thus better use the pond for settling. This condition has been noted when the quality of water leaving the East Outlet Structure deteriorates relative to that leaving the West Outlet Structure. Such a condition is evident by monitoring turbidity or color and has followed periods of high inflow.
- **Adjust the Flow Diverted to the West Wet Closure.** This would be implemented by adjusting the setting of canal gate OS-SS4-2319. More water might be needed to maintain the required wet closure depth; more or less water might be necessary to improve the metal removal effectiveness of the Pond 2/wet closure system.
- **Adjust the Flow Diverted to the East Wet Closure.** Implementation and rationale would be similar to that described above for canal gate OS-SS4-2318.
- **Adjust the West Wet Closure Water Surface Elevation.** This action would be implemented by adding or removing stoplogs at the three outlet structures (OS-WWC-2322, OS-WWC-2323, and OS-WWC-2324). The action might be taken to better maintain the required water coverage in the wet closure area or to better use the metal removal abilities of the cell. It should be recognized that changing the water surface elevation can impact the rate of flow entering the wet closure.
- **Adjust the East Wet Closure Water Surface Elevation.** This action would be implemented by adding or removing stoplogs at the two outlet structures (OS-EWC-2320 and OS-EWC-2321). Rationale is as described above.
- **Raise or Lower the Pond 2 Water Surface Elevation.** This action would be implemented by adding or removing stoplogs from the Pond 2 Service Spillway structure (OS-PD2-3203). The reasons for taking such action could include those mentioned above for Pond 3, although minimal level fluctuation is provided in the intended design/operation of Pond 2. Also, the Pond 2 stoplogs might be raised to prevent Pond 2 discharge because of Pond 2 upset conditions and in conjunction with a decision to discharge directly via the Bypass Spillway.
- **Adjust the Flow Diverted to the Pond 1 Wet Closure.** This would be implemented by adjusting the setting of the Pond 2 outlet/Pond 1 inlet slide gate (KG-PD1-3204). An adjustment in flow might be required to maintain downstream wet closure water surface elevations, to adjust system pH and prevent metal mobilization, or to reduce the flow and metals loading displaced and subsequently returned to Pond 2 via the Pumpback System. A decrease in flow could also be necessary to lessen pumpback flow. Primary criteria to weigh in formulating decisions regarding flow through the wet closure include 1) the need to maintain the tailings flooded; and 2) the need to avoid negative impacts on Pond 2 water quality at the Pond 2 discharge.
- **Raise or Lower the Pond 1 Wet Closure Water Surface Elevation.** This would be implemented by adding or removing one or more stoplogs at the Pond 1 outlet structure (OS-PD1-3205). The reasons for raising the Pond 1 wet closure water surface could include a need to cover additional areas, to increase coverage depths, or to temporarily limit flow to the wet closures/Pumpback System below. Although a larger water volume might lead to lower metal discharge concentrations, lowering the water surface is an unlikely action because the indicated elevation is needed for tailings coverage.

- **Raise or Lower the South Cell Wet Closure Water Surface Elevation.** The action for the south wet closure outlet structure OS-SWC-3208 would be as described above for the Pond 1 wet closure.
- **Raise or Lower the Middle Cell Wet Closure Water Surface Elevation.** The action for the middle wet closure outlet structure OS-MWC-3209 would be as described above for the Pond 1 wet closure.
- **Raise or Lower the North Cell Wet Closure Water Surface Elevation.** The action for the north wet closure outlet structure OS-NWC-3210 would be as described above for the Pond 1 wet closure.

Although considerable flexibility exists for hydraulic control, there is no explicit guidance to exercise it. Some general rules apply that WSP operators should recognize and follow are listed below:

- It is best to minimize the number of control actions because this will promote the overall stability of the Ponds and wet closure systems.
- When a hydraulic control action is taken, it is best to make the adjustment gradually to avoid shocks to the Ponds system or to the receiving stream. For example, in raising the level of Pond 3, six stoplogs would typically be required (three at each outlet structure). It is preferable to place one stoplog per day over a 6-day period rather than placing all six at once. The latter approach would cut off flow from Pond 3 to Pond 2 for some period and would lead to a decrease and possible interruption of discharge from Pond 2 to the receiving stream. Similarly, if the Pond 3 level were to be lowered, removing all six stoplogs at once would create a surge of inflow to the Pond 2 system and could lead to a relative large slug of discharge to the receiving water. The preferred method is to create a gradual lowering over a longer period.

Section 5.0 summarizes the seasonal adjustments to the hydraulic controls.

5.0 NORMAL OPERATIONS

This section defines normal conditions and operator activities for the WSP system. The definitions provided are a starting point based on available information. The definitions and guidelines were revised, augmented, and refined during the Shakedown Period of operation. Typical, seasonal operations matrices presented in Figure 5-1 through Figure 5-4 provide general guidance for overall system operations at various times of the year. The next section below contains detailed discussions of routine operations tasks.

5.1 Routine Operations Tasks

The operator's normal routine includes several standard tasks:

- Start-of-day status check of the controls, Inlet Structure, and lime feed areas.
- Review for compliance laboratory monitoring data submittals.
- Daily check of Ponds area.
- Daily review/action regarding maintenance punch list.
- Completing daily operator logs
- End-of-day status check
- End-of-week status check
- Monthly reporting.

The specific subtasks and activities in each of these routine tasks are detailed in the following subsections.

5.1.1 Start-of-Day Status Check of the Controls, Inlet Structure, and Lime Feed Area

Upon arrival at the project site each day, the operator's first task is to check the status of project operations. Table 5-1 provides a checklist for this task. It was refined during the Shakedown Period and a daily inspection log is now in use.

Items 1 and 2 regarding checking alarms and current monitoring data provide the operator with a quick overview of the facility and operating conditions so the operator can provide immediate attention to major problems, if any have developed during his or her absence.

Item 3, checking yesterday's monitoring data, is a more evaluative and reflective task. As described in Section 8.0, graphical records are to be developed that plot daily summary/indicator data for the following categories of information:

- Lime operations
- Hydraulics
- pH

- Metal removal (copper as an indicator)
- Turbidity

These data are to be reviewed to detect recent trends (in the last week or two) and seasonal variations (over the past several months as compared with last year or typical years). It is through this review that the operator is to anticipate or detect subtle changes in the treatment system performance that could warrant operating adjustments. Circumstances may exist that require a quick response. However, it will be much more usual for changes to develop over several days, which could warrant consultation between the operator and Atlantic Richfield's Authorized Representative.

Items 4 through 9 (in Table 5-1) involve a tour of the inlet area facilities with observations of specific potential problem areas and routine checking of critical facilities. The items have been listed in a convenient order intended to facilitate an efficient step-by-step status check. Although the checklist contains considerable detail, in essence the operator absolutely must know:

- That the right quantity of lime is being placed into the influent water stream (e.g., the feeder is working correctly, mixer operating, solutions lines open and discharging freely);
- That there is no obstruction (e.g., a clogged trash rack) to the flow of the water;
- That the monitoring system used for lime-feed control is functioning properly, specifically for *stream flow (SS-1) and pH*; and
- That ancillary equipment is functional and controls are set properly.

At the end of the daily *Start-of-Day Status Check* the operator should be confident that each of these conditions is fulfilled.

5.1.2 Review of Laboratory Monitoring Data Submittals for Compliance

The monitoring program (see Section 8.0) is designed to provide data on the specific performance requirements in place for the WSP system (see Section 3.0). Monitoring data reports will be received weekly from the laboratory subcontractor. These reports must be reviewed as soon as practical by the operator to detect and make a timely notification (generally within 24 hours) of any noncompliance to regulatory agencies. Such review will always be completed immediately after the *Start-of-Day Status Check* if it was not practical to perform the review when the data were received the previous day. Section 3.0 provides detailed guidelines on conducting the review; Section 9.0 provides guidance on required actions if non-complying data are present.

5.1.3 Daily Check of Ponds Area

The operator will also perform a daily status check of the Ponds area. Table 5-2 provides an initial checklist for this tour, developed with the same intent as Table 5-1. Again, the essence of the tour is to provide the operator with firsthand knowledge of the following:

- All major embankments within the Ponds system are free of any changed or unusual conditions (i.e., erosion, cracking, slumping, seepage, etc.);
- The hydraulic controls are properly set;
- The pond facilities, including all the ancillary features and wet closures, are functioning as intended;
- The Pumpback System is operating to control the Groundwater Interception Trench level;
- There are no impediments to intended hydraulic flows;
- The monitoring facilities are functioning properly;
- There are no unusual or unexplainable monitoring readings;
- Appropriate action has been taken or scheduled to resolve any problem;
- Regulatory requirements are being met, to the best of the project's ability: and
- Water color does not indicate chemical or biological problems.

At the end of the *Daily Check of the Ponds Area*, the operator should be confident that he or she is fully aware of and has documented any dam-safety issues, physical problems, or unusual circumstances in the Ponds area. Furthermore, based on his or her observations of the Ponds and electronic monitoring readouts at SS-3E and SS-5, the operator should have at least a suspicion of any chemical or biological problem in the Ponds that is beginning to develop and will subsequently show up in the laboratory monitoring data when received.

5.1.4 Daily Review/Action on Maintenance Punch List

The operator's maintenance punch list is an agenda of scheduled and unscheduled maintenance that needs to be performed. Items can be added to the list either via regular updates to recognize activities that have now come due (see Section 10.0), or by a special addition if the operator observes a specific need but cannot resolve it immediately. When added to the list, items are to be annotated with the date of addition, a priority (a, b, or c), and a target date for completion. Once on the maintenance punch list, the item must stay listed until the action is completed. If the original target date for completion is missed, that date is to remain on the punch list; a revised target date is to be added. The operator and Atlantic Richfield's Authorized Representative should immediately consult if the punch list keeps growing and target dates are frequently missed.

5.1.5 End-of-Day Status Check

Shortly before departure from the site, the operator should again review the status of the project, particularly in the controls, inlet, and lime feed areas. Table 5-3 shows the initial checklist for this activity, which is an abbreviated version of the *Start-of-Day Status Check* described in Section 5.1.1 and Table 5-1.

The objective of the *End-of-Day Status Check* is to confirm that the facilities are continuing to function properly and that the correct conditions are in effect to provide for automatic, trouble-free operation until the site is again manned. Essentially, the same outlook and intentions are needed as in conducting the *Start-of-Day Status Check*. However, those items that require special effort to detect problems or problems that develop gradually can be deferred since they will be addressed in the next morning check.

5.1.6 Complete Daily Operator Logs

Before leaving the site, the operator will complete a daily log that records daily grab results for pH and turbidity at SS-1, SS-3E, and SS-5, along with all Instrument Reading Manual (IRM) and Instrument Reading Electronic (IRE) data. The operator will also record daily operations that took place, contractor work, and any system observations, i.e., high winds, increased turbidity, excessive vegetation growth in the water, and ice on/off.

5.1.7 End–of–Week Status Check

Each week the operator should verify the project status relative to various routine operations. The list of items includes those that are routine but do not require or warrant daily review. Included are items such as verification of the accuracy of water level readings, manual level readings, and periodic debris removal. The end-of-week status check is shown in Table 5-4.

5.1.8 Monthly Reporting

Regulatory agencies require submittal of routine monthly reports of mandated monitoring data and of compliance/noncompliance with performance standards (see Section 3.0 and Section 9.0). Such reports are to be compiled by the operator and submitted through Atlantic Richfield's Authorized Representative. The specific approach and format for these reports is detailed in Section 9.0.

5.2 Pond System Normal Operations/Normal Settings

This section provides a brief description of the normal settings and operational mode for the hydraulic structures associated with the WSP facilities. Section 2.2 contains detailed information concerning hydraulic operations.

Pond 3 Inlet
Under normal conditions all flow in Silver Bow Creek is diverted through the Pond 3 approach channel to the Inlet Structure. The gates at the Inlet Structure will remain fully open during all flow conditions unless approved maintenance on downstream structures requires diversion of the flow (any such diversion must be approved by the EPA). The flow is measured at the Inlet Structure using a continuous recording gage (LT-SS1-5100). Lime (calcium hydroxide) solution is added downstream of the Inlet Structure gates to adjust the pH to meet water quality objectives.

Pond 3
The flow passes down the inlet channel to Pond 3. The normal pool at Pond 3 is set by the stoplogs located at the East and West Outlet Works structures (OS-SS3E-2313 and OS-SS3W-2311). The initial setting is at elevation 4,869.4 feet for both structures. The normal pool at this setting is 4,870.0 feet.

The discharge from Pond 3 is controlled by outlet structures OS-SS3E-2313 and OS-SS3W-2311. The discharge rate through each outlet structure can be changed by adjusting one or more of the three stoplog openings to help equalize flow through the Pond and thus achieve more uniform water quality at the outlets. Also, a small quantity of unregulated flow is siphoned from Pond 3 to the Wildlife Ponds through three small siphon pipes.

The gates for the Bypass Spillway (KG-PD3-2309 and KG-PD3-2310) are set at elevation 4,872 feet, which will prevent flow into this spillway during normal conditions. The Bypass Spillway will operate, however, during flooding or other abnormal operating conditions.

Pond 2 Inlet Channel

The Pond 3 Outlet Works discharge into the Pond 2 inlet channel. The flow travels in the channel to the Flow Measurement Weir where it is split between the two wet closure cells or passes directly to Pond 2. The flow into each wet closure cell is controlled by an inlet orifice and gate at the Flow Measurement Weir. The flow rate into each cell is measured by the differential head across the orifice as indicated by staff gages and/or electronic level sensor(s). Normal operation of the gates is to be fully open unless conditions dictate otherwise. If necessary, flow entering the wet closure cell can be regulated by throttling (partially closing) the respective gate and observing the associated flow rate. Flows in excess of the capacity of the wet closure cells pass over the weir and into Pond 2 through the main inlet channel. The flow over the weir is measured by a staff gage/electronic level sensor located in a stilling well.

Pond 2 Wet Closure Cells

The flow out of each cell will generally match the flow in by maintenance of constant stoplog elevations at each outlet. The flow rate through each cell will be relatively uniform for the full range of flows into Pond 2. The pool level in the wet closures is controlled by the stoplog setting at the outlet structures. The minimum pool elevation (as defined by the outlet stoplog settings) is set to maintain a nominal minimum water depth of one foot over the tailings and associated soils and will not be altered except for approved maintenance purposes. Because of the relatively uniform flow rate allowed into each wet closure cell, pool level fluctuations will be small. The minimum pool elevations required are east wet closure: 4,838.3 feet and west wet closure: 4,837.8 feet.

Pond 2

During normal operation Pond 2 provides final water treatment polishing before discharge to the receiving stream. The normal pool elevation in Pond 2 is controlled by the setting on stoplog OS-PD2-3203 at the Pond 2 Service Spillway. By maintaining a constant stoplog elevation, the flow out of Pond 2 is allowed to vary to match the flow in. Pool level fluctuations are small over the range of typical inflows. The initial setting of the stoplog crest is 4,834.8 feet, which should be maintained except under unusual conditions as stated in Section 4.2.2.

Pond 2 discharges through the Service Spillway to the Pond 2 outlet channel. The flow rate is measured by LT-PD2-3202 at the culvert/drop structure located in the outlet channel. The outlet channel discharges to the Mill-Willow Bypass.

Pond 2/Pond 1
A minor flow is circulated from Pond 2 through the outlet structure that feeds the Pond 1 wet closure. The discharge rate is expected to be relatively uniform with seasonal adjustments to maintain wet closure pools levels. A typical flow is anticipated to be approximately 2.5 cfs.

Pond 1 Wet Closure and Lower Wet Closure Cells
These four wet closure cells function as described above for the Pond 2 wet closure cells. The inflow from Pond 2 into the Pond 1 wet closure subsequently passes in series through the other three cells. Each cell must be maintained at its stipulated pool elevation in order to provide the required 1-foot inundation of tailings deposits. The minimum pool elevations required are Pond 1: 4,816 feet; South: 4,805 feet; Middle: 4,800 feet; and North: 4,796.5 feet.

Groundwater Interception Trench
The trench is designed to capture groundwater from the surrounding area by creating a hydraulic gradient toward the trench. The trench slopes toward a sump, located at the east end, which is pumped to maintain an average trench water surface elevation of 4,779 feet. Maintenance of a gradient towards the trench is necessary to comply with the Inactive Area UAO groundwater quality requirements. Groundwater quality must be acceptable for discharge off-site. Normal operational settings and setting ranges for the WSP system hydraulic structures are listed in Table 5-5.

5.3 Lime Treatment at the Inlet Structure

5.3.1 System Overview

The following description outlines the normal operational mode to be used at the Pond 3 Inlet Structure/lime treatment facility. This brief system overview complements the subsequent Description of Control Settings in Section 5.3.2.

1. Raw water to be treated by the systems enters from Silver Bow Creek. This water enters the system via the Pond 3 Inlet Structure.
2. The influent stream level is monitored upstream of the inlet trash rack to alert the operator of the possibility of blockage at the inlet.
3. A portion of the influent stream is pumped to an existing gage house (SS-1) for sampling of pH and turbidity. After being sampled, the sample stream is discharged back to the Pond 3 inlet. The stilling well below the gage house receives water from the stream just above the Flow Measurement Weir. Using the level transmitter in the stilling well and an established level/flow relationship table, influent flow is calculated.
4. The stream has lime solution applied from the normal usage lime feed system located at Silo No. 2 at the discharge of the Inlet Structure during normal flow and operation. The lime feed rate/concentration can be controlled by a number of different modes of control. Under normal operation, the standard control would consist of the actual lime dosage being compared to a system dosage setpoint. This comparison is used in a standard Proportional, Integral and Derivative (PID) loop configuration.

5. The normal usage lime feed system is used under normal operating conditions. Lime is fed from Silo No. 2 into a lime solution tank via a pneumatic Salina Vortex knife gate (FCV-LP-1824) and a Schenck AccuRate Feeder (XE-LP-1830) hopper/helix. The knife gate is bolted to the base of Silo No. 2 and is controlled by a signal from the feeder hopper load cell: open on minimum weight and close on maximum weight, or close on timer. Absolute minimum weight shuts the feeder down, resulting in interlocked system shutdown. In normal operation, the lime feed system operates in AUTO (Gravimetric) mode. In Gravimetric mode, the lime feeder will automatically provide lime from the silo/hopper to the helix, which meters the appropriate lime dosage based on the operational lime setpoint and influent flow. Lime is discharged at a metered rate from the feeder helix to the 500-gallon tank with mixer (MX-LP-1). With the local DISOCONT® Control Panel lime feeder switch placed in the volumetric position, the control of the helix rotation speed is set manually by adjusting the speed control knob on the OP-1 control panel to meet the dosage setpoint input by the operator. The knife gate must be manually set in the open position prior to volumetric operation. The silo is equipped with a vibrator and aeration system to aid in dispensing the lime and to prevent compaction or "caking" of the lime within the silo. Once the lime has been fed into the solution tank and is in solution, it is fed to the stream and applied via a lime slurry delivery manifold.

6. The flood stage lime feed system is used under flood stage conditions or in the event that Silo No. 2 is not operational. Lime is fed from Silo No. 1 directly to the stream at a point downstream of the normal usage lime application point. The lime is fed to the stream via a pneumatic Salina Vortex knife gate (FCV-LP-1724), a Schenck AccuRate Feeder (XE-LP-1730) hopper/helix, a screw feeder, and a jet slurry mixer. The knife gate is bolted to the base of Silo No. 1 and is controlled by a signal from the feeder hopper load cell: open on minimum weight and close on maximum weight, or close on timer. Absolute minimum weight shuts the feeder down, resulting in interlocked system shutdown. In normal operation, the lime feed system operates in AUTO (Gravimetric) mode. In Gravimetric mode, the lime feeder will automatically provide lime from the silo/hopper to the helix, which meters the appropriate lime dosage based on the operational lime setpoint and influent flow. Lime is discharged at a metered rate from the feeder helix to the screw conveyor (SF-LP-1700), which transfers dry lime to the jet slurry mixer (MX-LP-2). In AUTO (Gravimetric) mode, lime transfer tasks such as knife gate cycling are controlled through the feeder control setpoints. Blower operation is controlled through PLC programming. The programming ensures the blower is operating when the knife gate is open and stops when the knife gate is shut. The silo is equipped with a vibrator and aeration system to aid in dispensing the lime and preventing compaction or "caking" of the lime within the silo. Once the lime has been fed into the jet slurry mixer, it is delivered as a solution to the stream through a flood stage lime slurry pipe.

7. The effluent stream is manually sampled for pH. This sample point is the basis to determine compliance with the target pH of 9.3.

8. The lime storage silos are filled by truck. As a new truckload of lime arrives, it will normally be loaded into Silo No. 1. As required from usage or by manual selection, lime will be transferred from Silo No. 1 to Silo No. 2 via blowers. The screw feeder (SF-LP-1700) in Silo No. 1 is placed in reverse, which transfers lime via a rotary vane feeder (RVF-LP-1410) to

the transfer line and eventually to Silo No. 2. The Salina Vortex pneumatic diverter valve (FCV-LP-1413) must be placed in the "Silo No. 2" position on the HMI. The lime silos are both equipped with load cells, used to monitor the silo weight, and high-level probes for controlling both the truck fill operations and the lime transfer operations.

9. Lime can also be transferred back into a truck from Silo No. 1 using the transfer system described above and placing the Salina Vortex pneumatic diverter valve (FCV-LP-1413) in the "truck loading" position on the HMI.

10. The silos are aerated with air slides using plant blowers. The silos are aerated based on time and usage rates.

11. The silos each contain dust collection systems and use two plant compressors and air reservoir tanks in cleaning the dust filters. This is accomplished using a pulse jet arrangement atop the silos.

12. The system contains an industrial PLC to control all automatic operations within the plant. The PLC performs all control functions and displays system status and alarms at the plant mimic panel. The PLC, an operator interface software package, and the HMI provide the operator with all pertinent system information. The system provides a graphical depiction of the plant with all live data, status, and alarms as well as allows the operator to enter system operational data such as process or alarm setpoints. It also provides, as programmed, logs of all plant alarms, required process data and history, and inventory analysis. There is also an automatic telephone dialer. The dialer, in conjunction with the PLC, can contact personnel off-site and/or after hours based upon the level of response required for each plant alarm.

5.3.2 Description of Control Settings

This section lists the electrical and control requirements to operate the equipment associated with the lime treatment process. The information provided is not intended to identify the reasons for various modes of operation, but merely presents the necessary electrical/mechanical conditions required for the stated condition to occur. Information for each item is separated into the following categories:

- Conditions required for the equipment item to start manually.
- Conditions required for the equipment item to start automatically.
- Conditions under which the equipment item will stop operation.
- Settings for normal mode of control.

Where appropriate, the list includes additional information pertinent to understanding the control mode or necessary auxiliary piping/valving conditions. Section 11.0 - Emergency Procedures contains supplemental information regarding the use of standby/redundant equipment, the emergency power system, and alarm conditions/ responses. Section 2.0 provides additional understanding/descriptions of the process function of the control system(s) and the conditions under which alternative modes of control should be employed.

1. Influent Sample Pump (P-SS1-1)

a. The pump will start manually when all the following conditions are satisfied:
   1) MCC control switch in **HAND** position.
   2) Motor thermal overload is reset.
   3) Local motor disconnect switch closed.

b. The pump will start automatically when all the following conditions are satisfied:
   1) MCC control switch in **AUTO** position.
   2) Motor thermal overload is reset.
   3) Motor run/stop enable at HMI set to **RUN** or the HMI status switch in **FAILURE** position.
   4) Local motor disconnect switch closed.

c. The pump will stop when any of the following conditions are satisfied:
   1) MCC control switch in **OFF** position.
   2) Motor thermal overload.
   3) Control switch in **AUTO** position and motor run/stop enable at HMI set to **STOP** and HMI status switch in **ENABLE** position.
   4) Local motor disconnect switch opened.

d. The normal mode of control for the pump is automatic and requires the following setup conditions:
   1) MCC control switch in **AUTO** position.
   2) Motor run/stop enable at operator interface set to **RUN** or the HMI status switch in **FAILURE** position.

2. Air Compressors AC-LP-1001 and AC-LP-1002

a. The compressors(s) will start manually when all the following conditions are satisfied:
   1) MCC control switch in **HAND** position.
   2) Motor thermal overload reset.
   3) Local motor disconnect switch closed.

b. The compressor(s) will start automatically when all the following conditions are satisfied:
   1) MCC control switch in **AUTO** position.
   2) Low pressure in respective air reservoir tank present.
   3) Motor thermal overload reset.
   4) Motor run/stop enable at operator interface set to **RUN** or the operator interface status switch in **FAILURE** position.
   5) Local motor disconnect switch closed.

c. The compressor(s) will stop when any of the following conditions are satisfied:
   1) MCC control switch in **OFF** position.
   2) Low pressure in respective air reservoir tank no longer present.
   3) Motor thermal overload.
   4) Control switch in **AUTO** position and motor run/stop enable at operator interface set to **STOP** and operator interface status switch in **ENABLE** position.
   5) Local motor disconnect switch opened.
   6) Either ESS-LP-1014 or ESS-LP-1015 is activated.

d. The normal mode of control for the compressors is automatic and requires the following setup conditions:
   1) MCC control switch in **AUTO** position.
   2) Motor run/stop enable at operator interface set to **RUN** or the operator interface status switch in **FAILURE** position.

3. Silo No. 2 Aeration Blowers B-LP-2 and B-LP-3

a. The blower(s) will start manually when all the following conditions are satisfied:
   1) Mimic panel Control switch in **HAND** position.
   2) Motor thermal overload is reset.
   3) Local motor disconnect switch closed.

b. The blower(s) will start automatically when all the following conditions are satisfied:
   1) Mimic panel Control switch in **AUTO** position.
   2) Timed "on" duty cycle active and time has not expired.
   3) Disable Auto function not active.
   4) Motor thermal overload is reset.
   5) Motor run/stop enable at operator interface set to **RUN** or the operator interface status switch in **FAILURE** position.
   6) Local motor disconnect switch closed.

Note: *There are two sets of duty cycles: one for when the silo is operating and one for when the silo is idle and not actively dispensing lime. Both the on and off times for both duty cycles are operator adjustable at the interface computer. There is also an alternation schedule to automatically alternate runtime between the two blowers and the schedule is operator adjustable as well. If for any reason either of the blowers is unable to run or has failed while running, the remaining blower will be requested to start, if available. For times when the silo may be idle for a long period of time or when it might not be desirable to aerate the silos, there is an Auto Disable function, which when initiated by the operator prohibits the aeration to occur until the expiration of the operator-adjustable time setpoint.*

c. The blower(s) will stop when any of the following conditions are satisfied:
   1) Mimic panel Control switch in **OFF** position.

2) Timed "on" duty cycle active and time has expired.
3) Disable Auto function activated.
4) Motor thermal overload.
5) Control switch in **AUTO** position and motor run/stop enable at operator interface set to **STOP** and operator interface status switch in **ENABLE** position.
6) Local motor disconnect switch opened.
7) ESS-LP-1015 is activated.

d. The normal mode of control for the blowers is automatic and requires the following setup conditions:
   1) Mimic panel control switch in **AUTO** position.
   2) Motor run/stop enable at operator interface set to **RUN** or the operator interface status switch in **FAILURE** position.
   3) Duty cycle time setpoints entered and not zero.
   4) Disable Auto function not enabled.

4. Silo No. 1 Aeration Blower B-LP-1 or B-LP-4

a. The blower(s) will start manually when all the following conditions are satisfied:
   1) Mimic panel Control switch in **HAND** position.
   2) Motor thermal overload reset.
   3) Local motor disconnect switch closed.

b. The blower(s) will start automatically when all the following conditions are satisfied:
   1) Mimic panel Control switch in **AUTO** position.
   2) Blower selected as the Silo No. 1 aeration blower either remotely at the interface computer or locally at the mimic panel interface monitor.
   3) Timed "on" duty cycle active and time has not expired.
   4) Disable Auto function not active.
   5) Motor thermal overload reset.
   6) Motor run/stop enable at operator interface set to **RUN** or the operator interface status switch in **FAILURE** position.
   7) Local motor disconnect switch closed.

Note: *There are two sets of duty cycles: one for when the silo is operating and one for when the silo is idle and not actively dispensing lime. Both the on and off times for both duty cycles are operator adjustable at the interface computer. For times when the silo may be idle for a long period of time or when it might not be desirable to aerate the silos, there is an Auto Disable function, which when initiated by the operator prohibits the aeration to occur until the expiration of the operator-adjustable time setpoint. AB-1 has been designed as the primary blower for Silo No. 1 aeration. If, however, AB-1 is out of service or it is desirable to use AB-4 as the aeration blower, the operator can select which blower performs the aeration functions at the HMI or at* *the mimic panel interface monitor.* ***Aside from the system software setup, the operator must physically provide the correct valve paths for the blowers.***

c. The blower(s) will stop when any of the following conditions are satisfied:
   1) Mimic panel Control switch in **OFF** position.
   2) Timed "on" duty cycle active and time has expired.
   3) Disable Auto function activated.
   4) Motor thermal overload.
   5) Control switch in **AUTO** position and motor run/stop enable at operator interface set to **STOP** and operator interface status switch in **ENABLE** position.
   6) Local motor disconnect switch opened.
   7) ESS-LP-1014 is activated.

d. The normal mode of control for the blowers is automatic and requires the following setup conditions:
   1) Mimic panel control switch in **AUTO** position.
   2) Motor run/stop enable at operator interface set to **RUN** or the operator interface status switch in **FAILURE** position.
   3) Duty cycle time setpoints entered and not zero.
   4) Disable Auto function not enabled.
   5) Blower selected as the Silo No. 1 aeration blower either remotely at the interface computer or locally at the mimic panel interface monitor.

5. Lime Transfer Blower B-LP-4 or B-LP-1

a. The blower(s) will start manually when all the following conditions are satisfied:
   1) Mimic panel Control switch in **HAND** position.
   2) High weight setpoint not exceeded in Silo No. 2 and low weight setpoint not exceeded in Silo No. 1 **or** manual weight override at HMI set to **OVERRIDE** and the operator interface status switch in **ENABLE** position.
   3) Motor thermal overload reset.
   4) Local motor disconnect switch closed.

Note: *The hand or manual operation of the blower is a hard-wired function and may operate if the PLC is not running. The silo weight interlock mentioned above is accomplished by using a normally closed contact wired in series with the hand circuit of the motor starter. The PLC controls the action of this contact and if the requirements are met will open the contact thus disabling manual operation of the blower. If for any reason the PLC is not running, the blower can still be operated but without the weight interlock.*

b. The blower(s) will start semi-automatically when all the following conditions are satisfied:
   1) Mimic panel Control switch in **AUTO** position.

2) Transfer control selected as **BATCH**, valid batch weight entered and initiated at the HMI by the operator.
3) Blower selected as the lime transfer blower either remotely at the HMI computer or locally at the mimic panel.
4) High weight setpoint not exceeded in Silo No. 2.
5) Low weight setpoint not exceeded in Silo No. 1.
6) Truck fill operations are not in progress.
7) Motor thermal overload reset.
8) Motor run/stop enable at operator interface set to **RUN** or the operator interface status switch in **FAILURE** position.
9) Local motor disconnect switch closed.

Note: *The batch weight setpoint is adjustable and is located at the HMI as is the "pushbutton" for initiating the start of a batch transfer. B-LP-4 is designed to be the primary blower for lime transfer. If, however, B-LP-4 is out of service or it is desirable to use B-LP-1 as the lime transfer blower, the operator can select which blower performs the lime transfer functions at the HMI or at the mimic panel.* ***Aside from the system software setup, the operator must also physically provide the correct valve paths for the blowers.***

c. The blower(s) will start automatically when all the following conditions are satisfied:
   1) Mimic panel Control switch in **AUTO** position.
   2) Transfer control selected as **AUTOMATIC** and valid high and low weight setpoints (Silo 2) have been entered at the HMI by the operator.
   3) Blower selected as the lime transfer blower either remotely at the HMI computer or locally at the mimic panel.
   4) Low weight setpoint exceeded in Silo No. 2.
   5) Low weight setpoint not exceeded in Silo No. 1.
   6) Truck fill operations are not in progress.
   7) Motor thermal overload reset.
   8) Motor run/stop enable at operator interface set to **RUN** or the operator interface status switch in **FAILURE** position.
   9) Local motor disconnect switch closed.

Note: *The low and high weight setpoints are adjustable and are located at the operator HMI computer. B-LP-4 is designed to be the primary blower for lime transfer. If, however, AB-4 is out of service or it is desirable to use B-LP-1 as the lime transfer blower, the operator can select which blower performs the lime transfer functions at the operator HMI computer or at the mimic panel.* ***Aside from the system software setup, the operator must also physically provide the correct valve paths for the blowers.***

d. The blower(s) will stop when any of the following conditions are satisfied:
   1) Mimic panel Control switch in **OFF** position.

2) Transfer under **AUTOMATIC** control and either the high weight setpoint in Silo No. 2 has been exceeded or the low weight setpoint in Silo No. 1 has been exceeded.
3) Transfer under **BATCH** control and either the batch weight has been met, the high weight setpoint in Silo No. 2 has been exceeded, or the low weight setpoint in Silo No. 1 has been exceeded.
4) Transfer under **MANUAL** control and the high weight setpoint has been exceeded in Silo No. 2 and the low weight setpoint has been exceeded in Silo No. 1. Both of these conditions require the manual weight override at HMI to be set to **DISABLED** and the operator interface status switch in **ENABLE** position.
5) Loss of air flow sensed in the transfer line.
6) Truck fill operations activated.
7) Sustained high differential pressure across the dust filter(s).
8) Motor thermal overload.
9) Control switch in **AUTO** position and motor run/stop enable at operator HMI set to **STOP** and operator interface status switch in **ENABLE** position.
10) Local motor disconnect switch opened.
11) Malfunction of an interlocked piece of equipment also involved in the lime transfer operation. These interlocked pieces of equipment include RVF-LP-1410, SF-LP-1700, and XE-LP-1730.
12) ESS-LP-1014 is activated.

Note: *Under normal operation, once the transfer completes a cycle all the associated pieces of equipment involved in that transfer perform an orderly shutdown sequence. Under abnormal shutdown or failure of any piece of associated equipment, all other equipment involved in that transfer will shut down immediately. The operator will be notified by an alarm in the event of an abnormal shutdown.*

e. The normal mode of control for the blowers is automatic and requires the following setup conditions:
   1) Mimic panel control switch in **AUTO** position.
   2) Transfer control selected as **AUTOMATIC** and valid high and low weight setpoints have been entered at the HMI.
   3) Blower selected as the lime transfer blower either remotely at the interface computer or locally at the mimic panel interface monitor.
   4) Motor run/stop enable at operator interface set to **RUN** or the operator interface status switch in **FAILURE** position.

6. Normal Usage Well Pumps P-LP-1 and P-LP-2

a. The pump(s) will start manually when all the following conditions are satisfied:
   1) MCC control switch in **HAND** position.
   2) Motor thermal overload reset.
   3) Local motor disconnect switch closed.

b. The pump(s) will start automatically when all the following conditions are satisfied:
   1) MCC control switch in **AUTO** position.
   2) Mimic panel well pump selector switch in desired pump position (**WELL 1** or **WELL 2**) **or** mimic panel selector switch in **AUTO** position and alternation timer is enabled for the respective pump.
   3) Silo No. 2 lime solution tank level not high.
   4) Silo No. 2 is in use and is selected for lime feed.
   5) Motor thermal overload reset.
   6) Motor run/stop enable at operator interface set to **RUN** or the operator interface status switch in **FAILURE** position.
   7) Local motor disconnect switch closed.

Note: *When the mimic panel well pump selector switch is in the AUTO position, the system will alternate pump usage based on an operator-adjustable time setpoint at the HMI. If the selected pump fails to run (based on overload or a low flow condition), the system will automatically attempt to start the remaining pump. If the mimic panel selector switch is in the WELL 1 or WELL 2 position, the system will run the selected pump without regard for the alternation timing and will not request the remaining pump if the selected pump fails.*

c. The pump(s) will stop when any of the following conditions are satisfied:
   1) MCC control switch in **OFF** position.
   2) Well pump discharge flow is low.
   3) Mimic panel selector switch position is changed (if deselecting the pump).
   4) Silo No. 2 solution tank level is high, cycles and time delay(s) expire.
   5) Silo No. 2 stops operation and associated time delay expires.
   6) Motor thermal overload.
   7) Control switch in **AUTO** position and motor run/stop enable at operator interface set to **STOP** and operator interface status switch in **ENABLE** position.
   8) Local motor disconnect switch opened.
   9) ESS-LP-1015 is activated.

d. The normal mode of control for the pump is automatic and requires the following setup conditions:
   1) MCC control switch in **AUTO** position.
   2) Mimic panel well pump selector switch in **AUTO** position.
   3) Motor run/stop enable at operator interface set to **RUN** or the operator interface status switch in **FAILURE** position.

7. Flood Stage Well Pump P-LP-3

a. The pump will start manually when all the following conditions are satisfied:

1) MCC control switch in **HAND** position.
2) Motor thermal overload reset.
3) Local motor disconnect switch closed.

b. The pump will start automatically when all the following conditions are satisfied:
   1) MCC control switch in **AUTO** position.
   2) Silo No. 1 is in use and is selected for lime feed **or** Silo No. 1 is not in operation and the exercise cycle is enabled, and the time schedule is active and has not expired.
   3) Motor thermal overload reset.
   4) Motor run/stop enable at operator interface set to **RUN** or the operator interface status switch in **FAILURE** position.
   5) Local motor disconnect switch closed.

Note: *The exercise cycle allows for the pump to be cycled during times when Silo No. 1 is not in active operation for long periods of time. This provides a means to keep the line clean and operational. The exercise function consists of an on time (in minutes) and an off time (in days) both adjustable at the HMI.*

c. The pump will stop when any of the following conditions are satisfied:
   1) MCC control switch in **OFF** position.
   2) Well pump discharge flow is low.
   3) Silo No. 1 stops operation.
   4) Silo No. 1 has been idle and the exercise cycle has been running the pump and the time expires.
   5) Motor thermal overload.
   6) Control switch in **AUTO** position and motor run/stop enable at operator interface set to **STOP** and operator interface status switch in **ENABLE** position.
   7) Local motor disconnect switch opened.
   6) ESS-LP-1014 is activated.

d. The normal mode of control for the pump is automatic and requires the following setup conditions:
   1) MCC control switch in **AUTO** position.
   2) Motor run/stop enable at operator interface set to **RUN** or the operator interface status switch in **FAILURE** position.

8. Silo No. 1 Schenck AccuRate Feeder XE-LP-1730

a. The feeder will start manually when all the following conditions are satisfied:
   1) OP-1 local control switch in **HAND** position.
   2) Interlocked/associated equipment in correct state (running or stopped, dependent on piece of equipment).

3) The DC drive is not faulted.
4) The feeder motor is not in a thermal overload.
5) Local motor disconnect switch is closed.

Note: *Under manual control, the feed rate is controlled locally at the feeder by the speed adjustment knob on the OP-1 panel.*

b. The feeder will run automatically when all the following conditions are satisfied:
   1) OP-1 local control switch in **AUTO** position.
   2) Interlocked/associated equipment in correct state (running or stopped, dependent on piece of equipment).
   3) The DC drive is not faulted.
   4) The feeder motor is not in a thermal overload.
   5) Motor run/stop enable at HMI set to **ENABLE**.
   6) Local motor disconnect switch is closed.

Note: *Feed rate is automatically controlled by the dosage setpoint that is input by the operator at the HMI.*

c. The feeder will stop when any of the following conditions are satisfied:
   1) OP-1 local control switch in **OFF** position.
   2) System is performing lime transfer and a permissive is lost, such as Silo No. 1 low weight or Silo No. 2 high weight, etc.
   3) System is actively dispensing lime to the stream and the request from the system is dropped.
   4) System is actively dispensing lime to the stream and the system switches control from Silo No. 1 to Silo No. 2.
   5) Interlocked/associated equipment in incorrect state (running or stopped, dependent on piece of equipment).
   6) The DC drive is faulted.
   7) The feeder motor is in a thermal overload.
   8) OP-1 local control switch in **HAND** position and local speed set is **ZERO**.
   9) Mimic panel control switch in **AUTO** position and local control switch in **REMOTE** position and control output from the control loop is **ZERO**.
   10) Control switch in **AUTO** position and motor run/stop enable at operator interface set to **STOP** and operator interface status switch in **ENABLE** position.
   11) Local motor disconnect switch is opened.
   12) ESS-LP-1014 is activated.

d. The normal mode of control for the feeder is automatic and requires the following setup conditions:
   1) OP-1 panel local control switch in **AUTO** position.

2) Motor run/stop enable at operator interface set to **ENABLE**.

9. Silo No. 2 Schenck AccuRate Feeder XE-LP-1830

a. The feeder will start manually when all the following conditions are satisfied:
   1) OP-1 local control switch in **HAND** position.
   2) Interlocked/associated equipment in correct state (running or stopped, dependent on piece of equipment).
   3) The DC drive is not faulted.
   4) The feeder motor is not in a thermal overload.
   5) Local motor disconnect switch is closed.

Note: *Under manual control, the feed rate is controlled remotely from the control system at a fixed rate or locally at the feeder by the speed adjustment on the variable speed drive.*

b. The feeder will run automatically when all the following conditions are satisfied:
   1) OP-1 local control switch in **AUTO** position.
   2) Interlocked/associated equipment in correct state (running or stopped, dependent on piece of equipment).
   3) The DC drive is not faulted.
   4) The feeder motor is not in a thermal overload.
   5) Motor run/stop enable at HMI set to **ENABLE**.
   6) Local motor disconnect switch is closed.

Note: *Feed rate is automatically controlled by the control system. The rate is the direct result of the selected control mode under which the system is operating. All aspects of the control mode, from tuning to setpoints, etc., can be adjusted at the HMI.*

c. The feeder will stop when any of the following conditions are satisfied:
   1) OP-1 local control switch in **OFF** position.
   2) System is actively dispensing lime to the stream and the request from the system is dropped.
   3) System is actively dispensing lime to the stream and the system switches control from Silo No. 1 to Silo No. 2.
   4) Interlocked/associated equipment in incorrect state (running or stopped, dependent on piece of equipment).
   5) The DC drive is faulted.
   6) The feeder motor is in a thermal overload.
   7) OP-1 local control switch in **HAND** position and local speed set is **ZERO**.
   8) Mimic panel control switch in **AUTO** position and local control switch in **REMOTE** position and control output from the control loop is **ZERO**.
   9) Control switch in **AUTO** position and motor run/stop enable at operator interface set to **STOP** and operator interface status switch in **ENABLE** position.

10) Local motor disconnect switch is opened.
11) ESS-LP-1015 is activated.

d. The normal mode of control for the feeder is automatic and requires the following setup conditions:
   1) OP-1 panel local control switch in **AUTO** position.
   2) Motor run/stop enable at operator interface set to **ENABLE**.

10. Silo No. 1 Rotary Vane Feeder RVF-LP-1410

a. The feeder will start manually when all the following conditions are satisfied:
   1) Mimic panel control switch in **HAND** position and local control switch in **REMOTE** **or** local control switch in **HAND** position.
   2) Interlocked/associated equipment in correct state (running or stopped, dependent on piece of equipment).
   3) The jam/over torque limit switch is not actuated.
   4) Motor thermal overload reset.
   5) Local motor disconnect switch is closed.

b. The feeder will run automatically when all the following conditions are satisfied:
   1) Mimic panel control switch in **AUTO** position and local control switch in **REMOTE** position.
   2) System is requesting lime transfer and all permissives have been made.
   3) Interlocked/associated equipment in correct state (running or stopped, dependent on piece of equipment).
   4) The jam/over torque limit switch is not actuated.
   5) Motor thermal overload reset.
   6) Motor run/stop enable at operator interface set to **RUN** or the operator interface status switch in **FAILURE** position.
   7) Local motor disconnect switch is closed.

c. The feeder will stop when any of the following conditions are satisfied:
   1) Mimic panel control switch in **OFF** position or local control switch in **OFF** position.
   2) System is auto and is transferring lime from Silo No. 1 to Silo No. 2 and the transfer has either been completed or aborted.
   3) Interlocked/associated equipment in incorrect state (running or stopped, dependent on piece of equipment).
   4) The jam/over torque limit switch is actuated.
   5) Motor thermal overload.
   6) Control switch in **AUTO** position and motor run/stop enable at operator interface set to **STOP** and operator interface status switch in **ENABLE** position.
   7) Local motor disconnect switch is opened.

6) ESS-LP-1014 is activated.

d. The normal mode of control for the feeder is automatic and requires the following setup conditions:
   1) Mimic panel control switch in **AUTO** position.
   2) Local control switch in **REMOTE** position.
   3) Motor run/stop enable at operator interface set to **RUN** or the operator interface status switch in **FAILURE** position.

11. Silo No. 1 Screw Feeder SF-LP-1700

a. The feeder will start manually when all the following conditions are satisfied:
   1) Mimic panel control switch in **HAND** position and local control switch in **REMOTE** **or** local control switch in **HAND** position.
   2) Interlocked/associated equipment in correct state (running or stopped, dependent on piece of equipment).
   3) The case door is not open.
   4) Motor thermal overload reset.
   5) Local motor disconnect switch is closed.

Note: *The HAND position of the control switch will enable the motor starter to run, but it is the responsibility of the operator to place the directional jog switch in the correct position for operation, either FORWARD or REVERSE.*

b. The feeder will run automatically when all the following conditions are satisfied:
   1) Mimic panel control switch in **AUTO** position and local control switch in **REMOTE** position.
   2) System is requesting either lime transfer or lime discharge to the stream and all permissives have been made.
   3) Interlocked/associated equipment in correct state (running or stopped, dependent on piece of equipment).
   4) The case door is not open.
   5) Motor thermal overload reset.
   6) Motor run/stop enable at operator interface set to **RUN** or the operator interface status switch in **FAILURE** position.
   7) Local motor disconnect switch is closed.

Note: *The system will control the direction of the feeder when under automatic control. The feeder will operate one direction for application of lime to the stream and the opposite direction for lime transfer.*

c. The feeder will stop when any of the following conditions are satisfied:
   1) Mimic panel control switch in **OFF** position or local control switch in **OFF** position.

2) System is auto and is transferring lime from Silo No. 1 to Silo No. 2 and the transfer has either been completed or aborted **or** system is applying lime to the stream and the demand request has been dropped.
3) Interlocked/associated equipment in incorrect state (running or stopped, dependent on piece of equipment).
4) The case door is opened.
5) Zero speed has been detected.
6) Motor thermal overload.
7) Control switch in **AUTO** position and motor run/stop enable at operator interface set to **STOP** and operator interface status switch in **ENABLE** position.
8) Local motor disconnect switch is opened.
9) ESS-LP-1014 is activated.

d. The normal mode of control for the feeder is automatic and requires the following setup conditions:
1) Mimic panel control switch in **AUTO** position.
2) Local control switch in **REMOTE** position.
3) Motor run/stop enable at operator interface set to **RUN** or the operator interface status switch in **FAILURE** position.

12. Silo No. 1 Vibrator

a. The lime silo vibrator will run when all the following conditions are satisfied:
1) Vibrator switch is turned on.
2) Vibrator speed control is adjusted.

b. The lime silo vibrator will stop when any of the following conditions are satisfied:
1) Vibrator switch is off.
2) Vibrator on time speed control is set at "0."

13. Silo No. 2 Vibrator

a. The lime silo vibrator will run when all the following conditions are satisfied:
1) Vibrator switch is turned on.
2) Vibrator speed control is adjusted.

b. The lime silo vibrator will stop when any of the following conditions are satisfied:
1) Vibrator switch is off.
2) Vibrator on time speed control is set at "0."

5.3.3 Lime Transfer Control Sequence

Operation of the pneumatic lime transfer facilities between Silo No. 1 and either Silo No. 2 or a truck involves coordination of various electrical and mechanical components. The following text describes the sequence of events involved in this operation.

a. Normal operation of an automatic lime transfer sequence requires that all the associated pieces of equipment required for a transfer be set up for automatic operation (refer to each equipment breakdown for this setup). The following pieces of equipment are used during an automatic transfer cycle: B-LP-4 (or B-LP-1 if setup), XE-LP-1730, SF-LP-1700, RVF-LP-1410, and FCV-LP-1413.

b. Before starting the transfer, two mechanical setups are required.

   1) The valve path must be set correctly depending on the blower to be used whether it be B-LP-4 or B-LP-1. There is a flow switch in the transfer line to detect air flow; if the valve path is not properly set, there will not be a valid air path and will consequently prohibit a transfer.
   2) The diverter valve (FCP-LP-1413) must be in the correct position depending on whether transfer is to Silo No. 2 or to a truck. The diverter valve is controlled through the HMI.

c. Determine transfer type: MANUAL, BATCH, or AUTOMATIC. If manual transfer is desired, then the control of each piece of equipment is the responsibility of the operator. If batch or automatic is desired, the system will control the sequence of equipment.

d. The following is the automatic sequence for either a batch or an automatic transfer:

   Note: This is all performed automatically using the HMI for Auto, Batch, and Manual. The operator does not need to manually turn equipment on or off.

   <u>Starting Sequence</u>
   Start Blower B-LP-4 (or B-LP-1)
   Verify status of blower, if running continue
   Confirm sufficient air flow at flow switch for a time delay
   If air flow sufficient, continue
   Start Rotary Vane Feeder RVF-LP-1410
   Verify status of feeder, if running continue
   Start Screw Feeder SF-LP-1700 (in correct direction)
   Verify status of feeder as well as not zero speed, if running continue
   Start Feeder XE-LP-1730
   Verify status of feeder, if running continue
   Continue until transfer is complete or a malfunction occurs

Stopping Sequence

Stop Feeder XE-LP-1730, verify status
Wait for time delay
Stop Screw Feeder SF-LP-1700, verify status
Wait for time delay
Stop Rotary Vane Feeder RVF-LP-1410, verify status
Wait for time delay
Stop Blower B-LP-4 (or B-LP-1)

The time delays allow for "purging" of each section of the system so as not to allow buildup or caking within the piping.

5.3.4 Control and Monitoring Device Summary

1. **Control Building**
   a. Operator HMI
      1) Graphic screens
      2) Motor run/stop enables
      3) Time delay settings
      4) Process setpoints and tuning
      5) Alarm summary
      6) System trends
      7) System historical logging

2. **Blower Building-MCC Room Main Control Panel**
   a. Hand-off-auto control switch with red (running), red flashing (motor or fault), and green (stopped) indicating light for each pump, blower, and feeder with the exception of the well pumps P-LP-1, P-LP-2, and P-LP-3, the sample pumps P-SS1-1 and 2, and the air compressors AC-LP-1 and AC-LP-2, which have control switches mounted elsewhere.
   b. Red indicating lights for each silo high level limit switch.
   c. Enable-failure network communication selection switch.

3. **Silo No. 1 Local Control Panel(s)**
   a. OP-1 control panel for feeder.
   b. Forward-Reverse jog switch for SF-LP-1700.
   c. Hand-Off-Auto control for RVF-LP-1410.

4. **Silo No. 2 Local Control Panel(s)**
   a. OP-1 control panel for feeder.

5. **Special Operating Procedures and Notes**
   a. Motor Run Fault Alarm Reset
   If a motor run fault occurs, the motor in alarm will be indicated by a blinking red light on the graphic panel and it will also be indicated on both the HMI as well as the panel

interface terminal. After inspecting the motor and the starter and correcting the problem, turn the motor control switch to the **OFF** position and back into the **AUTO** position. The motor is reset and ready to run. This fault is typically caused by an overload trip or by the motor starter breaker being turned off. The cause for the fault needs to be corrected before the motor will run.

5.3.5 System Glossary

HAND: Hand or Manual position of either a Hand-Off-Auto or Hand-Off-Remote control or selector switch. When in this position, the device is under manual control.

OFF: Off position of a control or selector switch. When in this position, the device is turned off.

AUTO: Auto position of either a Hand-Off-Auto control or selector switch. When in this position, the device is under automatic control by the control system.

REMOTE: Remote position of a local Hand-Off-Remote control or selector switch. When in this position, the remote switch determines actual control actions. If remote switch is in Auto position, the control system will control the device under automatic control. If remote switch is in Hand position, then the device is under manual control.

OPERATOR INTERFACE: This is a personal computer running an industrial control software package which acts as an HMI. It allows the operator to view the process, status, and alarms of the entire system. It allows graphic depiction of the system. It also provides access to all required setpoints and operator adjustable values as well as manual override and motor run/stop selections.

OPERATOR INTERFACE STATUS: This is a switch that allows the operator to disable all functions coming from the operator interface system or to disable the need for permissives that are required from the operator interface system. This could be required during times when the personal computer is out of service or is required for another purpose. The switch has two positions: ENABLE and FAILURE. When in the Enable position, the system operates as normal. When in the Failure position, the system bypasses the need for permissives from the operator interface system.

5.4 Pumpback Facilities

5.4.1 System Overview

The following description outlines the normal operational mode at the Pumpback Facilities.

1. Water enters the Groundwater Interception Trench and flows by gravity down the trench bottom to the sump located at the east end of the trench.

2. Water leaves the sump through an intake structure with a manually cleaned trash rack (where coarse debris is removed) and flows through a conduit to the traveling screen building.

3. Flow passes through the traveling screen where small debris, which could cause plugging of pumps, is removed. The traveling screen is cleaned automatically by a backwash spray system that includes a submersible pump located in the discharge sump of the building and a spray bar in the screen enclosure. The screen drive mechanism is interlocked to operate in conjunction with the backwash pump after sufficient pressure is generated to satisfy a pressure switch located on the pump discharge piping. The cleaning cycle is based on either a differential head loss as measured by level sensors on each side of the screen or on an adjustable time interval, whichever comes first. Screened debris is deposited on a grating and/or caught in a secondary screen for manual removal and disposal.

4. A control panel is in the traveling screen building for automatic control of the screen drive and backwash pump. The level transmitter for the trench sump water level is also located in the building.

5. Flow from the traveling screen building passes through a conduit to a buried manifold at the Pump Station. The manifold connects separately to each of four vertical casings each containing a vertical turbine pump. The pump, when operating, lowers the water level within the casing sufficiently to induce flow from the trench sump, through the traveling screen, through the manifold, and to the pump inlet.

6. Each pump discharges its flow through an above grade discharge head, past an air release/vacuum valve, through a check valve (electronic pump control valves for Pumps 1, 2, and 3; swing check valve for Pump 4), and to a common header, which exits the building in an effluent pipe where the flow is measured and pumped uphill to a ditch that discharges into Pond 2. Flow is recorded into the database.

7. The Pump Station includes a separate control room with MCC, control panel with a PLC, and separate pump director panels for each electric check valve.

8. Pump 4 runs continuously through a VFD to maintain a setpoint level in the sump. Water level is transmitted by signals from an ultrasonic level transducer located on the upstream side of the traveling screen.

9. Pumps 1, 2, and 3 will be on stand-by status. If water level exceeds the high level setpoint, the secondary pump will initiate pumping until the water level in the GWIT sump is below an established level. Should the water level increase, existing control logic will be activated to initiate additional pumping capacity using existing setpoints. Multiple pumps will be activated as necessary to accommodate rising water levels, and will drop offline as water levels are reduced

10. Pump startup includes starting the pump against a closed valve, until air is evacuated from the column. After the pump generates sufficient pressure, the electric check valve begins to open slowly. Normal pump shutdown involves gradual closing of the electric check valve

prior to shutting off the motor. These operations are controlled by the respective pump director panels using a pressure switch and solenoid valves located at the electric check valve.

5.4.2 Description of Control Settings

This section lists the electrical and control requirements to operate the vertical turbine pumps located in the Pump Station. The information lists the necessary electrical/mechanical conditions required for the stated condition to occur. Information for each item is separated into the following categories:

1. Conditions required for the pump motor to start manually.
2. Conditions required for the pump motor to start automatically.
3. Conditions under which the pump motor will stop operating.
4. Settings for normal mode of control.

A pump will start manually when all the following conditions are satisfied:

1. The MCC motor circuit breaker is in the "closed" position and 480-volt power is present.
2. The motor thermal overload is properly reset.
3. The Hand-Off-Auto selector switch located on the Pump Director Panel is placed in the "Hand" position.

A pump will start automatically when all the following conditions are met:

1. The MCC motor circuit breaker is in the closed position and 480-volt power is present.
2. The motor thermal overload is properly reset.
3. The Hand-Off-Auto selector switch located on the Pump Director panel is placed in the "Auto" position.
4. There is 120-volt power to the Pump Director Panel and to the PLC.
5. The level in the Groundwater Interception Trench reaches the start level setpoint for the pump position assigned the pump.

A pump will stop when any of the following conditions are satisfied:

1. The MCC motor circuit breaker is in the open or tripped position.
2. The Hand-Off-Auto selector switch on the Pump Director Panel is placed in the Off position.
3. The thermal overload relay has tripped.
4. The pump was not able to satisfy an operating pressure for the pump control valve.
5. The pump control valve failed to open properly.
6. Loss of control power to the PLC or to the Pump Director Panel.
7. The water level in the Groundwater Interception Trench reaches the stop level setpoint for the pump position assigned the pump.

8. A loss of the Groundwater Interception Trench level signal.

The normal mode of control for the pump is automatic and requires the following setup conditions:

1. The Hand-Off-Auto selector switch on the Pump Director panel placed in the Auto position.
2. The pump motor assigned to a pumping position with a programmed stop and start level setpoint.

5.5 SolarBees

Reference the SolarBee SB 10000 Owner's Manual (SolarBee, 2009) for more information regarding unit operation.

If additional units are to be added, they will be installed by the system operator or other qualified contractor. Installation will be in accordance with a risk-assessed, approved work plan or the contractor's Standard Operating Procedures. General guidelines are provided here.

Guidelines: Minimally, two qualified technicians will install the units using the guidelines below.

1. Assemble the units completely (on dry land) prior to placing them in the water
2. Turn the control box to the off position.
3. Adjust the floats to the lowest setting possible by extending the three turnbuckles to their full extension. The induction plate and hose should be as tight against the bottom of the machine as possible.
4. Lift the unit into the water using a jib-hoist or lifting device capable of lifting the weight. Use a three-point rigging system and connect to the rigging points of the unit. If a boat ramp is available, SolarBee units can be hauled and deployed using a pickup and trailer.
5. Once in the water the unit can either be pushed or pulled to the desired located using a boat. The recommendation is to use a 12-foot Jon boat because of the straight bow and low draft in the water. The boat will also require a motor that meets the specifications of the boat.
6. A buoy is installed at each SolarBee location anchored by two concrete mooring blocks with a stainless steel chain. Each mooring block weighs approximately 70 pounds and is made of concrete with a HDPE cover. Once the unit is pushed to the correct location, detach the chain connected to the buoy and connect to the SolarBee unit. Lower the induction plate/intake hose to the desired level by lowering the stainless steel chains from the chain bracket. Each chain has indicators at every foot mark. Use a weighted tape measure to find the depth of the water at each location.
7. Set the distribution dish level by adjusting the turnbuckles on each pontoon.
   a. Locate the notch on each chain bracket of the unit and lower the pontoons until the desired water level setting is reached.

b. Next turn the unit on, using the main power switch on the side of the control box.
c. Check the water level notch and ensure the unit is still at the appropriate level.

Operators must check the operation of the units daily, as explained in Table 5-1, and conduct physical inspections of the units at a minimum of twice a year (in the spring and fall). The **inspections** include the following:

- Check and clean the impeller and distribution dish. *Before cleaning the impeller or distribution dish, always make sure the unit is off.*
  - Open the solar panel gate for easier access.
  - Adjust the turnbuckles to raise the machine level.
  - Use a squeegee to clean any aquatic buildup or weeds that may be wrapped around the impeller.
  - Remove the aquatic weeds from the distribution dish and place them in a garbage bag and remove them from the ponds to prevent them from going through the unit again.
  - If the buildup is also in the intake hose, remove the impeller by pulling the clevis pin located below the gear box. Grab the impeller shaft below the flag indicator, lift up and then outward until the lower coupling and shaft are disconnected from the upper coupling and motor. Once the buildup is removed, re-install the impeller in reverse order.
- Check the condition of the intake hose (because of the varying pond levels). Use a weighted tape measure to locate the depth of the pond and check the level indicators on the chains of the induction plate to ensure the intake hose is at the desired level
- Check the condition of the solar panels.
- Clean the solar panels: use a squeegee, glass cleaner, and paper towels or wash cloth. Simply rinse the panel with water, use the squeegee or towel to clean the panel, spray with glass cleaner to clean, and rinse the panel.
- Check the angle adjustment of the solar panels. It is best to keep them at a 45 degree position during the spring/summer/fall months and in the fall before winter, adjust them to a 55 degree angle to prevent snow buildup. Operators can adjust the panels using two, half inch SAE wrenches.

Occasionally the SolarBee units require other minimal maintenance to ensure each unit is operating at the best efficiency. During the warmer months of summer algae blooms occur in the ponds. Algae growth can occur within the impeller and distribution dish causing the unit to not function correctly. If the unit cannot turn the impeller it will automatically perform an anti-jam sequence where the motor will run in reverse to try and remove the blockage. The motor will then alternate between reverse and forward until it can spin freely in forward or the sequence is performed a set number of times after which it will turn off. Operators must then clean the unit.

5.5.1 Solar Mixing Unit Repairs

Occasionally, the units must be repaired, most often after the ice melts off the ponds. The ice and wave action can damage the intake tube and onboard electronics. To replace the intake hose the unit must be removed from the water. Removing the unit from the water is the reverse of installing the unit (instructions detailed under **Guidelines** in the previous section). Summary instructions to remove the unit from the water are below; refer to the **Guidelines** section in the previous section.

1. Retract the intake hose and inductor plate to the unit.
2. Adjust the turnbuckles **clockwise** to raise the unit up in the water.
3. Attach a buoy to the chain for the mooring blocks or pull the two mooring blocks out of the water.
4. Using the straight bowed boat and motor, push or pull the unit back to shore.
5. Once on shore, use the three rigging points on top of the unit to connect the unit to the jib-hoist or lifting device capable of lifting the weight.
6. Pull the unit out of the water and place it on a flat and stable surface.
7. Repair the unit and put it back into position in the water (refer to **Guidelines** in the previous section).

5.6 Revisions to Standard Operating Procedures (SOPs)

Each operating system contains specific procedures to accommodate various operation conditions. Procedures are specific to the particular operating system. Operations personnel are required to complete Standard Operating Procedures (SOP) training and demonstrate competency prior to performing procedures. All operations personnel must complete this training annually.

All system SOPs will be reviewed annually and updated as necessary. The SOPs will be revised by the system Lead Operator, or designated alternate, as necessary. Changes to any of the following will trigger a change to the affected SOP:

- Program operation or system components;
- Updates of manufacturer's recommended practices for the system or equipment;
- Change in regulatory or compliance requirements;
- Deviations from operating boundaries, physical damage, or loss or containment;
- Changes in operating conditions;
- Physical alterations to equipment;
- New knowledge and experience of deterioration mechanisms, or parameters that could affect the equipment integrity or reliability; or
- Alterations or modification of the system or system equipment.

Revised SOPs must be reviewed and authorized by Health, Safety, Security and Environment (HSSE) personnel for any changes to relevant Task Safety and Environmental Assessments/Work Risk Assessments (TSEA/WRA). Final revised documents must then be approved by the Project Manager and communicated to all affected personnel through the Lead Operator. Training protocol must be followed to ensure all affected parties are informed and up to date of the changes and training is conducted to ensure competency.

A list of SOPs developed by Pioneer Technical Services, Inc., is provided in Appendix B. The list is current as of the writing of this O&M manual and may be revised.

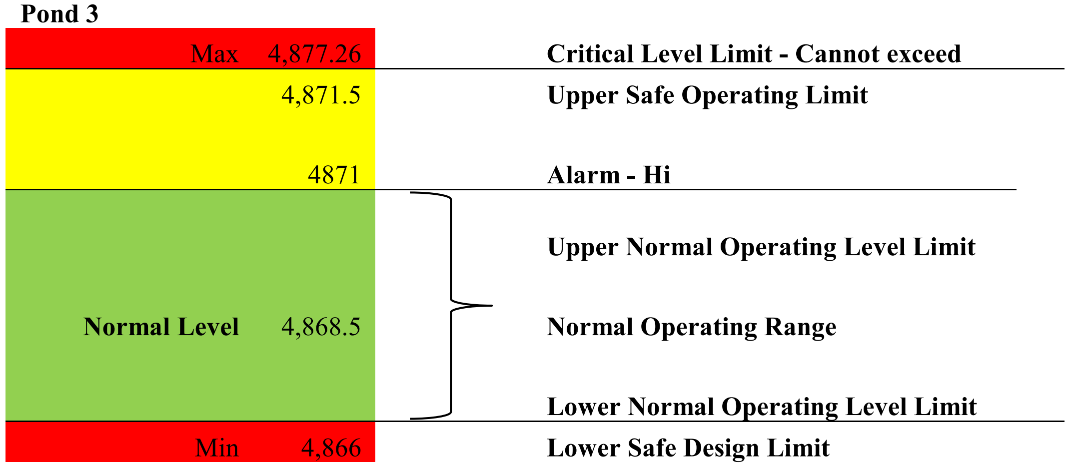
6.0 SAFE OPERATING LIMITS

The following provides maximum allowable limits of process conditions to prevent damage to process equipment, personnel, and subsequent release to the environment. Operating limits for individual process equipment are also available in Appendix M.

6.1 System Operating Level Limits

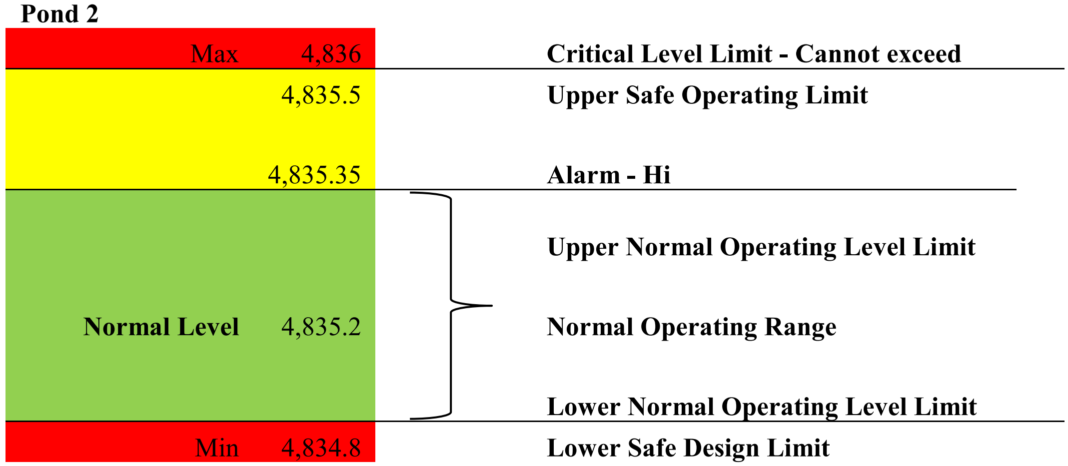
The water levels that make up the safe design envelope for the system are provided below.

Pond 3



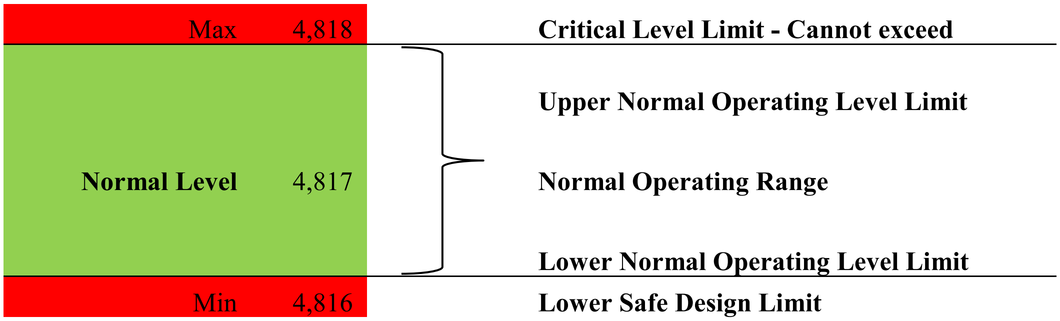
Pond 3 Emergency Spillway Elevation = 4,876.6

Pond 2

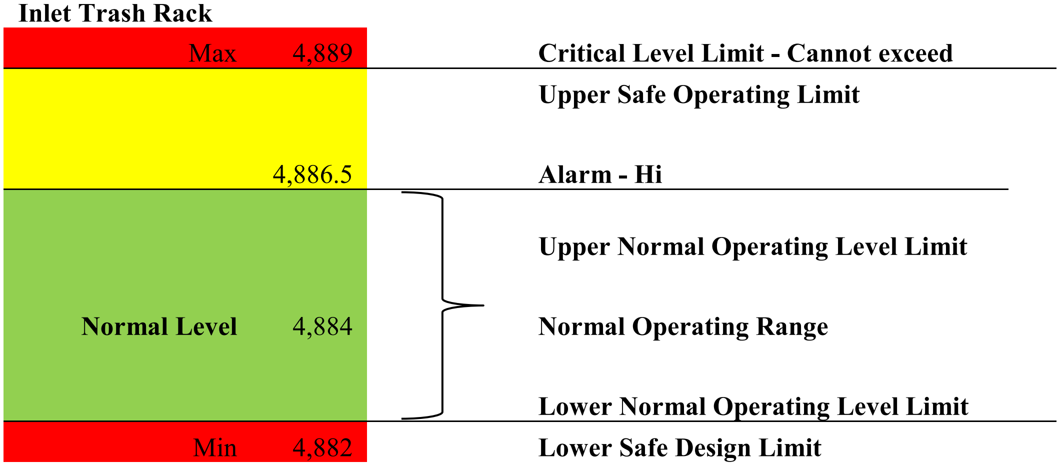


Pond 2 Emergency Spillway Elevation = 4,836.5

Pond 1



Inlet Trash Rack



Fuse plug pilot channel elevation = 4,893.4

6.2 Pressure

Compressed Air System

Normal discharge pressure for the compressed air system is 100 pounds per square inch gauge (psig). System operating pressure will not exceed 200 psig. Low pressure will not be less than atmospheric. Pressure components are not rated to maintain vacuum or pressure less than atmospheric.

Blower System

Maximum discharge pressure for the blower system is about 7 pounds per square inch and is dictated by the pressure relief valves (PRV-LP-1102, PRV-LP-1202, PRV-LP-1302, and PRV-LP-1402) directly downstream of the blowers. Setpoints can be adjusted by adding and subtracting metal plates to the top of the pressure relief valve. Low pressure will not be less than atmospheric. Pressure components are not rated to maintain vacuum or pressure less than atmospheric.

Pumpback System
Maximum discharge pressure for the Pumpback System is dictated by the pressure/vacuum breakers (PVB-PB-4104, PVB-PB-4204, PVB-PB-4304, and PVB-PB-4404) directly downstream of the pumps. Relief valves are also placed at intervals along the pumpback effluent line. Low pressure will not be less than atmospheric. Pressure components are not rated to maintain vacuum or pressure less than atmospheric.

6.3 Temperature

6.3.1 Groundwater

Temperature of the groundwater is typically within the range of 42-47 degrees F. However, open cell structures are subject to freezing when fluid is allowed to remain stationary in low ambient temperature conditions.

6.3.2 Normal Usage and Flood Stage Wells

Temperature within the wells is consistent with groundwater temperature.

6.3.3 Ambient

Ambient temperatures range from -40 to 110 degrees F.

6.4 Electrical

The Warm Springs site is fed off an overhead distribution circuit operating at 12,500 volts. A three-phase bank of pole-mounted transformers rated at 300 kVA provide the plant with an electric service operating at the 480\277 voltage level. The main breaker is rated for 300 amps at 480 volts, three-phase. Operation of the main breaker will interrupt normal utility power to the plant.

7.0 OPERATIONS DURING UPSETS

This section addresses operational responses to potential upset conditions resulting in water quality excursions that could develop during operation of the WSP treatment system. All potential upset conditions will be immediately reported to Atlantic Richfield's Authorized Project Representative and that official will notify EPA and DEQ as specified in the notification tree.

A primary purpose of the Shakedown Plan was to identify upset conditions and, where possible, appropriate response actions. Potential conditions that were investigated during this effort include the following:

- High (or low) pH and/or elevated arsenic concentrations related to seasonal, biologically induced effects;
- Flood related impacts on water quality;
- Seasonal turnover/re-suspension of Pond bottom sediments;
- Interaction of algae and metals carryover; and
- Upstream impacts on influent water quality.

The above conditions are primarily of concern relative to Ponds 2 and 3, the active treatment components of the WSP system. However, they are also potentially significant relative to the Pond 1 and lower wet closures, particularly the effects of pH and flow-through rate on metals stability and return to and removal within Pond 2.

Based on the list above, response actions were incorporated into this section as experience was gained during the Shakedown Period. The section includes alternative responses and mitigation measures, approaches to identify the cause of problems, and sources for additional information and assistance.

7.1 High pH and/or Arsenic Related to Seasonally, Biologically Induced Effects

Increased biological activity during the spring, summer, and fall months typically results in pH in Pond 2 increasing above 9.5, even when lime is not being added to the system. Also, elevated arsenic can also result from the natural biologic activity in the ponds. These effects have been clearly demonstrated over the past years. Atlantic Richfield and the agencies have agreed to continue to perform additional studies to better understand the natural processes that can cause elevated pH and arsenic and to evaluate if there are any changes in operations that can mitigate these processes without negatively impacting the ponds' ability to continue to consistently meet discharge criteria for other constituents.

7.2 Flood Related Impacts on Water Quality

Increased flows and turbidity entering the WSP system have significant impacts on water quality. The system operations matrices presented in Section 5.0 specify measures to be taken during these events. Overall, more time is required on-site to assure that system flows are routed properly and that all equipment is functioning correctly. Specific items to monitor include the following:

- **Inlet Facility Trash Rack.** Increased flows into the system typically result in increased debris accumulation on the inlet facility trash rack. This debris is removed by an excavator. Operations personnel need to coordinate with approved earthwork contractors to have equipment on-site at all times and qualified equipment operators on standby during times of high flow. The water level is monitored upstream of the trash rack via an ultrasonic level probe. Operations personnel can monitor this water elevation by checking the HMI computer or by calling into the SCADA system. Operations personnel need to monitor this water level at increased frequency (both day and night) during periods of high flow. In the event that the water elevation meets or exceeds a pre-programmed high level, the SCADA system will automatically call operations personnel at pre-programmed telephone numbers until the alarm is acknowledged.
- **Lime Dosage Rate.** During periods of highly turbid inflows (typically greater than 25 NTU), the lime dosage rate is increased to meet a target pH of 8.0 to 8.3, with a maximum dosage rate of 25 mg/L. This increased lime dosage rate assists in removing fine suspended sediments in Pond 3 by acting as a flocculent.
- **Pond 3 Water Level.** During periods of highly turbid flow, the water elevation in Pond 3 is typically raised in order to increase the detention time. As shown in Table 4-1, the water surface elevation and the elevation of the Bypass Spillway gates should always be maintained within the acceptable limits to allow for proper flood routing.
- **East Hills Run-Off.** Can increase the turbidity.

7.3 Seasonal Turnover or Re-Suspension of Pond Bottom Sediments

Seasonal turnover or any other event that results in re-suspension of pond bottom sediments (e.g., sustained high winds, ice scour events, etc.) is typically noted by increased turbidity over a relatively short time period. Effects to pH, dissolved oxygen, and other physical parameters may also be noted.

During these times, the Pond 3 water surface should be raised temporarily. This temporary increase in water elevation results in increased detention time within the Ponds to help settle out the suspended material. As shown in Table 4-1, the water surface elevation and the elevation of the Bypass Spillway gates should always be maintained within the acceptable limits to allow for proper flood routing. Increase in lime addition has very little effect unless the incoming stream is also experiencing increased turbidity.

7.4 Interaction of Algae/Metals Carryover

History has shown that interactions with algae resulting in metals carryover has not been an issue.

7.5 Upstream Impacts on Water Quality

Upstream impacts on water quality can result from many things, including ongoing stream restoration or overbank and out-of-channel flow from flood events. Typically, these events result in high turbidity water entering the WSP system. Typical responses to high-turbidity influent (i.e., increasing lime dosage rate and increasing the stage of Pond 3) have proven to be effective in these situations.

8.0 ROUTINE MONITORING AND LABORATORY TESTING

The purpose of this section is to define the routine monitoring activities required of the site operator with respect to system control and compliance reporting. Monitoring sites and facilities were described in Section 2.6. The focus in this section is to define the specific scope of monitoring, its purpose, objectives, and the tasks necessary to accomplish the monitoring function and apply the results.

Monitoring procedures required for embankment, water conveyance, and hydraulic structures facilities including monitoring related to dam safety, piezometers, dry closure areas, and inspection and maintenance of hydraulic facilities are summarized in Section 8.9. Inspection and Maintenance Procedures (IMPs) 1 through 9 in Appendix C detail specific guidelines for each component.

Monitoring efforts related to the surface water treatment process control and compliance reporting include flow, levels, water characteristics (e.g., pH, temperature, dissolved oxygen, etc.), lime usage, and weather, which could be used in evaluating impacts on Ponds system performance. Sections 8.1 through 8.7 include information related to these functions. Monitoring related to groundwater quality and hydraulic gradient is discussed primarily in Section 8.8.

8.1 Scope of Responsibilities for Data Generation

Facilities, locations, and capabilities for project data generation were described in Section 2.6. This section further defines the specific data to be generated by those facilities and supplementary methods, and then assigns associated responsibilities to appropriate personnel. To facilitate this purpose, the discussion is initially organized in terms of the following information categories:

- Operator observations.
- Control system generated data.
- Automatic electronic measurement data.
- Non-automated (manual) water level, flow, and quality data.
- Groundwater data.

8.1.1 Operator Observation

Normal operation of the Ponds/treatment system involves a number of operator activities, some of which are routine, planned activities and others that are not. Many of the routine activities involve data forms or checklists that the operator completes as he or she proceeds through the work day. Where practical, these forms are provided in a computer database format so that the operator completes the forms directly on a computer. Implementation of the process required intensive effort during the Shakedown Period to structure individual datasheets and consolidate them into a useful computer summary of operations, which is now contained in the WSP Data Management System manual.

Many of the routine operator activities and most of the unplanned activities involve other observations that should be documented for future reference. Such observations can include the extent of pond ice cover, movement of the ice sheets, resuspension of organic sediment, algal and macrophyte (aquatic plant) density and range, and other biological, chemical, or physical activities within and influencing the Ponds/treatment system. This documentation provides a basis for report preparation and response to potential questions and/or refinement of operations. Operator observations are to be kept in an operator diary maintained in such a way that another person can understand each entry. The operator is responsible for generating and recording both types of observations on a daily basis.

8.1.2 Control System Generated Data

Data generated by the control system includes both a record of electronically sensed data as described in Section 2.6 and data regarding alarms and operator actions. For example, when the operator adjusts the pH setpoint or switches from one automatic control mode to another, the facility computer maintains a record of that occurrence that can be retrieved later. Automated records as well as hand-entered data are all contained within the WSP database, located in the Control Room. The database system was last updated in 2007.

8.1.3 Automatic Electronic Monitoring Data

Facilities described in Section 2.6 generate large amounts of data on water flow rates and pond levels. Those data are recorded on the treatment system server computer located in the Control Room. The predominant use of the data is for review and analysis of Ponds system effectiveness and to improve understanding of the factors that affect performance. The Shakedown Period of project operation included substantial efforts toward these results.

The accuracy of the electronic monitoring systems requires continuing attention. The operator must perform routine inspections to visually confirm proper operating conditions. Also, the sampling technician (who will be on-site twice per week and who is equipped to independently confirm water quality measurements) will perform confirmation tests as a routine quality control measure.

Electronic monitoring systems data are compared to field instrument (which are calibrated before each use) data. If there is a difference greater than 10% the electronic monitoring system will be adjusted. This is logged on the daily checklist and on the twice weekly sample sheets. Calibrations of the electronic monitoring systems will be checked using standards as well when the comparison from the field instruments varies more often.

8.1.4 Other Water Level, Flow, and Quality Data

Electronic monitoring facilities are available for collecting only a portion of the project's water data. Other data come from field water level or flow measurements and from composite and grab samples. The samples require both field and/or laboratory analyses. Subsequent receipt, use, and data management/storage are also necessary. Water levels, flow, and water quality data are particularly important because most regulatory performance requirements are stated in terms of these parameters.

Specific agency-required monitoring requirements are detailed in the UAOs (see Appendix E). Various supplementary data are developed, on a discretionary basis, by Atlantic Richfield. Table 8-1 and Table 8-2 provide a comprehensive overview of the various sites, sampling methods, and frequency of the water quality parameters analyzed. All tests, other than those obtained through continuous monitoring, require sample collection and analysis by a sampling/laboratory team. Sample analysis is performed by subcontractors. The operator is responsible for confirming the timely performance of the analysis and for coordinating sampling activities and receiving and reporting the resulting data.

Operators can develop supplemental water level and flow data as part of their daily/weekly routine (see Table 5-2 and Table 5-4 in Section 5.0 - Normal Operations). All operator routine activities are to include datasheets and a diary sufficient to provide a thorough record of the data items for which the operator is responsible.

8.1.5 Groundwater Data

Groundwater data include both water quality and groundwater level. Both sets of data are used for compliance monitoring to verify that contamination is not leaving the site during the time the Pumpback System is in use. Data are further used to establish the point in time when the Groundwater Interception Trench and Pumpback System can be terminated. The monitoring program to provide these data is described in Section 8.8.

Operator responsibilities include verifying that piezometers are read and that samples are taken and analyzed at specified frequencies. The piezometer manual provides additional specifics on piezometer monitoring. Reporting procedures for compliance data are identified in Section 9.0. The operator should further review data for abnormalities that could warrant verification of data and/or notification of Atlantic Richfield's Authorized Representative of potential noncompliance.

8.2 Routine Operator Checking and Calibration of On-Site Monitoring Systems

Monitoring instrumentation must be routinely checked to verify equipment accuracy and ensure proper calibration. Operators must pay attention to how instruments are functioning to provide accurate information on important Ponds operating parameters. The following paragraphs discuss various types of instrumentation, common problems associated with their operation, and attention required by the operator to ensure their proper functioning. Monitoring equipment also requires periodic, routine recalibration and maintenance as described in Section 10.0.

8.2.1 Inlet Area pH Meter

The continuously reading pH meter, located at the Pond 3 Inlet Structure (SS-1 monitoring station SS-1), measures pH upstream of the lime addition facility. The proper functioning of the pH meter at the Inlet Structure (SS-1 monitoring station) should be verified minimally twice a week as part of the routine sampling procedure. The verification must include independent measurement of sampling stream pH with a portable pH meter immediately after verification or calibration of the portable meter per manufacturer's instructions. If discrepancies between the monitoring system and verification pH exceed an acceptable amount, the operator must check the verification instrument and, if necessary, recalibrate the monitoring system pH meter according to manufacturer's instructions.

8.2.2 Inlet Flow Measurement

Stream flow is the key monitoring variable that can be used to control lime addition. Stream flow is measured at the Pond 3 Inlet Structure (SS-1). The instruments used as sensors for this measurement are relatively rugged pressure transducers that detect changes in water pressure due to the varying depth of water overlying them. These instruments are not particularly susceptible to either breakdown or drift. Accurate readings are also relatively easy to verify: read the water level using a staff gage or measuring tape, obtain the associated flow from the rating table, and compare it with the flow indicated by the instrument system readout. The operator should also check for strange circumstances, such as ice formation at the measurement weir (or other key locations), that might cause deviations of water level measurements from those that would accurately represent the stream flow. Conditions such as downstream ice jamming can cause flow to back up and flood the weir causing erroneous flow readings. A record of constant flow with minimal variation could indicate potential problems such as plugging of the sensing line that connects the stilling well at the gage house to the creek channel.

The operator must resolve any problems detected by taking corrective action or by recalibrating the sensor according to manufacturer's instructions, as appropriate.

8.2.3 Other Inlet Area Monitoring Equipment

Other inlet area monitoring equipment includes a turbidity sensor installed at Station SS-1, the composite sampler at SS-1, and the various equipment status sensors installed to facilitate the lime-feed system operation. The operator's morning status check will include specifically observing each of these monitoring facilities to visually confirm that their operation appears satisfactory. For example, the operator will compare current turbidity readouts with typical/expected values. If the readings are within an acceptable range no further action is required. Similarly, the operator will verify that the composite sampler is functional. The operator will record any irregularities observed, take immediate action to correct problems (including recalibration of instruments according to manufacturer's instructions), and note additional actions required on his or her maintenance punch list.

A Davis Vantage Pro2 weather station is located east of the Control Room Building. Data are sent wirelessly to the console located in the Control Room. The data are logged into the office computer. Operators can use the WeatherLink software on the office computer to view or graph the data.

8.2.4 Automatic Monitoring Equipment at Other Locations

Other monitoring equipment is provided on-site, primarily in the vicinities of the Pond 3 East Outlet Works and the Pond 2 Service Spillway. During his or her daily site inspection, the operator must specifically observe each monitoring facility and confirm its satisfactory operation. Such inspections will be conducted similar to those described previously for other inlet monitoring equipment. The pH monitoring equipment at Pond 2 and Pond 3 monitoring buildings should be routinely checked and calibrated as necessary. Data derived from those instruments are used in establishing the target pH for control at the inlet and in confirming compliance with the final pH objective of the system.

8.2.5 Groundwater Interception Trench Water Level

The controls for the Pumpback System operate the pumps based on trench water level. The operator must routinely compare actual trench water level with that being measured by the electronic transducer to quickly detect and repair any drift or breakdown of this key system.

8.3 Day-to-Day Review of Monitoring Data for Operations

The principal value of having accurate monitoring data comes from using the data. If acquired data are simply stored in a computer database or allowed to accumulate in a file until some official report is due, much of the potential value of the data is lost. Such circumstances are avoided by day-to-day operator review of key data items and operators using the data to help maintain an overview of what is happening. This allows early discovery or prevention of problems that could otherwise become much more significant. Such problems could involve a variety of situations ranging from operations issues and pond water quality excursions to drifting/breakdown of monitoring instruments and invalid/unreliable data.

The operator must observe water quality trends for key parameters and turbidity or color. If an operator notes a condition that suggests an impending excursion (or upset condition within Pond 3 or Pond 2), the operator must notify Atlantic Richfield's Authorized Representative and request quick turnaround on sample analysis and possibly accelerate the sampling frequency. These procedures help identify when additional measures are required or if violation notification is necessary.

There are five primary categories of monitoring data that require day-to-day operator attention (described below). In each case, the operator's overview and understanding will be enhanced by using time-based graphs of the data to recognize cycles and trends (or deviations).

8.3.1 Lime Feed and Inventory

The operator must maintain knowledge of the amount of lime used and on hand for two very important reasons:

- Lime inventory must be controlled to avoid shortages and keep the supply from becoming stale.

- Major deviations in lime usage must be detected to initiate troubleshooting activities either to explain why such usage is appropriate or to correct the problem.

Operators must decide when a lime order is needed and place the order. Lime is normally delivered 5 to 7 days after placement of orders. Deliveries are made in 24 to 30-ton trucks with pneumatic unloading capabilities.

Reordering lime: Operators must reorder lime from the lime provider before the lime weight reaches 6 Tons between Silo 1 and Silo 2. The lime weight for each silo appears on the HMI.

Storing the lime: When lime is delivered to the site, operators must make sure that the delivery personnel do not unload more than the required amount of lime to fill the silo. **Overfilling the silo will create operational difficulties.**

****Operators must re-order lime from the lime provider before lime weight reaches 6 Tons between Silo 1 and Silo 2.****

Lime order contact information:

Graymont Western US Inc.
“Indian Creek Plant”
Townsend, Montana 59644

Contact: Marla Yuhas
Phone: 406-317-2548

Alternate Contact: Troy Page
Phone: 801-716-2619

The load cells are used to track lime inventory while the batch weights on each feeder are used to track lime usage. Operators can automatically generate graphs of daily lime usage from the feeders using the trending software located on the HMI computer and from the WSP database. The operators should prepare these trends periodically and confirm no major deviations in lime usage are occurring. Two useful trends to prepare include the following:

- The graph(s) for the latest entire year (January-December) or a typical year.
- The graph for the year-to-date (with the current data displayed every day).

On the graphs, operators must examine the plot for recent trends, compare the results to past data, and identify apparent deviations that could indicate problems. Each load cell will typically be calibrated annually at the beginning of the lime addition season.

8.3.2 Ponds System Flow/Elevations

The operator must maintain a record/overview (tables and time-based graphs) of the amount of water entering, retained in, and leaving the Ponds system. The main reasons for this hydraulic overview are as follows:

- Increase metals removal efficiency: The effectiveness of metals removal is likely to vary with hydraulic flows and pond detention. The operator might be able to compensate for anticipated reductions in effectiveness by modifying system operation. For example, pond level can be adjusted to change the detention time.
- Anticipate events: It is beneficial to anticipate and plan whenever possible for precipitation events that will cause discharges directly from Pond 3 to the Mill-Willow Bypass (bypassing Pond 2).
- Gain insight for responses: Operators can gain insight into appropriate responses by reviewing system performance/response to similar prior conditions.

To track the Ponds system hydraulics, operators can generate the trends from the WSP database, similar to those described in Section 8.3.1.

8.3.3 Tracking pH

The pH of the water in the Ponds system is the primary determinant of whether metals in the water are being converted to precipitates and settling out. The purpose of lime addition is to raise the influent pH to the target range and to maintain it in that range throughout the Ponds system, thus facilitating as much precipitation and removal of metals as possible. The operator needs to be particularly attentive to pH; *the operator's primary water quality assignment is to see that pH is maintained in the target range.* The primary way to achieve this is to adjust the lime dosage and measure the resultant pH at Station SS-2, immediately below the lime feed facility.

To facilitate tracking of the Ponds system pH, operators can generate a pH trend from the WSP database. The approach to graph preparation and trend review is similar to that described previously for *Lime Feed and Inventory* in section 8.3.1.

8.3.4 Copper

Because the primary purpose of the Ponds system is to remove metals from Silver Bow Creek, it is important that the operator understands whether the system is accomplishing this task. As copper is one of the metals for which concern is most intensive, it is used as an initial indicator of pond treatment effectiveness. By maintaining up-to-date records/overview of copper concentrations, the operator can recognize decreases in treatment system effectiveness and search for and initiate corrective actions or initiate consultation with Atlantic Richfield's Authorized Representative and others, as appropriate.

To track the Ponds system copper concentrations, the operator can generate a trend showing copper concentrations throughout the Ponds system. The operator will review and update the trend immediately upon receipt of data reports from the laboratory.

8.3.5 Pumpback System Flow

Flow through the Pond 1 and lower wet closures, and ultimately through the Pumpback System to Pond 2, is monitored as part of the Inactive Area O&M. To assure correct performance of the Pumpback System, operators prepare and monitor a trend of the flow data from the system.

8.4 Review of Monitoring Data for Compliance with Performance Standards

The performance standards (see Section 3.0) with which the project must comply are stringent, complicated, and have associated requirements for rapid reporting of any noncompliance, generally within **24 hours** of project personnel becoming aware of the noncompliance. To appropriately respond to these requirements, the operator must review compliance monitoring data **as soon as practicable** upon receipt and detect any instances where specific standards are not met. Operators must check such occurrences (to determine if there is reason to suspect a data error) and, if appropriate, initiate (and fully complete) a noncompliance report through the Atlantic Richfield Authorized Representative within the allotted time period. Refer to Section 9.2 for requirements and procedures related to immediate reporting of noncompliance.

To facilitate timely review and response, the sampling and laboratory technicians must provide all compliance monitoring data in a computer readable format. Immediately upon receipt of the data, the operator will review the data to detect non-compliances. Although current monitoring data reviews require the operator to manually evaluate the data, a computer-based method to detect items that represent noncompliance is being evaluated (for future use).

8.5 Sampling Technician Routine Tasks

The sampling technician is primarily responsible for collecting representative water quality samples as required by the UAO. Automatic samplers are provided to assist with this task. While on-site, the sampling technician will perform various quality control tasks to verify operation of installed instrumentation:

- The automatic composite samplers will be programmed to automatically start and complete a 24-hour composite sample collection on a twice weekly schedule that anticipates a sampling technician visit shortly after completion of the compositing period.
- During each visit to collect composite samples, the sampling technician must use portable field measurement instruments to check the current readings of each electronic sensor. If the electronic measurement reading is within a specified deviation from the portable (checking) unit, then the continuous measurement data will be considered accurate. If an unacceptable deviation is found, the portable unit will be checked and recalibrated. If the deviation persists, the continuous measurement unit will be checked and recalibrated according to manufacturer's instructions. The permanently installed continuous monitoring unit will be used for reporting purposes unless it has to be removed from service for repairs.
- The composite samplers will be checked on each visit to confirm their proper functioning.
- The sampling technician will collect the composite samples according to a carefully specified routine designed to prevent contamination of the samples and to ensure that the collected sample or subsample is representative. The sample must be properly preserved and labeled

for subsequent transport to the laboratory. All aspects of sample collection will follow relevant EPA-approved procedures.

- The sampling technician will collect grab samples from an actively flowing portion of the water course. The monthly samples will be taken from a similar spot in the stream's flowing cross section.
- Water quality parameters that must be field analyzed will be analyzed using EPA-approved procedures.

8.6 Laboratory Analysis

The sample analysis technician will perform water quality analyses in conformance with the UAO and use EPA-approved methods for Total Recoverable metals analysis. Additional methods (i.e., dissolved) may be periodically specified at Atlantic Richfield's discretion. Other parameters will be analyzed according to standard methods approved by EPA as reflected in 40 Code of Federal Regulations (CFR) Part 136.

8.7 Quality Assurance/Quality Control

Water quality monitoring activities will be completed in accordance with Quality Assurance (QA) and Quality Control (QC) requirements applied to MPDES discharge permits and any supplemental requirements as specified by the UAO.

8.8 Groundwater Monitoring Program

8.8.1 Objective

The objective of the Inactive Area groundwater monitoring program is to verify compliance with the specified groundwater quality and controlled hydraulic gradient performance standards.

8.8.2 System Basis

The groundwater monitoring program is based on the performance standards including numeric limits, point and times of compliance, the hydraulic gradient standard, and well construction standards. All piezometers constructed for this groundwater monitoring program are in compliance with all applicable Montana DNRC rules for monitoring wells, and in accordance with the guidelines set forth in the Clark Fork River Superfund Site Investigations Standard Operations Procedure (SOP) GW-3 Monitoring Well Design and Construction and SOP GW-4 Well Development.

Piezometers
All piezometers were completed with a screened interval of 5 or 10 feet within the lower portion of the upper aquifer, which has an average total thickness of 15 feet. The bottom of the screened interval is at the bottom of the upper aquifer. The piezometers constructed on both sides of the interception trench have a nominal diameter of 4 inches and a screened interval length of 10 feet to demonstrate compliance with the hydraulic gradient performance standard, and to ensure

collection of representative samples to demonstrate compliance with the water quality performance standard.

The piezometers along the west side of Pond 1 and within Pond 1 have a 2-inch diameter and minimum screened interval of 5 feet. The piezometers are provided to demonstrate compliance with the hydraulic gradient performance standard. If the hydraulic gradient is found to be negative (flowing toward the stream), the easternmost piezometer must be sampled for water quality. Additional data related to installation, location, and data reduction are provided under separate cover in the WSP Piezometer Manual.

Staff Gages
All surface water staff gages are non-recording gages installed according to Clark Fork River Superfund Site Investigations SOP SW-8 Stream Gage Selection and Operation. The staff gage locations are selected to provide water level measurements that can be directly compared with piezometer water levels.

8.8.3 Station Locations

The design monitoring network includes the following stations as shown on Figure 8-1:

- 9 piezometers along the Groundwater Interception Trench (4 along the south side, 4 along the north side, and 1 at the east end);
- 4 staff gages along the bottom of the interception trench;
- 1 staff gage at the west end of the Pond 1 Toe Ditch;
- 1 staff gage along the relocated Mill-Willow Bypass channel; and
- 6 piezometers along the west side of Pond 1 (3 along the Pond 1 Dike and 3 within the pond approximately 400 feet east of the dike).

8.8.4 Water Quality Parameters

The following is a list of water quality parameters that are to be included in routine analysis of groundwater from the 9 piezometers located along the interception trench and Piezometer P-14. This list includes the specified parameters of concern and 5 additional general water quality parameters.

General Water Quality	Required Parameters
pH*	Arsenic (dissolved)
Electrical Conductivity (EC)*	Cadmium (dissolved)
Temperature*	Chromium (dissolved)
Total Dissolved Solids	Lead (dissolved)
Copper	Mercury (dissolved)
Zinc	Nitrate-Nitrogen
Sulfate	

*Field measurements

8.8.5 Measurement and Sampling Frequency

Water Level Measurements
Water level monitoring for all stations is to continue as long as the Groundwater Interception Trench and Pumpback System operate. The frequency of water level measurement for all stations is as follows:

- Monthly for a period of up to 24 months after installation (through February 1997).
- Semiannually after initial 24-month period.

Water Quality Sampling and Monitoring
Groundwater quality compliance monitoring immediately north of the interception trench is to continue throughout operation of the trench/Pumpback System. Sampling and analysis south and east of the interception trench is also to be implemented during trench/Pumpback System operation. Compliance monitoring and additional sampling and analysis is to continue until consistent compliance with groundwater quality standards immediately south of the interception trench is demonstrated for a 24-month period.

Upon approved termination of pumping, groundwater quality compliance monitoring is to commence immediately south of the interception trench as part of Inactive Area Phase II O&M.

The frequency of compliance and additional water quality sampling from the interception trench piezometer network is semi-annual.

8.8.6 Piezometer Sampling

Piezometers are constructed according to applicable rules under Title 36, Chapter 36, ARM, Subchapter 8, Monitoring Well Construction Standards and Clark Fork River Investigations Standard Operating Procedures. Piezometers sampling must follow the current version of the following Clark Fork River Investigations SOPs (provided in a separate volume [CFR SSI AR92]) as needed:

SOP No.	Procedure
GW-1	Groundwater Sampling for Inorganics
GW-5	Measurement of Water elevation, Floating Product Thickness, and Determination of Well Casing Volume
G-4	Field Logbook/Photographs
G-5	Sample Packaging and Shipping
G-6	Field Quality Control Samples
G-7	Sample Custody
G-8	Decontamination of Equipment Used to Sample Soil and Water
G-11	Identification of Samples and Analytical Results
G-12	Data Security and Data Transfer
HG-3	Sample Container Preparation for Aqueous Samples
HG-4	Preservation and Handling of Aqueous Samples

8.8.7 Staff Gages

Non-recording staff gages are installed in the relocated Mill-Willow Bypass channel, Groundwater Interception Trench, and Pond 1 Toe Ditch.

8.8.8 Field Measurement and Laboratory Analysis Methods

Field Measurements

Water Level Measurement
The water level in all piezometers must be measured according to the procedures detailed in SOP GW-5, Measurement of Water Elevation, Floating Product Thickness, and Determination of Well Casing Volume.

Field Analysis Methods
Properly calibrated field measurements must be used to measure groundwater sample pH, conductivity, and temperature at the time of sample collection. The field analysis methods for these parameters must follow the methods listed in the following SOPs or approved equivalent (provided in a separate volume):

SOP No.	Procedure
G-8	Decontamination of Equipment Used to Sample Soil and Water
HG-6	Field Measurement of Water Temperature
HG-7	Measurement of Conductivity and Temperature
HG-8	Measurement of pH, Eh, and Dissolved Oxygen

Laboratory Analysis

Laboratory analysis of groundwater samples must follow analytical methods approved under 40 CFR Part 136.

8.9 Earthwork Inspection and Maintenance Procedures

Inspection and maintenance procedures for earthwork facilities are listed in Appendix C. Procedures 1 through 10 (IMP-1 through IMP-10) are summarized below:

- **IMP-1 Embankment Monitoring.** Monitoring, inspection, and maintenance procedures for all embankments except dry closure areas (covered under IMP-3). This IMP includes guidelines for dam safety inspections and also covers inspection procedures for emergency spillways and soil-cement toe drains as they pertain to dam safety.
- **IMP-2 Piezometer Monitoring.** Covers monitoring of earthwork piezometers as they pertain to embankment stability. Detailed data relating to the piezometers including installation data, locations, monitoring frequency, and data recording procedures are provided under separate cover in the WSP Piezometer Manual. Water level in each piezometer will be monitored as discussed in IMP-2. Readings above specified flag levels will be reported to Atlantic Richfield's Authorized Representative.
- **IMP-3 Dry Closure Monitoring.** Monitoring, inspection, and maintenance procedures for all dry closure facilities. This IMP addresses performance of the dry closure covers and contaminant containment performance issues.
- **IMP-4 Mill-Willow Bypass Monitoring.** Monitoring, inspection, and maintenance procedures for the Mill-Willow Bypass including restrictive vegetation growth management.
- **IMP-5 Monitoring Water Conveyance Channels.** Monitoring, inspection, and maintenance procedures for all earthen water conveyance channels except the Mill-Willow Bypass (covered under IMP-4) including vegetation growth management, erosion, trash and debris removal, ice build-up, riprap performance, and other issues effecting the earthen channels operation.
- **IMP-6 Hydraulic Structures Monitoring.** Monitoring, inspection, and maintenance procedures for all hydraulic structures, except Ponds 2 and 3 Emergency Spillways (covered under IMP-1). This IMP covers various procedures to detect potential maintenance items on hydraulic structures and special procedures for cold-weather operations.
- **IMP-7 Deformation Monitoring.** Monitoring and reporting procedures for embankment deformation survey monuments on the WSP Dams.

- **IMP-8 Silver Bow Creek/Inlet Approach Channel Monitoring and Safety Awareness Plan.** Procedures for monitoring, inspection, and maintenance of the Silver Bow Creek channel upgradient of Pond 3.
- **IMP-9 Pond 2 Dike Deformation Monitoring.** Procedures for monitoring stability of the downstream face of Pond 2 embankment visually and by survey.
- **IMP-10 Noxious Weed Management.** Procedures for noxious weed management.

9.0 OPERATION REPORTING AND RECORDKEEPING

The information in this section is based on Inactive Area UAO Exhibit 4 and Section XV Reporting Requirements, and Active Area UAO Exhibit 4 and Exhibit 5, all provided in Appendix E. To comply with the required directives, all records and reports must be submitted and maintained as identified in the following subsections.

9.1 Monthly UAO Monitoring Report Requirements

This section covers the monthly reporting and submittal requirements associated with the Active Area UAO Discharge Monitoring Report (DMR). It identifies the procedures and requirements of the UAOs:

- 9.1.1, Reporting of Monitoring Results (Compliance Data). This section lists the correct forms and time frame for reporting compliance data and lists the appropriate agencies to receive the reports.
- 9.1.2, Additional Monitoring. This section addresses reporting and using monitoring data that are collected more frequently than required.
- 9.1.3, Monitoring Data Report Procedures. This section lists the basic information that must be included with monitoring data submittals.
- 9.1.4, Retention of Records. This subsection identifies the requirements for retaining all records related to the Remedial Action.

The procedures identified in the sections above are based on Exhibit 5 of the Active Area UAO (Appendix E). To simplify reporting and review, and because no specific requirements were identified in the UAO for monthly reporting of Inactive Area monitoring, the procedures specified in this section are being applied to monitoring efforts for the entire site.

9.1.1 Reporting of Monitoring Results (Compliance Data)

Compliance monitoring results (**Compliance Data**) obtained over the course of a month must be summarized and reported on an appropriate form before the 28th day of the following month.

Effluent monitoring data will be reported on a **Discharge Monitoring Report** (**DMR**) form; the data must come from the **Pond 2 (002) discharge.** In the event of a **Pond 3 (003) bypass** discharge, effluent monitoring data will also be collected and reported on a slightly different DMR.

The **DMR** consists of several pages of parameters that must be summarized and averaged from data that was gathered during the month. See Section 9.6 for more detail about the DMR preparation.

The compliance report mailing must be postmarked **no later than the 28th day** of the month following the completed collection period (month).

Water Quality monitoring data (compliance data as summarized on the DMR) must also be reported in the Clark Fork Data Management electronic format concurrent with submittal of the compliance report. Data are to be submitted on or about the first of each month as identified in the example submittal (Attachment 1) in the Attachments section.

Legible copies of the DMR must be signed by **Atlantic Richfield's Authorized Representative** and certified according to the Signatory Requirements in Exhibit 5 of the Active Area UAO (Appendix E). Reports are to be submitted to the Director, Montana EPA Office and the Director, State Water Quality Bureau at the following addresses:

Original to: United States Environmental Protection Agency
Region 8, Montana Office
Federal Building
10 West 15th Street, Suite 3200
Helena, MT 59620-0096
Attention: Allie Archer
Remedial Project Manager

Copies to: Montana Department of Environmental Quality
P.O. Box 200901
Helena, MT 59620-0901
Attention: Daryl Reed

United States Environmental Protection Agency
Region 8, Montana Office
Federal Building
10 West 15th Street, Suite 3200
Helena, MT 59620-0096
Attention: Mr. Henry Elsen, Esq.

Montana Department of Environmental Quality
P.O. Box 200901
Helena, MT 59620-0901
Attention: Jonathan Morgan

The **monthly report** to be submitted to EPA will include the following:

- Compliance data. Mandatory data collected for:

Effluent compliance:	**DMR** form
Ambient compliance:	Ambient Monitoring Report form
Monitoring well sampling:	Groundwater Monitoring Report form
Monitoring well levels:	Hydraulic Gradient Monitoring Report form

- Supplementary data

  Data collected for process control/evaluation including data generated at the inlet works, upgradient monitoring wells at the interception trench (during Phase I O&M), Inactive Area surface water quality monitoring, temporary sampling stations, and at the Environmental Data Collection Management System (EDCMS) stations.

- Daily Logs

  Data recorded daily on the **Daily Log** form concerning operational settings and variables influencing process/monitoring results.

- Mill-Willow Water Quality Data

  Data collected on Mill-Willow Bypass, used in the assessment of performance during Phase I O&M and in compliance monitoring during Phase II O&M.

Section 9.6 illustrates the approach to completing the DMR that was used during Tier I operation. Sections 9.7 through 9.10 describe the contents of the various submittal documents (e.g., Supplementary data, Daily Logs, and Mill-Willow Water Quality Data).

9.1.2 Additional Monitoring

Part II. D.E. of Exhibit 5 of the UAO requires that if Atlantic Richfield monitors any pollutant **more frequently** than is directed by the UAO (and further identified in Section 8.1.4) for those parameters listed in Exhibit 5 of the UAO using approved test procedures, the results of the increased monitoring must be reported on the DMR and included in the calculation of the **average**. The **time frame** for the increased frequency must also be reported. Subsequent discussions with EPA have resulted in the waiver of this requirement if data is collected for the purpose of system optimization or to further understand specific system mechanics.

9.1.3 Monitoring Data Report Procedures

All water quality compliance monitoring report information must include the following:

1. The date, exact place, and time of sampling or measurements;
2. The initials or name(s) of the individual(s) who performed the sampling or measurements;
3. The date(s) analyses were performed;
4. The time analyses were performed;

5. The initials or name(s) of individual(s) who performed the analyses;
6. References and written procedures, when available, for the analytical techniques or methods used; and
7. The results of such analyses, including the bench sheets, instrument readouts, computer disks or tapes, etc., used to determine the results.

9.1.4 Retention of Records

All records of monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by Exhibit 5 of the UAO (and other compliance data), and computer disks used to store information must be **retained** for a period of at least **10 years** from the **date** of the sample, measurement, or report. This period may be extended at EPA's request. Data collected on-site, copies of DMRs, and a copy of Exhibit 5 must be maintained on-site until Remedial Action is complete.

9.2 Immediate Reporting of Noncompliance

The site operator must immediately report any **noncompliance** to **Atlantic Richfield's Authorized Representative**. **Atlantic Richfield**'s Authorized Representative will report by **telephone** to the **EPA**, Region 8, Montana Office at **406-457-5035** and the **State of Montana** at **406-841-5041.** Atlantic Richfield's Authorized Representative may also report via **e-mail** to the **EPA** at archer.allie@epa.gov and the **State of Montana** at dreed@mt.gov.

9.2.1 Twenty-Four (24) Hour Notification

The site operator must immediately notify **Atlantic Richfield's Authorized Representative** for the following occurrences of noncompliance. Atlantic Richfield's Authorized Representative will report to EPA and the State **within** and **no later** than **24** hours, from the time the operator first became aware of the circumstances.

1. Any noncompliance that could seriously endanger **health** or the **environment**.
2. Any violation of a **maximum daily** discharge limitation for any of the pollutants listed in the performance standards in Section 3.0, (also refer to Exhibit 5 of the UAO).

9.2.2 Next Day Notification

The site operator must immediately notify **Atlantic Richfield's Authorized Representative** for the following occurrences of noncompliance. Atlantic Richfield's Authorized Representative will report to EPA and the State by the **first workday** (8:00 a.m. - 4:30 p.m. Mountain Time) following the day the operator first became aware of the circumstances.

1. Any **unanticipated bypass** that exceeds any effluent limitation in Section 3.0 Performance (Exhibit 5 of the UAO); or
2. Any **upset** that exceeds any effluent limitation in Section 3.0 (Exhibit 5 of the UAO).

9.3 Written Notification of Noncompliance

A **written** submission of the violations listed under 9.2.1 and 9.2.2 must also be provided within **five** days of the time that the operator becomes aware of the circumstances. The report will be generated with the operator's help, but the submission must come from the office of **Atlantic Richfield's Authorized Representative** and must contain the following:

1. A description of the noncompliance and its cause;
2. The period of noncompliance including exact dates and times;
3. The estimated time noncompliance is expected to continue if it has not been corrected; and
4. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

9.4 Other/Additional Noncompliance Reporting

Instances of noncompliance not required to be reported within 24 hours must be reported at the time that monitoring reports for Section 9.1.1 are submitted. The reports must identify any conditions listed in Section 9.2.2 and contain the information listed in Section 9.3

In the case of an **expected** or **anticipated bypass** through the **Pond 3 Bypass Spillway** the site operator must immediately notify Atlantic Richfield's Authorized Representative, who in turn will notify the EPA at their regional office.

9.5 Reporting with Respect to Scheduled Compliances

All compliance or noncompliance reports in regard to achieving interim and final requirements must be submitted no later than 14 days following the scheduled date.

9.6 Water Quality Monitoring Report

Attachment 2 contains sample DMR forms showing forms for Ponds 2 and 3 (002 and 003) with Tier I and II standards. The Pond 2 example is filled out to show a completed form, and the Pond 3 form is provided because it has a minor deviation in one of the parameter listings. The Attachment section also contains forms for future ambient reporting, Attachment 3, and groundwater quality compliance sampling, Attachment 4. The parameters that require monitoring on these forms are quite evident when viewing the form, making a detailed explanation of the entire form unnecessary. However, some explanation is appropriate for the various entries required and is provided as follows:

- The typed information in columns that are labeled **"Quality or Concentration"** reference the "Compliance Standards" associated with each parameter. Listed, where appropriate, are the **minimum**, **average**, and the **maximum**. In the case of **Silver** there is no standard, only the data collected are to be reported. Using Zinc as an example, the standard monthly average is 0.16, daily maximum 0.30, and the daily minimum is only reported, but has no limit. As explained in Section 3.0, the Tier I Monthly Average Standard for Cadmium and Zinc are to be adjusted for each sample with a measured hardness greater than 150 mg/L. The adjusted hardness-based standard should be calculated on a separate sheet (as shown in Table 3-1) and attached to the completed compliance form. If the adjusted standard increases the allowable standard, the adjusted standard should be shown on the form in lieu of the typed value. The adjusted standard to be entered for "average" is the numeric average of all monthly average standards calculated for individual samples collected during the month; whereas, the "maximum" standard is the Daily Maximum Standard calculated based on the measured hardness associated with the sample having the greatest concentration during the month. When Tier II and the Final Standards are in effect it will be necessary to list measured data alongside each calculated Maximum Daily Standard for parameters that require a hardness-based calculation. This comparison, which should be attached to the compliance form, will enable verification of compliance with Maximum Daily Standards that vary with hardness. Table 3-3 and Table 3-4 contain examples of this procedure.

- The column labeled **"No. Ex"** means **number of exceedances,** referring to the number of times the monitoring results exceeded the standard. The number in front of the slash (/) refers to the number of times the sample exceeded the limitation and the number after the slash refers to the total number of samples taken over the course of the monitoring period (monthly). Again, using Zinc as an example, the notation “0/9” means that the monitoring result did not exceed the limitation in any of 9 samples taken over the course of the month. The notation N/A means Not Applicable - no compliance criteria in effect. Where standards are to be adjusted for hardness, the number of exceedances for each parameter should be identified on the corresponding attached calculation sheet.
- The column labeled **"Frequency of Analysis"** indicates the number of times a sample is collected and analyzed. Notations such as "2/31" mean that a sample was analyzed twice out of 31 days (a month). The notation "2/7" indicates that a sample was collected and analyzed twice every 7 days or twice per week. A notation of “31/31” means a sample was collected and analyzed every day.
- **"Sample Type"** is the last column on the form and this refers to the type of sampling used for collection. There are three basic types: **composite, instantaneous,** and **grab**. For more specific detail see Section 8.0 on monitoring.

The slight difference in the Pond 3 (003) DMR Tier I Standards is in the "average" section of the Quality or Concentration column for iron, where the requirement is only to report the average. For the Pond 2 (002) DMR, the average is to be compared with the limitation of 1.5 mg/L.

9.7 Reporting of Hydraulic Gradient Monitoring Results

Groundwater monitoring results are to be summarized for each monitoring episode and submitted as part of the monthly compliance report. Following certification of completion of remedial action, monitoring information will be included only in the quarterly O&M reports, as required by paragraph 59 of the UAO. Groundwater monitoring report requirements identified in the UAO include the following:

- Date, location, and time of measurements.
- Name(s) of the individual(s) who performed the measurements.
- References and written procedures, when available, for the methods used.
- Results of water level measurements and analysis results.

This information must be provided on the Hydraulic Gradient Monitoring Report form (Attachment 5): raw data/field measurements on Page 2/3 under water depth and staff gage readings; an analysis and compliance evaluation on Page 1/3; and reference elevations for the piezometer and staff gauges on Page 3/3.

9.8 Daily Log

Also included in the Attachments section are example "filled-in" and blank Daily Log forms (Attachment 7). The example forms that are filled in with data document operational settings and variables that could affect process/monitoring results.

Copies of the log along with any **concerns** should be sent to **Atlantic Richfield's Authorized Representative** every month.

9.9 Supplementary Data

This is data that will be collected for process control and system evaluation. Data obtained for this purpose will come from the Pond 3 Inlet/treatment facilities, the environmental monitoring/sampling stations, Inactive Area monitoring stations (surface water quality sampling stations and upgradient monitoring wells at the interception trench), and temporary sampling stations throughout the site. Additional data might include inspection, operation, and maintenance records such as:

- Lime feed records (daily usage and concentration applied);
- Monthly system pH graphs (Inlet, Pond 3, Pond 2, and target after lime addition); and
- Monthly system copper concentration graph.

As discussed previously in Section 9.1.2, EPA has waived the requirement of submitting supplemental data that was collected for system optimization or to further understand specific system mechanics.

9.10 Mill-Willow Water Quality Data

During Phase I O&M, sampling from the three stations on the Mill-Willow Bypass (MWB-1; MWB-2; MWB-3) provided data to evaluate potential compliance with Ambient Standards during Phase II O&M. During Phase II O&M, MWB-3 data will be reported on a compliance form (see Sections 9.1 and 9.6), whereas, MWB-1 and/or MWB-2 data will be used to establish background quality and continue to be reported with appropriate values included on the compliance form.

The forms relevant to this part of the monitoring process are listed below and included in the Attachments section (Attachment 6 containing the Mill-Willow Water Quality Report Form and Attachment 7 containing the other forms). These forms or approved equivalent forms should be used in submitting data.

- **Water Sampling Field Data Form:** Used by the subcontractor to record samples as they are collected.
- **Chain of Custody:** This form is used to document those samples that are transferred to the custody of the laboratory subcontractor.

Mill-Willow Bypass Monitoring Summary Form: Used to report the laboratory analysis of samples collected along the Mill-Willow Bypass at stations MWB-1, MWB-2, and MWB-3.

9.11 Quarterly Operation and Maintenance Report

Quarterly Operation and Maintenance Reports are required in accordance with section XV of the UAOs, paragraph 58, Active Area, and paragraph 59, Inactive Area. The reports must be submitted on a quarterly basis to aid in the evaluation of the Pond system performance and progress in meeting performance standards. The submittal requirements as established in both UAOs are substantially the same. Requirements as documented in the Inactive Area UAO are as follows:

a. A description of O&M activities performed during the reporting period.
b. A description of the performance of each component of the remedial action requiring O&M, including a summary of any monitoring data demonstrating the performance of the remedy and its effectiveness in meeting performance standards.
c. A description and summary of the results of all monitoring performed in connection with the remedy.
d. A statistical evaluation of the monitoring data and a conclusion as to whether the results exceed performance standards, and whether the exceedances necessitate the implementation of contingency measures.
e. Identification of any problems or potential problems and a description of all steps taken or to be taken to rectify the problems.
f. An appendix containing all validated data and supporting documentation collected during the reporting period and not previously submitted.

Based on these requirements, the reports must include, at a minimum, the following information:

- A description of O&M activities performed during the reporting period.
- An evaluation of the performance for each component of the remedial action.

The evaluation will include a compliance evaluation of the following:

- Pond 2 discharge (002) for Daily Maximum and Monthly Average for appropriate discharge standards that are in effect (Final Standards, as of October 25, 1997).
- Groundwater Monitoring Wells for MCLs north of the interception trench (Phase I), and for potential Phase II operation MCL comparison south of the trench.
- Hydraulic gradients at the Groundwater Interception Trench and west Pond 1.
- A summary and evaluation of results for all monitoring station data collected in connection with the Pond system operation. This evaluation could include statistical and arithmetical analysis of trends for selected parameters routinely measured within the Pond system.
- A compilation of data for the Mill-Willow Bypass sampling (MWB-1, MWB-2, MWB-3).
- A presentation of toe-drain monitoring data if sampled and analyzed during the reporting period.
- Parameters to be summarized from the Pond 2 monitoring station will include Pond pH, dissolved oxygen, turbidity, specific conductance, water temperature, pond water elevation, and discharge flow. For the Pond 3 data station, the following parameters will be graphically summarized: Pond pH, water temperature, pond water elevation, turbidity, and specific conductance.
- A presentation of piezometer data collected during the reporting period and an identification of dam safety concerns, if any.
- Identification of any identified or anticipated problems and a description of the steps taken or to be taken to remedy the problem.
- An appendix containing all validated data for water quality monitoring and supporting documentation.

The O&M reports will be submitted on a quarterly basis, on or before the 10th day of January, April, July, and October and continue until EPA indicates that the frequency of reporting may be reduced. Section 9.1 identifies the report distribution for monthly compliance reporting.

10.0 ROUTINE INSPECTION AND MAINTENANCE GUIDELINES

10.1 Inspection and Maintenance Guidelines for Process Equipment

10.1.1 Scope and Organization

This section describes the routine inspection and maintenance tasks necessary for the process equipment. For the purposes of inspection and maintenance, the following facilities contain process equipment:

- Treatment facilities
- Pumpback System
- Environmental Data Collection Management System (EDCMS)

The section details the routine inspection and maintenance tasks including a schedule of task performance, identification of required equipment maintenance, and a discussion of records and reporting procedures.

The maintenance program has been developed as a guide based on recommendations by various manufacturers of the process equipment. Because of local environmental (dust, high temperatures, water, etc.) and operating conditions (frequent and infrequent use, etc.), the maintenance program should remain flexible with maintenance tasks and intervals adjusted as necessary based on the actual operating conditions.

10.1.2 Description of Routine Maintenance Tasks

Inspection and maintenance for the process equipment includes preventative maintenance (both scheduled and unscheduled), corrective maintenance, and emergency maintenance tasks. Inspection and maintenance tasks are based on maintenance manuals and related documentation submitted with the installed equipment. The inspection and maintenance tasks are integrated into the operations via the maintenance schedule (provided in Appendix D).

Daily and weekly routine inspection and maintenance tasks described in Section 5.0 Normal Operations are also included in the schedule.

10.1.3 Schedule of Task Performance

The task performance items in the schedule have been established based on the manufacturers' recommendations for the various system components and adjusted based on operations experience. The inspection and maintenance schedule will be updated when new inspection and maintenance tasks are defined as the result of ongoing operations.

10.1.4 Equipment

Individual equipment manuals and other documentation provided by the manufacturers are included as supplements to this O&M Manual and are contained in separate volumes. A listing of the equipment documentation is provided in Appendix J. The documentation and listing will be updated as equipment is installed or replaced. **Volume** K (separate to this manual) contains excerpts of maintenance instructions from equipment manuals (Volume K is an abbreviated reference guide for routine field usage and also includes the volume section from which the excerpt was taken).

Equipment documentation received for each system component has been reviewed for operation and maintenance instructions, warranty provisions, and for responses to specific operating problems. Appropriate information has been incorporated to ensure that the maintenance instructions provided by the manufacturer will be closely followed to avoid invalidating the equipment warranty. The schedule includes all components of the process system that are likely to need regular maintenance. Some of the equipment listed does not have specific maintenance instructions or schedules provided by the manufacturer. In these cases, reasonable maintenance procedures and intervals have been defined in the schedule (from operator experience).

10.1.5 Records and Recordkeeping

The eMaintenance/Maintenance Management System (MMS) program will be the primary tool to manage the inspection and maintenance operations for the process equipment. The operator accesses the eMaintenance tool through www.bpvendor.com with a username and password that is unique to the site. The eMaintenance tool provides numerous services to manage the inspection and maintenance program for the process control facilities, including the following:

- Preventative maintenance scheduling.
- Maintenance task management.
- Equipment maintenance history.

The eMaintenance training documentation can be found in Appendix D.

10.2 Inspections and Maintenance Guidelines for Earthwork Facilities

10.2.1 Scope and Organization

Although inspection and maintenance of the earthwork facilities are considered a separate function from the process equipment management, they are included in the schedule to facilitate completion. The earthwork facilities that will require inspection and maintenance are listed below:

- All embankments (i.e., dams, dikes, berms, etc.)
- Mill-Willow Bypass channel

- Wet and dry closures
- Water conveyance channels
- Hydraulic structures (gates, orifice plates, trash racks, etc.)
- Embankment piezometers
- Staff gages

The inspection and maintenance program for these items has been set up in a format that outlines the details for each task and provides forms for recordkeeping purposes (see Appendix C). These records are maintained separately from the process control facilities records and provide a simple system to track all previous earthwork inspections and maintenance histories.

10.2.2 Description of Tasks

Inspection and maintenance of the earthwork facilities have been separated into the following tasks (Inspection and Maintenance Procedures or IMPs):

- Embankment monitoring
- Piezometer monitoring
- Dry closure monitoring
- Mill-Willow Bypass monitoring
- Water conveyance channel monitoring
- Hydraulic structures monitoring
- Deformation monitoring
- Silver Bow Creek/Inlet Approach Channel Monitoring and Safety Awareness Plan
- Pond 2 Dike deformation monitoring
- Noxious weed monitoring

Appendix C describes each task in detail. The IMPs include the scope of work for the particular task, responsibilities involved, monitoring procedures, monitoring equipment, maintenance procedures, and report forms. Also, as a result of a Notice of Violation (NOV) in 2003, the EPA submitted a Request for Additional Work in a letter dated December 5, 2003. Item number 7 in the list of requests from this letter reads as follows:

"*Eradicate Russian Olive shrubs and trees introduced into the Mill-Willow Bypass. As part of Atlantic Richfield Company's ongoing efforts to ensure that dam safety and flood passage requirements are met, by periodically trimming willows and other shrubs and trees adjacent to the berms, EPA urgently requests the eradication of Russian Olive from the bypass and entire pond system*."

Upon further clarification with EPA, it was decided through verbal communication that Russian Olive growing within the Mill-Willow Bypass would be removed, but any Russian Olive growing on the rest of the site could stay unless it was on a dam. A later communication included discussions regarding Russian Olive existing on some of the islands and the safety issue of accessing them. The determination by the United States Fish and Wildlife Service (USFWS) was that these locations were also fine and did not need removal.

10.2.3 Schedule of Task Performance

The frequency for performing earthwork inspection and maintenance tasks is listed in the task description and included in the schedule. In general, the tasks are performed annually and in conjunction with more severe weather conditions or earthquake events. Monitoring of piezometers and staff gages are scheduled more frequently. At a later date, some of these readings may be scheduled less frequently as appropriate to document behavior of the embankments.

A qualified engineer or team of engineers selected by Atlantic Richfield will conduct an inspection of the earthwork facilities and hydraulic structures at least once every five years. The five-year inspection will be performed in accordance with the requirements in ARM ξ 36.14.600 (see Appendix F).

The eradication of Russian Olive within the bypass is to be completed annually in conjunction with weed spraying in the springtime (see IMP-4).

10.2.4 Records and Reporting

Reports completed in conjunction with inspection and maintenance tasks will be placed in a three-ring notebook designated for earthwork inspection and maintenance. Report forms for each task are available to describe the results of the inspections, record photographs, list required maintenance, and track conditions that may not necessarily require immediate attention (or maintenance) but do dictate further monitoring. Forms are also provided for describing the date, location, and specifics about a particular maintenance item that was completed. Alternative forms approved by Atlantic Richfield's designated representative may be used. Using stored time intervals, the schedule provides the operator with a timely reminder of required inspections and maintenance.

10.3 Inspection and Maintenance of Protective System Devices

As described previously in Section 2.7, PSD inspection and maintenance activities must follow the Inspection and Maintenance Plan provided in Appendix H.

10.4 Dam Mitigation Equipment

The following sections describe testing procedures to be performed on the dam mitigation system and equipment.

10.4.1 Siren Testing

Silent testing of the sirens must be performed on a monthly basis. An aluminum rolling ladder with platform is installed at each siren location, at RDU-8 and at the Traveling Screen Building, for access to the panel. To perform silent testing, the panel must be opened and the silent test button pressed. If performed correctly, the speakers will be heard turning on.

Siren activation test must be performed on an annual basis. To perform a siren activation test, the "test" button on the HMI screen is pressed from the Control Building. The siren will sound a 1-minute alert tone and then a voice command will be heard. The voice command is "*Attention. This has been a test of the embankment failure warning system. This was only a test*." One day prior to the test, signs will be posted at the entrances providing notification of the test and the administrator at the Montana State Hospital in Warm Springs will be contacted. Tests will be conducted between 10 am and 2:30 pm.

10.4.2 Cameras

Testing the cameras and enclosures is not required. The external lowering devices should be inspected annually. Inspection should consist of checking the winch cable, cleaning and lubricating the winch, confirming seals on the junction box, and checking pins and probes.

10.4.3 Downstream Flow Monitoring

The purpose of testing the flow downstream is to verify the function of the High Flow and Rate of Change alarms from the U.S. Geological Survey station. Coordination with either Kevin Sattler (ksattler@usgs.gov, 406-457-5954) or Norm Midtlyng (nmidtlyn@usgs.gov, 406-457-5948) is needed. The test consists of the U.S. Geological Survey representative raising the float to 4.3 feet stage height and verifying that the alarms are triggered.

10.4.4 Pond 1 Dry Closure Float Switch

The purpose of testing the float switch is to verify the function of the high-level alarm in the Pond 1 Dry Closure. To perform this test, the float switch is submerged in water and the alarm activation is verified. The test should be performed bi-annually.

11.0 EMERGENCY PROCEDURES

This section covers the following emergency procedures:

1. Alarm conditions and response actions.
2. Using standby equipment.
3. Dam safety emergency procedures.

11.1 Alarm Conditions

11.1.1 Lime Feed System

An extensive array of alarm conditions have been established as part of the automatic control system for the lime feed system located at the Pond 3 inlet and Pump Station 1. Table 11-1 identifies the lime feed system alarms in terms of a control system loop and the described circumstance for each alarm. Table 11-2 lists the various types of alarms in detail, identifies the likely causes, and suggests a response to resolve the problem and clear the alarm. The next section contains information on system alarms for Pump Station 1.

The automatic control systems are equipped with SCADA software capable of contacting the site operator via telephone at numerous phone numbers. The SCADA system announces a distinct, pre-recorded message for each alarm condition encountered. The operator also can call into the SCADA system at any time to check on high-priority items, such as water elevations and flow rates at various stations throughout the site.

SCADA notification is designed to advise the operator of appropriate needs, while minimizing nuisance alarms that could ultimately nullify using the system. When no immediate effect on plant performance is probable, dialer notification will not be made and the alarm will be dealt with on the next operator visit.

11.1.2 Pump Station 1

This section addresses alarm conditions at Pump Station 1 and identifies likely causes and appropriate trouble shooting actions.

The run status of the four pumps in Pump Station 1 is indicated on the HMI in the Control Room. Additional information, including Groundwater Interception Trench level, lead pump status, and pump start setpoint, appears on the Panel Mate display located on the PLC cabinet door in the Pump Station. Alarms that are programmed into the SCADA system for Pump Station 1 are as follow:

1. Pump Station 1 Power Failure
2. Pump #1 Run Fault
3. Pump #2 Run Fault

4. Pump #3 Run Fault
5. Pump #4 Run Fault

Pump Station 1 Power Failure:

1. Check the position of the Pump Station's ***main circuit breaker***, which is located in the first section of the MCC.

   If the main circuit breaker is in the tripped position inspect the power phase monitor status lamp on the MCC main breaker door. This status lamp will indicate if the incoming power has the proper voltage and phase characteristics. If the lamp is illuminated, contact NorthWestern Energy at (888) 467-2353. *Do not attempt to reset the main circuit breaker or start a pump as the electrical distribution system may have lost a phase.*

   If the main circuit breaker is in the tripped position and no problem is indicated with the main power supply, attempt to reset the breaker by first turning all the pump H-O-A selector switches to their *off* position, resetting the main breaker handle to the closed position, then resetting the 480-volt pump control breakers to the closed position. This will restore power to the station in the event that the electrical fault causing the breaker to trip has cleared itself. If any of the breakers will not reset, contact an electrician to locate the problem.

   If the main circuit breaker can be reset to the closed position then power will be restored to the station control system. Restore each pump's H-O-A selector switch to the A (automatic) position. The pumps will start in the programmed sequence to draw the level in the Groundwater Interception Trench down.

2. If the station main power supply is on, check each of the individual ***pump circuit breakers*** to determine if any have tripped off-line.

   If a pump circuit breaker is in the tripped position, attempt to reset the breaker by first turning the pump H-O-A selector switch to the *off* position and then resetting the breaker handle to the closed position. If the breaker will not reset, contact an electrician to locate the problem.

   If the breaker can be reset in the closed position then power will be restored to the pump. Restore the H-O-A selector switch to the automatic position and the pump will start under the high-level condition.

Run Fault Alarms:

1. Touch the screen of the Panel Mate display located on the PLC cabinet in the Pump Station. Red alarm screens will appear noting a run fail alarm for the applicable pump. Acknowledge the run fail alarm by pressing the appropriate location on the touch screen.

2. Reset the H-O-A switch on the pump director panel for each affected pump by turning the switch to the *off* position, then cycling back to the automatic position. This action sets the

pump control back to the automatic position, enabling the pumps to start based on the level in the interception trench.

In addition to the alarms programmed in the SCADA system, the pump director panels have a series of alarm conditions noted. These alarms do not initiate a call through the SCADA system, but are noted by indicator lights on the pump director panels.

Pump Director Panel Alarm:

If the station's main breaker and all the pump main circuit breakers are in the closed position, then check the ***pump director panels*** for an indication of a pump run fault.

Low suction pressure, ***high discharge pressure***, or a loss of control power to the pump director panel will cause a pump to shut down.

If either of the pressure shutdown conditions exist, attempt to reset the pump director panel by moving the selector switch to the *reset/off* position and back to automatic. The pump will attempt to start for the high-level condition. If either of the pressure conditions cause the pump to shut down again, check the operation of the pump control valve.

If ***control power*** is lost to the pump director panels, open the control instrument panel and check circuit breaker No. 2, which is the control circuit. Reset the breaker if it is tripped and control power will be restored. The pumps should start in their programmed sequence under the high-level condition.

11.2 Using Standby Redundant Equipment and Facilities

The lime feed system has a number of standby/redundant features. The operator must be aware of these features and of actions required to properly use them. Many of these redundancies have been described in earlier sections. They are summarized here and in Table 11-3 to provide a consolidated overview.

11.2.1 Silo No. 2 (Normal Use Silo)

Substantial redundancy has been provided to keep Silo No. 2 operational and effective a high percentage of the time. The backup features included include those listed below:

- **Lime Solution Distribution System:** The system for conveying the lime solution to the Inlet Structure for discharge into Silver Bow Creek (see Section 2.3.3 and Figure 2-25 through Figure 2-27) is a trough with four outlets distributed across the channel.

- **Water Pumps:** Two wells and associated pumps are provided as water sources for the Silo No. 2 lime feed system. If one pump goes out of service for any reason, the other is automatically brought online to maintain the required water flow for the lime solution.

- **Aeration System:** Two blowers are provided as part of the aeration system that periodically loosens the lime in Silo No. 2. These blowers (B-LP-2 and B-LP-3) are identical. Each is protected by a check valve and a butterfly valve, and they both feed the aeration pipe to Silo No. 2. If one does not respond when aeration is needed, the control system automatically starts the other as backup. If the automatic control system is inoperable, either blower can be run manually (hand position). Manually controlled vibrators are provided on the silo as backup to the aeration system. However, they should be used only as a last resort if the aeration system proves ineffective at loosening hydrated lime bridging. *Also, they should only be used momentarily because they can further pack the hydrated lime.*

- **Inventory Control:** Two independent mechanisms are used to ensure an adequate supply of lime in Silo No. 2. A load cell weight setpoint is used to signal a low lime level and initiate a transfer operation from Silo No. 1. A low weight alarm is activated at a lower setpoint. Further redundancy is provided through load cells in the hopper that track lime weights of individual batches and calculate total lime usage.

- **Overfill Control:** Independent mechanisms are used to protect against overfilling Silo No. 2. A load cell weight setpoint is used to signal a high lime weight and stop a transfer operation from Silo No. 1 or provide an initial indication to a truck unloading operation that the silo is nearly full. A high weight alarm is activated at a higher setpoint. The final backup is a high-level alarm (based on a probe extending from the top of the silo to sense a too-high lime surface).

- **Truck Receiving/Unloading System:** Silo No. 2 has a truck unloading system, even though trucks will usually be unloaded into Silo No. 1. This provides backup in case the Silo No. 1 unloading system or the pneumatic transfer system (from Silo No. 1 to Silo No. 2) is inoperable.

- **Silo No. 1 as Back Up to Silo No. 2:** Silo No. 1 is the standby system in case Silo No. 2 is inoperable. The operating range of Silo No. 1 overlaps the upper 80 percent of Silo No. 2 and can be operated intermittently (fixed duty cycle operation) to provide lime feed capabilities at lower feed rates.

11.2.2 Silo No. 1 (Flood Stage Silo)

Reduced redundancy is provided for the High Flow Silo because it is less frequently online and less likely to require maintenance during periods of operation. Periodic exercising of the system and normal preventative maintenance during non-operating periods should keep Silo No. 1 functional. The backup features include the following:

- **Aeration System:** The system contains two blowers (B-LP-1 and B-LP-4) to aerate Silo No. 1. However, transfer of this duty from one blower to the other requires a manual changeover of the valving and control system. B-LP-1 is the primary Silo No. 1 aeration blower and it is backed up by B-LP-4. However, B-LP-4 is the primary lime transfer blower; if it is transferred to aeration duty, it is no longer available for lime transfer duty except through another manual change over. Either blower (if set for aeration) can be operated manually. Manually controlled vibrators are also provided as backup to dislodge bridges. These should only be used as a last resort.

- **Inventory Control:** Facilities for Silo No. 1 to ensure an adequate supply of lime are identical to those provided for Silo No. 2. In the case of Silo No. 1, however, a low reading cannot initiate a transfer from the other silo; instead it is an indication that additional lime deliveries are necessary.

- **Silo No. 2 as Back Up to Silo No. 1:** Silo No. 2 is the backup if Silo No. 1 becomes inoperable. Silo No. 2 overlaps only the lower 10 percent of the feed range for Silo No. 1. Therefore, it is important to keep Silo No. 1 well maintained and operable.

11.2.3 Pneumatic Transfer System (Silo No. 1 to Silo No. 2)

The major redundancy provided for the pneumatic transfer system is the ability to use either of two blowers (B-LP-1 or B-LP-4) as the air source for the transfer. B-LP-4 is the primary blower for this function. If it is necessary to transfer duty to B-LP-1, valving and controls must be manually changed first (see Section 11.2.2 - Aeration). Either blower can be run manually for pneumatic transfer, provided the valving is properly set. The backup is to off-load lime from trucks directly into Silo No. 2 if the pneumatic transfer system is inoperable.

11.2.4 Compressed Air System

Two air compressors (AC-LP-1001 and AC-LP-1002) are used to operate pneumatic knife gates (FCV-LP-1724, FCV-LP-1824, and FCV-LP-1413) and dust collectors (U-LP-1703 and U-LP-1803) for each silo as described in Section 2.3.3. Each dust collector is automatically cleaned by a pulse jet system using compressed air from a common source. Each air compressor provides an adequate source of compressed air for the pulse jet cleaning systems.

11.2.5 Electrical Service

As described in Section 2.3.4, the inlet area facilities get backup electrical power from a 150-kilowatt diesel standby generator. The automatic control system starts the generator and brings it online when it senses a power outage. When normal power service is established, the diesel generator automatically shuts down.

11.2.6 Lime Feed Control

As described in Section 2.3.5, two control modes adjust lime feed rates:

- Gravimetric Operation - Automatic
- Volumetric Operation - Manual

11.2.7 Plant Control System

The plant automatic control system includes three different locations/facilities at which control can change settings or initiate operations (refer to Section 2.3.5):

- A programmable logic controller (PLC)
- The plant mimic panel
- The Human Machine Interface (HMI)

Following is a brief description of each components role in the control system.

Programmable Controller (PLC). The PLC is the actual hardware responsible for controlling the process. The control program (software), which dictates system operation, resides in the PLC. The PLC can control the system even if the HMI is out of service. In such a circumstance, while the comprehensive window into operations and control afforded by the HMI is lost, the uninterrupted power supply (UPS) and emergency generator system protects the memory of the PLC during power outages. If the PLC does go down temporarily it can be rebooted. The software (RSLogix by Rockwell Software) that operates the PLC is installed on the HMI computer if any PLC reinstallation or replacement is required. The PLC communicates directly with both the MCC and the mimic panel and is the center of communication between the HMI and mimic panel.

Mimic Panel. The mimic panel provides a limited representation of what is in the HMI. It includes hardwired lamps and switches, etc. The panel allows a quick visual inspection to identify what is presently operating and allows the operator to modify the operational settings using the limited selector switches. The mimic panel is a "hands on" interface, which communicates with the PLC and the MCC. The panelmate on the mimic panel provides a window into the alarms and digital readings similar to the HMI but with a reduced degree of detail and options. If the HMI is out of service, the operator can control the system from the mimic panel. If the PLC is out of service, the mimic panel provides a manual control station from which the various pieces of equipment can be started and stopped in the hand control position.

Human Machine Interface (HMI). The HMI provides an interface for the operator to view the lime treatment system and data collection from the sample stations and allows the operator to make system changes. From the HMI, the operator can view data or make changes to the lime delivery system (i.e., transfer lime).

Motor Control Center (MCC). While not part of the plant control system, the MCC is controlled by remote components (the PLC or the mimic panel). The only option available to the operator at the MCC is to turn equipment off by using the breakers.

11.3 Dam Safety Emergency Procedures

Dam safety emergency procedures are detailed in the site's Emergency Action Plan (separate to this document). This plan is updated annually and a copy maintained on-site.

12.0 SITE SAFETY AND HEALTH PLAN

BP-Remediation Management (RM) is committed to the safety of the workforce and public. The WSP is a BP-RM-owned site and operated by a third-party operator (Operator). Additional work at the site is completed by the Operator and other contractors under contract to BP-RM or to the Operator. BP-RM's safety aspirations for the site include:

- No accidents
- No harm to people
- No damage to the environment

All work must be performed in accordance with the BP-RM and the Operator HSSE Management Systems, and all applicable regulations and publications. These requirements are stated in the sections below.

12.1 Applicable Regulations/Publications

12.1.1 Site-Specific Health and Safety Plan

The Operator will develop a site-specific Health and Safety Plan (HASP) and ensure that it complies with the latest revision of the following codes and requirements (where applicable):

- Occupational Safety and Health Administration (OSHA), Title 29 CFR Part 1910, Occupational Safety and Health Regulations for General Industry and Title 29 CFR Part 1926, Occupational Safety and Health Regulations for Constructions.

12.2 Site-Specific Health and Safety Plan

Operator will prepare and submit a site-specific health and safety plan (SSHASP). The SSHASP will either reference or include the elements of the Operator's Corporate HASP, which will meet the most current RM HSSE requirements as well as applicable requirements of OSHA Title 29 CFR 1910 and 1926.

12.3 Certificates of Training

Prior to initiating work, the Operator will provide BP-RM with documentation of employee and applicable subcontractor training, including equipment task training, Hazardous Waste Operations and Emergency Response (HAZWOPER) training (if required).

12.3.1 Equipment Inspection

Prior to operating any equipment brought onto the site, the Operator will verify the equipment has been inspected. These inspections will be documented and available for review as requested.

12.3.2 Risk Assessment

The Operator will prepare an applicable risk assessment to identify hazards and associated mitigations for the project. The hazards and mitigations will be documented on the risk assessment and in the SSHASP. Completed risk assessments will be kept with the SSHASP.

12.4 Work Planning and Meetings

The following protocols will be followed:

- All contractors and subcontractors will attend a site orientation by the Operator of the site.
- Risk assessments and associated HASP will be verified by BP-RM.
- Operator will conduct a Daily Toolbox Health and Safety Meeting prior to beginning work for that day to review scheduled work and address health and safety issues, changing site conditions, activities, and personnel. All Operator, contractor and subcontractor employees working on the site on that day will attend the meeting. All meetings will be documented and attendees will sign acknowledgement of their presence at the meeting and fitness for the day, their review of the risk assessment for the work to be conducted, and any additional discussion points discussed during the meeting.
- Work arising from temporary or permanent changes to administrative, organization, or technical matters will be subject to the Management of Change (MoC) process. Personnel with relevant experience and required degree of competency will coordinate the MoC process. The process should involve an assessment of the risks, include a work plan to mitigate the risk, and should be authorized by the designated responsible person.

12.5 Personal Protective Equipment

Operator will determine and document the personal protective equipment (PPE) requirements in the SSHASP. At a minimum PPE Level D protection will be required for all personnel on-site at all times (this includes all contractor personnel on-site). Level D PPE consists of the following:

- Hard hat.
- Leather steel-toed boots with ankle support.
- Safety glasses with permanent side shields or wraparounds.
- Work clothes (long pants and shirt with long sleeves).
- Work gloves.
- High-visibility reflective safety vests/clothing.
- Hearing protection (as needed to prevent exposure exceeding 85 decibels [dB]).
- Any additional PPE as determined in the risk assessment.

13.0 MANAGEMENT AND STAFFING PLAN

The following sections provide general descriptions of the responsibilities assigned to Atlantic Richfield's Authorized Representative and the facility Operator, including a description of anticipated support requirements.

13.1 Managerial Responsibility

Atlantic Richfield is responsible for managing the O&M activities at WSP. Atlantic Richfield will assign an O&M manager (Atlantic Richfield's Authorized Representative) to oversee the O&M activities. Atlantic Richfield's Authorized Representative will have the following specified duties:

- Ensuring that appropriate recordkeeping procedures are initiated for O&M.
- Determining staff requirements and coordinating with other activities to ensure availability of personnel.
- Ensuring O&M personnel are adequately trained.
- Maintaining current written operational procedures.
- Developing and implementing the maintenance work schedule.
- Ensuring that all maintenance work is completed.
- Overseeing preparation of compliance reports, signing compliance reports, and making notifications required under the UAO.

13.2 Operational Responsibility

The Operator will be assisted with support personnel as necessary with respect to technical analysis, sampling and analysis, and maintenance activities. Specific responsibilities of the operational personnel will include the following:

- Staying informed of current O&M practices.
  Knowing and using the proper procedures and precautions to operate the systems.
- Completing daily verification of system component functions: making necessary adjustments to operations, tracking inventories, and ensuring orders are placed as necessary.
- Ensuring that sampling and analysis requirements are promptly undertaken and reported.
- Verifying that monitoring data is properly entered, reviewed, and archived in system software.
- Ensuring that maintenance activities are appropriately scheduled, completed, and documented.
- Advising Atlantic Richfield's Authorized Representative of the system conditions and special O&M requirements.
- Preparing compliance reports.

- Notifying Atlantic Richfield's Authorized Representative of items requiring his or her attention including those requiring 24-hour agency notification.

13.3 Support Personnel/Subcontractors

The following support will be made available upon the request of the Operator and authorization of Atlantic Richfield's Authorized Representative.

- Sampling Technician Services: A separate technician is available to collect samples on the schedule and in the manner identified in Section 8.0. The same individual(s) will be responsible for periodic calibration of field instrumentation.
- Laboratory Analytical Services: A laboratory will provide analytical testing as identified in Section 8.0 for the samples collected by the Sampling Technician.
- Equipment Maintenance - Electrical and Mechanical Contractors: Subcontractor services will be used at the direction of Atlantic Richfield to provide periodic maintenance of electrical and mechanical systems. Scheduling will be the responsibility of the Plant Operator.
- Earthwork Inspector(s), Dam Design Professional, Reclamation Professional: The services of these personnel are required on a periodic basis as identified in Section 10.0 and 11.0. They will be available at Atlantic Richfield's request and will either be drawn from Atlantic Richfield's personnel and/or from outside consultants as appropriate to the circumstance.

14.0 FUTURE REVISIONS/UPDATES TO MANUAL

14.1 Introduction

The O&M Manual for the WSP treatment system allows for simple inclusion of future revisions and updates. This version includes significant revisions from the original 1995 document that were too numerous to make as page replacement updates so a new document is being issued. Appendix A summarizes the major changes from the 1995 document. For future revisions, the O&M Manual is retained in a 3-ring binder to allow operators to update it as necessary throughout the operating life of the facility. A distribution list will be on file in Atlantic Richfield's Butte office, as well as the WSP site, which will allow for effective and timely shipping of the updates to the required individuals. No set period of time between updates has been specified to allow Atlantic Richfield flexibility in determining when update distributions are necessary; however, the anticipation is that updates will be made on an annual basis (minimally).

Each update package will contain the necessary update information, a summary sheet listing the changes, any additional instructions, and a revised listing of all previous updates. Each page in the update will include the date on which the update was made, as well as the update number. Atlantic Richfield will retain copies of revised sections prior to being updated for future reference. An example of the Update Summary Sheet is provided in Appendix A. The procedures for revising or updating the manual are outlined in the following section.

14.2 Procedure for Revising Manual

- An update/revision package will be sent to all individuals on the distribution list.
- Read the Update Summary Sheet, then add/replace the necessary pages of the O&M Manual.
- Replace the Listing of Previous Updates in the front of Appendix A.
- Place the Update Summary Sheet in Appendix A for future reference purposes.

15.0 REFERENCES

Atlantic Richfield, 2010. Final Construction Completion Report for the 2010 Temperature Modification and Gas Exchange Program Hardware. Atlantic Richfield, 2010.

Atlantic Richfield, 2013. Silver Bow Creek/Butte Area NPL Site, Warm Springs Ponds, Final Warm Springs Ponds (WSP) Lime Rate Optimization Pilot Study Work Plan. November 12, 2013.

BP, 2011. Remediation Management Site Technical Practice REMED-GP-35-0001.

BP, 2009. Engineering Integrity Manual Site Remediation Technologies, REMED GP 47-0001, Remediation Management Site Technical Practice.

EPA, 1993. Unilateral Administrative Order for the Silver Bow Creek/Butte Area (original portion) Superfund Site, Warm Springs Ponds Inactive Area operable unit remedial design, remedial action, and operation and maintenance, Docket No. CERCLA-VIII-93-223; signed June 17, 1993 and effective on July 19, 1993.

EPA, 1992. Record of Decision for Warm Springs Ponds Inactive Area Operable Unit (OU 12), Silver Bow Creek/Butte Area NPL Site (Original Portion), Clark Fork River Basin, Montana; June.

EPA, 1991a. Unilateral Administrative Order for the Silver Bow Creek/Butte Area (original portion) Superfund Site, Warm Springs Ponds Active Area operable unit remedial design, remedial action, and operation and maintenance, Docket No. CERCLA-VIII-91-25; signed September 25, 1991 and effective on October 25, 1991.

EPA, 1991b. EPA/ESD/R08-91/091. EPA Superfund Explanation of Significant Differences: Silver Bow Creek/Butte Area. EPA ID: MTD980502777, OU 04, Butte, MT. June 24, 1991. http://www.buttectec.org/?wpfb_dl=10.

EPA, 1990. Record of Decision, Silver Bow Creek/Butte Area NPL Site, Warm Springs Ponds Operable Unit, Upper Clark Fork River Basin, Montana. September.

ESA Consultants, 1993. Comprehensive RD/RA Work Plan and Preliminary Design Package, Warm Springs Ponds Inactive Area Operable Unit (OU12), Silver Bow Creek/Butte Area NPL Site (original portion), Clark Fork Basin, Montana: reported prepared for Atlantic Richfield Company, Anaconda, Montana, July 23.

ESA Consultants, 1991. Comprehensive RD/RA Work Plan, Silver Bow Creek/Butte Area NPL Site, Warm Springs Ponds Operable Unit (Active Portion), Upper Clark Fork River Basin, Montana: report prepared for Atlantic Richfield Company, Anaconda, Montana, December 23.

Hendrickson, Inc., 2007. Technical Memorandum for Warm Springs Ponds Operations Support, by Short Elliot Hendrickson Inc. July 31, 2007.

SolarBee, 2009. SolarBee SB10000 v18 Owner's Manual, SolarBee, Inc., 2009.

15.0 REFERENCES

Atlantic Richfield, 2010. Final Construction Completion Report for the 2010 Temperature Modification and Gas Exchange Program Hardware. Atlantic Richfield, 2010.

Atlantic Richfield, 2013. Silver Bow Creek/Butte Area NPL Site, Warm Springs Ponds, Final Warm Springs Ponds (WSP) Lime Rate Optimization Pilot Study Work Plan. November 12, 2013.

BP, 2011. Remediation Management Site Technical Practice REMED-GP-35-0001.

BP, 2009. Engineering Integrity Manual Site Remediation Technologies, REMED GP 47-0001, Remediation Management Site Technical Practice.

EPA, 1993. Unilateral Administrative Order for the Silver Bow Creek/Butte Area (original portion) Superfund Site, Warm Springs Ponds Inactive Area operable unit remedial design, remedial action, and operation and maintenance, Docket No. CERCLA-VIII-93-223; signed June 17, 1993 and effective on July 19, 1993.

EPA, 1992. Record of Decision for Warm Springs Ponds Inactive Area Operable Unit (OU 12), Silver Bow Creek/Butte Area NPL Site (Original Portion), Clark Fork River Basin, Montana; June.

EPA, 1991a. Unilateral Administrative Order for the Silver Bow Creek/Butte Area (original portion) Superfund Site, Warm Springs Ponds Active Area operable unit remedial design, remedial action, and operation and maintenance, Docket No. CERCLA-VIII-91-25; signed September 25, 1991 and effective on October 25, 1991.

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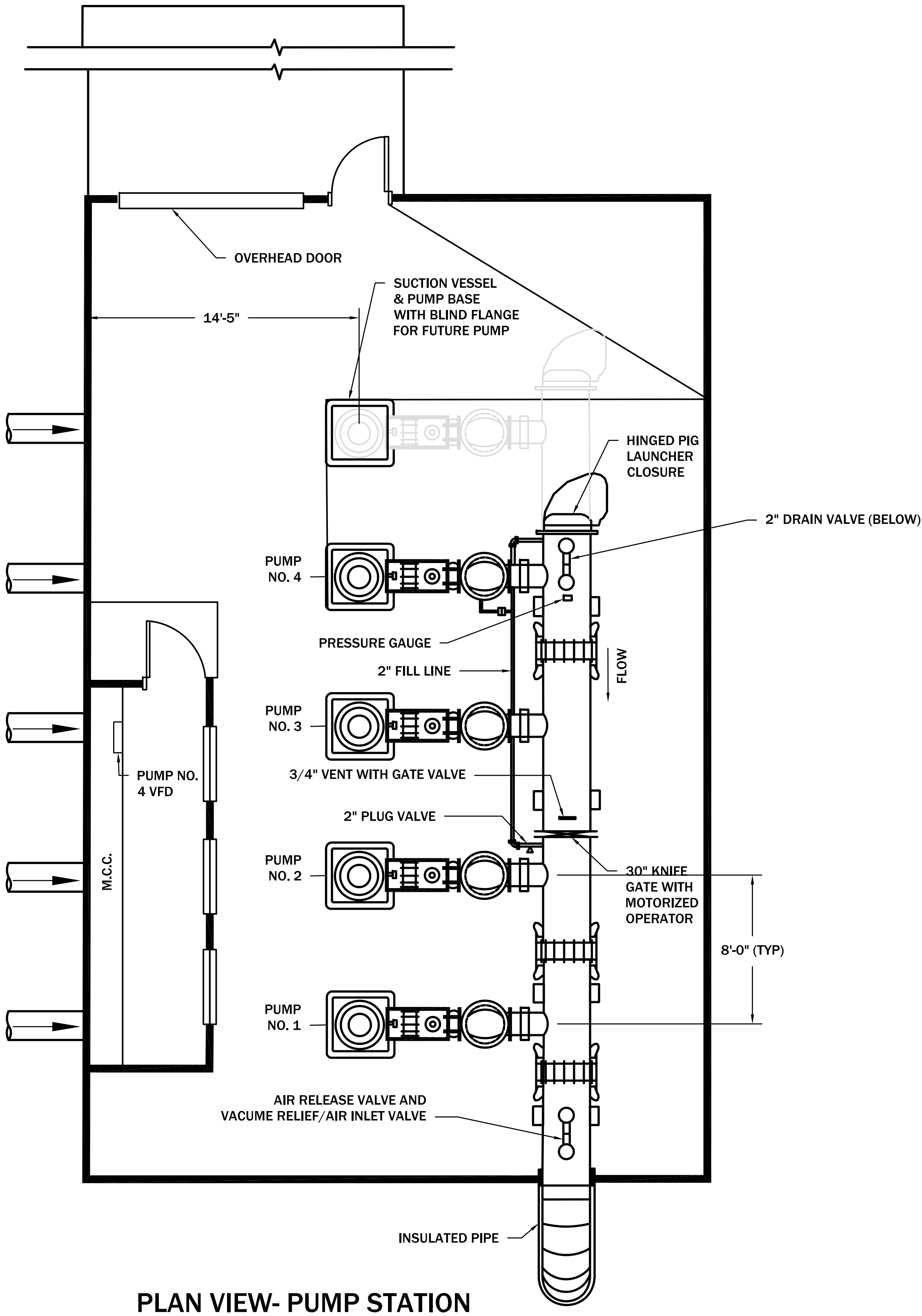
EPA, 1990. Record of Decision, Silver Bow Creek/Butte Area NPL Site, Warm Springs Ponds Operable Unit, Upper Clark Fork River Basin, Montana. September.

ESA Consultants, 1993. Comprehensive RD/RA Work Plan and Preliminary Design Package, Warm Springs Ponds Inactive Area Operable Unit (OU12), Silver Bow Creek/Butte Area NPL Site (original portion), Clark Fork Basin, Montana: reported prepared for Atlantic Richfield Company, Anaconda, Montana, July 23.

ESA Consultants, 1991. Comprehensive RD/RA Work Plan, Silver Bow Creek/Butte Area NPL Site, Warm Springs Ponds Operable Unit (Active Portion), Upper Clark Fork River Basin, Montana: report prepared for Atlantic Richfield Company, Anaconda, Montana, December 23.

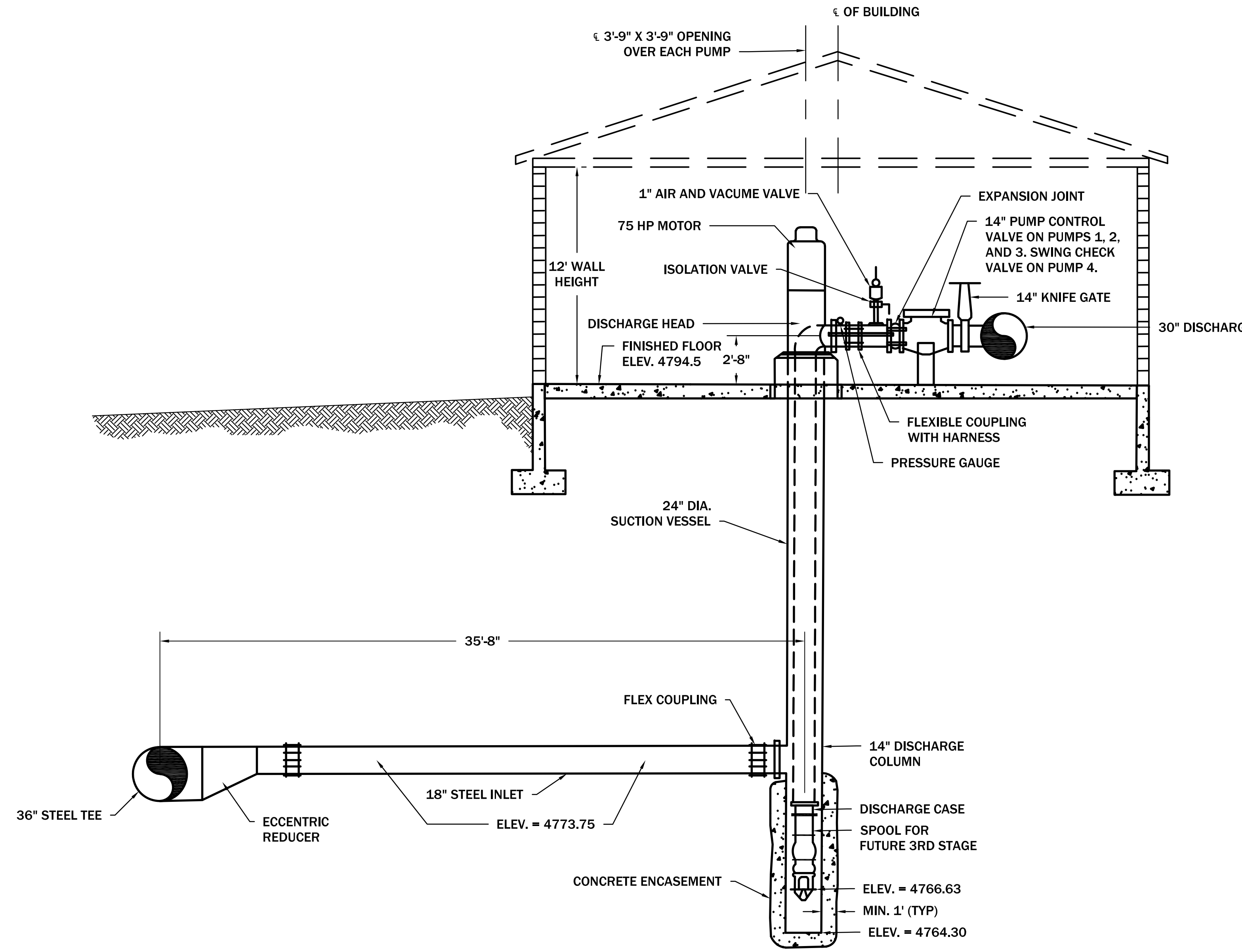
Hendrickson, Inc., 2007. Technical Memorandum for Warm Springs Ponds Operations Support, by Short Elliot Hendrickson Inc. July 31, 2007.

SolarBee, 2009. SolarBee SB10000 v18 Owner’s Manual, SolarBee, Inc., 2009.



PLAN VIEW- PUMP STATION

SCALE: 1/4"=1'



ELEVATION VIEW- PUMP STATION

SCALE: 1/4"=1'

DISPLAYED AS:	
COORD SYS/ZONE:	N/A
DATUM:	N/A
UNITS:	N/A
SOURCE:	N/A

SCALE IN FEET
0 NTS NTS

FIGURE 2-33

PIONEER TECHNICAL SERVICES, INC.
307 E. PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

WSP O&M MANUAL
PUMP STATION
PLAN & SECTION

DATE: 11/9/2018

11/12/2018 10:06:33 AM N:\ARCO\WSP\O&M MANUAL\2018 WSP O&M MANUAL\REVISED DRAWINGS\WSP-FG-DET-233-18.DWG

Revision Log for Warm Springs Ponds O&M Manual

In accordance with Section 13.0 of the O&M Manual, changes to the Warm Springs Ponds manual are to be summarized in update sheets provided in this Appendix. Changes made between the October 16, 1995 original manual and the June 2019 version are too numerous to summarize individually in update sheets but are listed below.

Update #1 – November 1999

Updated contact and other information in the Dam Safety / Emergency Action Plan and Site Safety and Health Plan text (pages vii, 10-27 and entire Section 11.0), figures (10-3 and 10-4) and tables (10-8).

Update #2 – June 2010

Global

1. Changed ARCO to AR.
2. Changed verb tense where necessary to reflect past events and regulatory requirements.
3. Updated references to the Shakedown Phase in text and removed Shakedown Plan from appendices.
4. Moved Tables and Figures to separate sections at end of text.

Section 0

1. Added discussion of call out trees.
2. Added call-out trees.
3. Updated table to reflect call-out trees.

Section 1

1. Section 1.4, added revision log reference.

Section 2

1. Section 2.1.7, added text stating average flow from pumpback system is 7 cfs. Added text regarding pumps 1 and 2 being rebuilt in 2007.
2. Section 2.1.9, removed references to weather stations.
3. Section 2.2.2, clarify flood flow operation. Change Pond 3 normal pool elevation to 4870 and bypass spillway weir crest elevation to 4872.
4. Section 2.2.4, updated Pond 3 nominal elevation to 4870.
5. Section 2.2.4, changed Pond 2 nominal elevation to 4835.2.
6. Section 2.2.5, changed bypass spillway weir crest elevation to 4872.
7. Section 2.2.6, changed Pond 3 nominal elevation to 4870, bypass spillway elevation to 4872, and removed wording relating to orifice plates as they have been removed from outlet structures.
8. Section 2.2.7, added verbiage regarding cleaning trash rack during flood conditions and coordination efforts required.

9. Section 2.2.8, Updated Pond 3 nominal elevation to 4870 and max pool elevation for 100-yr flood event to 4877.26.
10. Section 2.3.1, added target pH of 9.8 to 10.0 with max dosage rate of 50 mg/L when influent turbidity is greater than 50 NTU.
11. Section 2.3.3, removed description of backup slurry delivery methods from Silo #2.
12. Section 2.3.5, updated modes of control, remove pH control. Remove reference to dedicated telephone modem for PLC.
13. Section 2.4.4 updated power company contact information.
14. Section 2.4.5, updated PLC software to RS Logix 5000.
15. Section 2.6.1, removed reference to weather stations.
16. Removed section 2.6.2, weather monitoring.
17. Section 2.6.4, removed reference to automated sampling at SS-2.
18. Section 2.6.4, removed references to external dataloggers.
19. Section 2.6.5, added reference to ultrasonic level probe for influent high water level
20. Section 2.6.5, added inlet structure remote camera.

Section 3

1. Removed listings of Tier I and II Interim Standards for discharge since they are no longer in effect.
2. Section 3.2.2, added discussion of expected As and pH exceedances in spring, summer and early fall.

Section 4

1. Section 4.1 added discussion of lime as a flocculent.
2. Section 4.1 added target pH and dosage goal for high turbidity.
3. Section 4.1 added discussion of natural biological activity.
4. Section 4.2.1 changed pH control to dosage control.
5. Section 4.2.1 added discussion on biological treatment, pH increase and flocculation.
6. Added seasonal lime addition and hydraulic control reference.
7. Section 4.2.2 changed Pond 3 normal elevation to 4870.0. Change By-pass Spillway elevation to 4872.0. Changed Pond 2 normal elevation from 4835.3 to 4835.2.
8. Section 4.2.2 modify description of flood routing.
9. Reference new Table 4-1 (acceptable operating condition table) in Section 4.2.2.
10. Section 4.2.2 deleted reference to the development of explicit SOPs during Shakedown Period.

Section 5

1. Removed typical operations text for spring, summer, fall, and winter and simply reference seasonal operations matrices provided as new Figure 5-1 through 5-4.
2. Removed references to automated pH measurement at SS-2, global.

3. Removed reference to MMS.xls, replace with maintenance schedule, global.
4. Section 5.2, changed Pond 3 normal operating level to 4870 and bypass spillway gate setting to 4872.
5. Changed primary method of control from pH control to dosage control, global.
6. Removed references to local fill panels for silos, global.
7. Removed reference to alarm horn, global.
8. Section 5.4.1, added ultrasonic level transducer for pumpstation #1 pump control.
9. Section 5.4.1, removed alarm beacon.

Section 6

1. Added Sections 6.1 to 6.5 providing operational procedures to be used during various upset conditions.

Section 7

1. Section 7.1.2, removed reference to developing database, add database updated in 2007.
2. Section 7.1.3, removed reference to weather data.
3. Section 7.1.3, removed reference to remote datalogers, add system communications and database.
4. Section 7.2.1, removed reference to pH meter at SS-2.
5. Section 7.2.1, changed pH calibration frequency to 2x week.
6. Sections 7.3.1 to 7.3.5, removed reference to manually prepared graphs, insert trending software discussion.
7. Section 7.8.3, changed staff gauges in MWB from 3 to 1 to reflect current status.
8. Section 7.9, added references to two new IMPs in Appendix C.

Section 8

1. Deleted monitoring requirements required during construction of RD/RA and Phase I.
2. Section 8.1.1 changed address for EPA, change contact and address for MDEQ, add additional copies to EPA and MDEQ.
3. Section 8.1.2 added discussion regarding waiver of requirement to report additional data for system optimization.
4. Section 8.2, updated notification phone numbers for EPA and MDEQ.
5. Section 8.2, added email notification and e-mail addresses.
6. Section 8.8, changed frequency of submittal of operator daily log to monthly.
7. Section 8.9, added discussion regarding waiver of requirement to report additional data for system optimization.
8. Section 8.11, removed reference to submittal of employee training records.
9. Section 8.11, removed reference to Contract Laboratory Program Form I's
10. Section 8.11, removed reference to data collected from Pond 3 and Pond 2 weather stations.
11. Section 8 Attachments –

a. Updated CFDMS data transfer form letter.
b. Added Daily Field Inspection Log.
c. Added Daily Inspection Checklist.
d. Added Monthly Checklist.
e. Added Bridge Checklist.
f. Added COC Form.
g. Added 2009 Compliance Schedule.
h. Added lime delivery and usage tracking form and instructions.

Section 9

1. Removed reference to MMS, global. Replaced with project schedule.
2. Section 9.2.2 added new IMPs to existing list.
3. Section 9.2.2 added discussion of Russian Olive removal requirements in Mill Willow Bypass.

Section 10

1. Removed The Emergency Action Plan from Section 10.3. This plan will now become a stand-alone document (which is now referenced in a reduced Section 10.3 text) for easier annual updating in the future.

Section 11

1. Removed the Site Safety and Health Plan. The Site Safety and Health Plan will now become a stand-alone document, which is referenced in a reduced Section 11 text.

Section 12

1. Deleted reference to construction activities and Phase 1.
2. Deleted reference to MMS.

Section 13

1. Added text explaining why this revision of the O&M plan was done as new document rather than as replacement pages and directing the reader to Appendix A for a list of those changes.

Tables

1. Table 2-1 updated with Pond 3 nominal elevation at 4870 and Pond 2 nominal elevation at 4835.2.
2. Table 2-4 updated to match new Pond 3 operating and bypass weir crest elevation setting.
3. Table 2-5 updated to match new Pond 3 operating and bypass weir crest elevation setting.
4. Table 2-6 updated for the 100-year flood information and updated for 5, 10, 25 and 50-year data for new Pond 3 normal operations level.
5. Table 2-7 updated for new Pond 3 operating level.

6. Table 2-8 updated for new Pond 3 operating levels and bypass spillway weir crest elevations.
7. Table 2-11, weather monitoring, was removed and subsequent tables re-numbered.
8. Table 2-15 updated for new discharge data.
9. Table 4-1 (acceptable operating condition table) is new.
10. Table 5-5 updated for Pond 3 outlet stop log setting of 4869.4 and bypass spillway crest of 4872.
11. Table 7-2 updated for current water quality monitoring provisions.

Figures

1. Figure 2-37 was replaced with current weather station figure.
2. Figures 5-1 through 5-4 were added.
3. Figures 7-1 through 7-7 were removed, no longer necessary since trends are prepared by database.
4. Figure 7-8 became Figure 7-1.
5. Figures 10-1 through 10-4 were removed as they pertain to the Emergency Action Plan which will be provided under separate cover.

Appendices

- Appendix A (Revisions) updated for current changes.
- Appendix B (UAO Requirements) became Appendix E.
- Appendix C (Shakedown) removed.
- Appendix D (Dam Safety Act) became Appendix F. Kept original Dam Safety Act.
- Appendix E (SOPs) became Appendix B. Detailed SOPs were removed and a simple list of current SOPs is now provided as Appendix B.
- Appendix F (Maintenance Management System) became Appendix D. An updated equipment list and service schedule is provided along with user instructions for FastMaint software.
- Appendix G (IMPs) became Appendix C
    - Updated IMP-4 to reflect Russian Olive removal and modification of other vegetation management requirements in portions of the Mill Willow Bypass for revised ½ PMF flow and floodplain topography changes west of I-90.

- Updated IMP-6 to identify supplemental Pond 2 spillway inspection and maintenance requirements arising from 2009 rehabilitation work.
- Updated IMP-7 to reflect new Pond 1 survey monuments.
- Added IMP-8 - Silver Bow Creek/Inlet Approach Channel Monitoring and Safety and Awareness Plan.
- Added IMP-9 - Pond 2 Dike Deformation Monitoring
- Added IMP-10 – Noxious Weed Monitoring

<u>Update #3 – July 2012</u>

Section 2

1. Added Section 2.1.18 – Solar Mixing Units

Tables

1. Table 5-1 – updated for SolarBee™ operation.

Appendices

- Appendix A (Revisions) – updated for current changes.
- Appendix D (Maintenance Management System) – added semi-annual physical inspection and semi-annual preventative maintenance for each SolarBee™ unit.

<u>Update #4 – October 2012</u>

Tables

1. Table 7-2 – updated to collect additional surface water data.

<u>Update #5 – February 2014</u>

Global

1. Changed AR to Atlantic Richfield.
2. Changed equipment ID naming convention.
3. Added equipment IDs where appropriate for clarification.
4. Removed references at footer of individual page and added a reference section.
5. Eliminated all use of the word “pipeline”.
6. Changed “shall” to “will”.
7. Rearranged sentences throughout for better clarification and ease of reading.
8. Grammatical edits throughout.

9. Moved Attachments to separate section at the end of text.

Cover

1. Standardized on the title as Operations and Maintenance (O&M Manual for Warm Springs Operable Unit carried throughout the document).
2. Added a cover page with aerial photo of site.
3. Added "Pioneer Technical Services, Inc."

Section 0

1. Updated call-out trees.
2. Updated acronym list.

Section 1

1. Section 1.0, added a paragraph of introduction text and list of appendices.
2. Section 1.2.1, added a reference to site plot plans.
3. Added a new Section 1.3, Section 1.3.1, Section 1.3.2, and Section 1.3.3 for all relevant contact information.
4. Section 1.3 became Section 1.4
5. Section 1.4 became Section 1.5

Section 2

1. Section 2.0, added reference to Appendix G (Piping and Instrumentation Diagram)
2. Section 2.1.4, clarified how flow is measured.
3. Section 2.1.6, clarified how flow is measured.
4. Section 2.1.14, added text regarding pumps 3 and 4 being rebuilt in 2011.
5. Section 2.1.18, added text regarding Solar Bee's added to Pond 2 and 3.
6. Section 2.2.4, clarified flow path operation and how flow is measured.
7. Section 2.2.8, added this section on Low Flow Operations.
8. Section 2.2.8 became Section 2.2.9
9. Section 2.3.1, added reference to Appendix G (Piping and Instrumentation Diagram)
10. Section 2.3.3, added text for clarification of silo operation. Removed line about silo limit switches for automatic control of the dust collection system operation as they no longer exist.
11. Section 2.3.4, added text about generator maintenance under Emergency Power System section and added reference to Generator Maintenance Log in Appendix K. Changed reference of Electrical One-Line Diagram from Figure 2-27A to Appendix I.
12. Section 2.4.1, added reference to Appendix G (Piping and Instrumentation Diagram)
13. Section 2.4.4, changed reference of Electrical One-Line Diagrams from Figure 2-35 to Appendix I.
14. Section 2.6.2, revised text for the following sections: Pond 3 Inlet Flow Measurement, Pond 2 Inlet Flow, West Wet Closure Inlet, East Wet Closure Inlet, and Pond 2 Outlet Flow.

15. Section 2.6.3, revised text clarifying soil-cement toe drains do not discharge directly to Mill-Willow Bypass. Added text about maintenance of toe drains. Clarified text about SS-5 water quality monitoring equipment.
16. Section 2.6.4, added text stating load cells are calibrated annually.
17. Added Section 2.7, Protective System Devices.
18. Added Section 2.7.1, List of Protective System Devices.

Section 4

1. Section 4.2.2, clarified text pertaining to Pond 2 Outlet flow and adjusting wet closure water surface elevation.

Section 5

1. Section 5.1, added "Completing Daily Operator Logs" to list of Routine-Operations Tasks.
2. Added Section 5.1.6, Complete Daily Operator Logs.
3. Section 5.1.6 became Section 5.1.7
4. Section 5.1.7 became Section 5.1.8
5. Section 5.5, Added line stating SOPs developed by Pioneer Technical Services.

Section 6

1. Added Section 6.0, Safe Operating Limits, and subsections 6.1 – System Operating Level Limits, 6.2 – Pressure, 6.3 – Temperature, and 6.4 – Electrical.

Section 7

1. Section 6.0 and subsections became Section 7.0 and respective subsections.

Section 8

1. Section 7.0 and subsections became Section 8.0 and respective subsections.
2. Section 8.3.1, added text stating load cells are calibrated annually.

Section 9

1. Section 9.2, Updated email address of EPA for Immediate Reporting of Noncompliance.

Section 10

1. Added Section 10.3, Inspection and Maintenance of PSDs.

Section 15

1. Added Section 15.0, References.
2. Placed reference list in alphabetical order.
3. Added references.

Tables

1. Updated equipment IDs where appropriate for new naming convention.

2. Table 2-12, Revised Gage Pt 1 and 2 elevation and discharge.
3. Table 2-14B, Revised stage discharge relationship.
4. Table 2-15, Revised stage discharge relationship.

Figures

1. Recreated all Figure files and replaced border with Pioneer's standard figure border.
2. Updated equipment IDs where appropriate for new naming convention.
3. Added aerial photo to Figures 1-1, 1-2, 2-1, 2-2, 2-6, 2-13, 2-14, 2-30, 2-40, and 7-1.
4. Added Figures 1-3, 1-4, 1-5, 1-6, 1-7, and 1-8 for WSP Site Plot Plans
5. Figure 2-4, Elevation-Area Capacity curves were updated for Pond 3 after survey of pond bottom.
6. Figure 2-18, Updated water surface elevations to match changes in rating tables.
7. Removed Figure 2-27A and 2-35, replaced by new Electrical One-Line Diagrams in appendix.
8. Removed Figure 2-35
9. Figure 2-36 became Figure 2-35
10. Figure 2-37 became Figure 2-36
11. Figure 2-38 became Figure 2-37
12. Figure 2-39A became Figure 2-38
13. Figure 2-39B became Figure 2-39
14. Figure 4-2, 4-3, 4-4, and 4-5, shortened figure title to fit in border.
15. Removed Figure 13-1, example of Update Summary Sheet moved to Appendix A.

Attachments

1. Attachment 8-7, added Daily Toolbox Meeting Record form.

Appendices

- Appendix A (Revisions/Updates) updated for current changes. Added example of Update Summary Sheet.
- Appendix G (Piping & Instrumentation Diagram) was added.
- Appendix H (PSD List, PSD Inspection and Maintenance Plan, SAFE Chart) was added.
- Appendix I (Electrical One-Line Diagram) was added. These are updated from electrical one-lines that were removed from Figures.
- Appendix J (Equipment List) was added.
- Appendix K (Generator Maintenance Log) was added.

Update #6 – March 2015

Table of Contents

1. Appendix L – Critical Equipment (CE) List and Assessment Report was added to the List of Appendices.

Section 1

1. Added Appendix L to the list of appendices in the Introduction.

Appendix

- Appendix A (Revision Log) was updated.
- Appendix L (List of Critical Equipment (CE) and Assessment Report) was added.

Update #7 – July 2017

Section 0

1. Updated call-out trees.

Section 1

1. Updated contact list in Section 1.3.1.

Section 2

1. Added sentence about Pond 2 boat ramp to Section 2.1.6.
2. Added dam mitigation cameras to Description of Monitoring Facilities in Section 2.1.16.
3. Moved SolarBee operation and installation paragraph from Section 2.1.18 to Section 5.5 and 5.5.1.
4. Updated Sections 2.3.3 and 2.3.5 to align with Lime System Enhancement upgrades.
5. Updated List of Protective System Devices in Section 2.7.1.
6. Added Section 2.8 for description of Dam Mitigation cameras, sirens, and level switch.

Section 3

1. Removed some of the history behind Phase I/II and Tier I/II to only include the current operating phase.

Section 4

1. Added paragraph about operating under the Lime Reduction Pilot Study and changed pH values accordingly throughout.
2. Updated Section 4.2.1 to align with new control mechanisms.

Section 5

1. Updated Sections 5.3.1, 5.3.2, and 5.3.3 to align with Lime System Enhancements upgrades.

2. Added Section 5.5 that was moved from Section 2.1.18.
3. Added Section 5.5.1 that was moved from Section 2.1.18.

Section 6

1. Added reference to Appendix M.

Section 10

1. Added Section 10.4 and subsections 10.4.1, 10.4.2, 10.4.3, and 10.4.4 for testing of Dam Mitigation Equipment.

Section 11

1. Updated Sections 11.2.1, 11.2.4, and 11.2.6 to align with Lime System Enhancements upgrades.

Section 15

1. Updated reference list.

Figures

- Updated Figure 2-14 to include Pond 2 boat ramp.
- Updated Figure 2-23 to include Lime System Enhancements upgrades.
- Updated Figure 2-26 to include Lime System Enhancements upgrades.
- Updated Figure 2-27 to include Lime System Enhancements upgrades.
- Updated Figure 2-31 to include Traveling Screen wash pump replacement.
- Added Figure 2-41 Dam Mitigation Siren and Camera Location Map.
- Updated Figure 5-1 to incorporate lime reduction pilot study.
- Updated Figure 5-2 to incorporate lime reduction pilot study.
- Updated Figure 5-3 to incorporate lime reduction pilot study.
- Updated Figure 5-4 to incorporate lime reduction pilot study.

Tables

- Updated Table 2-9 with new lime feed rates.
- Updated Table 2-10 with new lime system equipment.
- Updated Table 11-1 with new lime system equipment.
- Updated Table 11-2 with new lime system equipment.
- Updated Table 11-3 with new lime system equipment.

Appendices

- Appendix A (Revisions/Updates) was updated for current changes.
- Appendix B (WSP SOP List) was updated to include new SOPs.
- Appendix D (Maintenance Management Systems) user guide was updated.
- Appendix G (Piping and Instrumentation Diagrams) was updated with Lime System Enhancements upgrades.
- Appendix H (PSD List, PSD Inspection and Maintenance Plan, SAFE Chart) was updated.

- Appendix I (Electrical One-Line Diagrams) was updated.
- Appendix J (Equipment List) was updated.
- Appendix M (Safe Operating Limits) was added.

Update #8 – June 2019

Section 0

1. Updated call-out trees

Section 1

1. Updated contacts in Sections 1.3.1 and 1.3.3

Section 2

1. Section 2.1.14, added text regarding Pumpback Upgrades.
2. Section 2.4.2, updated text regarding Pumpback Upgrades.
3. Section 2.4.5, updated text regarding updated control modes.
4. Section 2.7.1, removed ZT-PB-4409 from PSD List.

Section 5

1. Section 5.4.1, updated text regarding Pumpback Upgrades.

Section 8

1. Section 8.3.1, added lime ordering info as part of materials management effort.

Figures

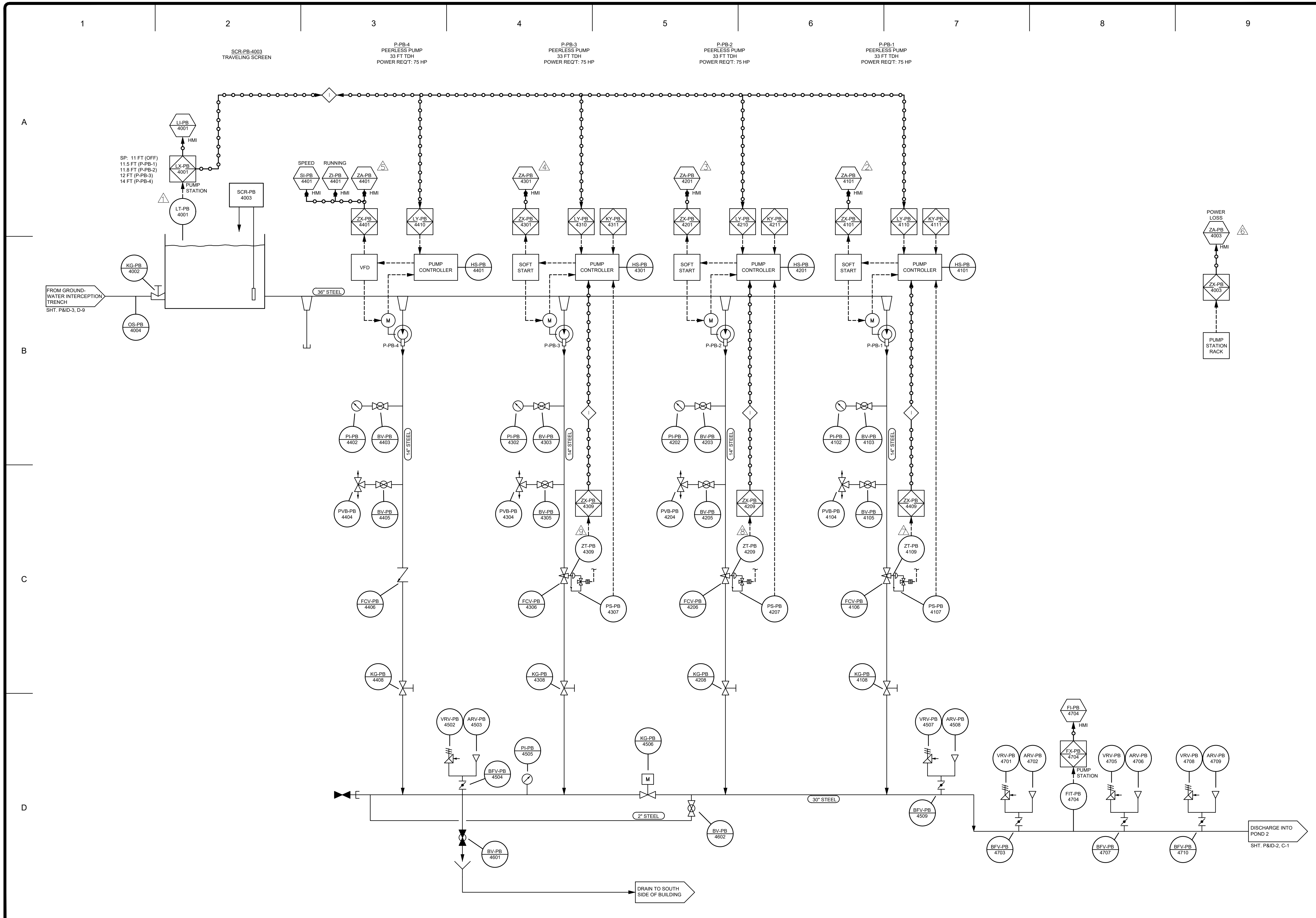
1. Update Figure 2-33 with Pumpback Upgrades

Appendices

- Appendix A (Revisions/Updates) was updated for current changes.
- Appendix B (List of Standard Operating Procedures) was updated.
- Appendix G (Piping and Instrumentation Diagrams) Sheet P&ID-4 was updated with Pumpback Upgrades.
- Appendix H (PSD List, PSD Inspection and Maintenance Plan, Safe Chart) was updated.

Standard Operating Procedures List

SOP Number	SOP Name	Site
SOP-1	Weekly Sampling	WSP
SOP-2	Monthly Mill-Willow Bypass Sampling	WSP
SOP-3	Sonde Calibration/Download	WSP
SOP-4	Piezometer Well Measurements	WSP
SOP-5	Instrument Probe Cleaning	WSP
SOP-6	Turbidity Probe Cleaning	WSP
SOP-7	Checking Ametek Pressure Transducer Elevation	WSP
SOP-8	Daily Site Checks	WSP
SOP-9	Cleaning the Screw Conveyors	WSP
SOP-11	Stop Log Removal/Installation	WSP
SOP-12	Silo Cleaning	WSP
SOP-14	Silo #2 Launder Chute Cleaning	WSP
SOP-15	Annual Toe Drain Sampling	WSP
SOP-17	Piezometer Sampling	WSP
SOP-19	Outlet/Inlet Structure Weed Removal	WSP
SOP-20	Pump Station Pump Manifold Cleaning	WSP
SOP-22	Sample Line and Hose Replacement	WSP
SOP-23	Sample Pump Replacement	WSP
SOP-24	Lime Silo Calibration	WSP
SOP-25	Lime Feed System Startup/Shut down Gravimetric Operation	WSP
SOP-26	AS Surface Water Sampling	WSP
SOP-27	Lime Transfer from Silo 1 to Truck	WSP
SOP-28	Backflush SS-1 Sample Pump Line	WSP
SOP-29	Annual Knife Gate Valve Exercise	WSP
SOP-30	Starting a Siphon Line	WSP
SOP-31	Backup Generator Monthly Startup	WSP
SOP-32	Greasing the Traveling Screen (Monthly)	WSP
SOP-33	Greasing the Lime Silo (Monthly)	WSP
SOP-34	Reading Outlet Structure Staff Gauges	WSP
SOP-35	Annual Reference Station Photos	WSP
SOP-36	Lime Feed System Startup/Shut Down Volumetric Operation	WSP
SOP-37	Solar Bee Installation and Removal	WSP
SOP-38	Solar Bee Battery Removal and Storage	WSP



REVISION: DATE:	BY:	DESC:
7/15	CFB	SILO UPGRADES / PSDs
5/16	CFB	UPDATE PSDs
11/18	CFB	PUMPBACK UPGRADES

DRAWN BY: CFB
DESIGNED BY: CFB
CHECKED BY: SDS
APPROVED BY: DSG
PROJECT NO:
DATE: 11/9/2018

DISPLAYED AS:
COORD SYS/ZONE:
DATUM:
UNITS:
SOURCE:

SCALE IN FEET
0 NTS NTS

ATLANTIC RICHFIELD COMPANY
WARM SPRINGS PONDS OU
WARM SPRINGS PONDS O&M

PUMPBACK PIPING AND INSTRUMENTATION DIAGRAM

PIONEER TECHNICAL SERVICES, INC.
307 EAST PARK AVE., SUITE 421
ANACONDA, MONTANA 59711
(406) 563-9371

SHEET P&ID-4

11/12/2018 12:07:42 PM N:\ARCO\WSP\INTEGRITY MANAGMENT\P&ID DRAWINGS\2018\WSPP&ID-AB-DET-004-18.DWG

PIONEER TECHNICAL SERVICES, INC.

Warm Springs Ponds
Facility Identification
Remediation System Identification

19775 East Side Road
Anaconda, MT 59711

rm

Register of Protective Safety Devices - November 2018

Protective System Device Register

DEVICE ID	TYPE	P&ID	P&ID LOCATION	FUNCTIONAL DESCRIPTION	MANUFACTURER	MODEL	SERIAL NUMBER	SETPOINT	SERVICE	MATERIAL OF CONSTRUCTION	ELASTOMER MATERIAL	FAIL POSITION
PRV-LP-1001A	Poppet Style Pressure Relief Valve	P&ID-1	A-7	Air Compressor (AC-LP-1001) Pressure Relief Valve (Head)		1/4"		325 psi	Air	Brass		Open
PRV-LP-1001B	Poppet Style Pressure Relief Valve	P&ID-1	A-6	Air Compressor (AC-LP-1001) Pressure Relief Valve (Tank)		1/4"		200 psi	Air	Brass		Open
PRV-LP-1001C	Poppet Style Pressure Relief Valve	P&ID-1	A-7	Air Compressor (AC-LP-1001) Pressure Relief Valve (Line)		1/4"		80 psi	Air	Brass		Open
PRV-LP-1002A	Poppet Style Pressure Relief Valve	P&ID-1	A-9	Air Compressor (AC-LP-1002) Pressure Relief Valve (Head)		1/4"		325 psi	Air	Brass		Open
PRV-LP-1002B	Poppet Style Pressure Relief Valve	P&ID-1	A-8	Air Compressor (AC-LP-1002) Pressure Relief Valve (Tank)		1/4"		200 psi	Air	Brass		Open
PRV-LP-1002C	Poppet Style Pressure Relief Valve	P&ID-1	A-9	Air Compressor (AC-LP-1002) Pressure Relief Valve (Line)		1/4"		80 psi	Air	Brass		Open
PRV-LP-1102	Pressure Relief Valve	P&ID-1	B-1	Air Blower (B-LP-1) Pressure Relief Valve	Sutorbilt	2PRVC1		NA	Air			Open
PRV-LP-1202	Pressure Relief Valve	P&ID-1	C-8	Air Blower (B-LP-2) Pressure Relief Valve	Sutorbilt	2PRVC1		NA	Air			Open
PRV-LP-1302	Pressure Relief Valve	P&ID-1	B-8	Air Blower (B-LP-3) Pressure Relief Valve	Sutorbilt	2PRVC1		NA	Air			Open
PRV-LP-1402	Pressure Relief Valve	P&ID-1	C-1	Air Blower (B-LP-4) Pressure Relief Valve	Sutorbilt	2PRVC1		NA	Air			Open
ZI-LP-1721	PLC Based Fault Alarm	P&ID-1	B-4	Screw Feeder (SF-LP-1700) Zero Speed		NA		NA	Lime			Open Circuit
ZS-LP-1013	PLC Based Fault Alarm	P&ID-1	A-2	ATS in Emergency Position		NA		Fault	Electrical			Open Circuit
ZA-SS3E-2325	PLC Based Fault Alarm	P&ID-2	A-8	SS-3E Power Failure		NA		Fault	Electrical			Open Circuit
ZA-SS5-3220	PLC Based Fault Alarm	P&ID-3	A-8	SS-5 Power Failure		NA		Fault	Electrical			Open Circuit
LT-PB-4001	Level Indication	P&ID-4	A-2	Groundwater Interception Trench Level; Activates pumps at setpoints				11 ft, 11.5 ft, 11.8 ft, 12 ft, 14 ft	Water			Open Circuit
ZA-PB-4101	PLC Based Fault Alarm	P&ID-4	A-6	Pump Station #1 Pump #1 Failure		NA		Fault	Electrical			Open Circuit
ZA-PB-4201	PLC Based Fault Alarm	P&ID-4	A-5	Pump Station #1 Pump #2Failure		NA		Fault	Electrical			Open Circuit
ZA-PB-4301	PLC Based Fault Alarm	P&ID-4	A-4	Pump Station #1 Pump #3 Failure		NA		Fault	Electrical			Open Circuit
ZA-PB-4401	PLC Based Fault Alarm	P&ID-4	A-3	Pump Station #1 Pump #4 Failure		NA		Fault	Electrical			Open Circuit
ZA-PB-4003	PLC Based Fault Alarm	P&ID-4	A-9	Pump Station #1 Power Failure		NA		Fault	Electrical			Open Circuit
ZT-PB-4109	Limit Switch Transmitter	P&ID-4	C-7	Plug Valve Limit Switch				NA	Electrical			Open Circuit
ZT-PB-4209	Limit Switch Transmitter	P&ID-4	C-6	Plug Valve Limit Switch				NA	Electrical			Open Circuit
ZT-PB-4309	Limit Switch Transmitter	P&ID-4	C-4	Plug Valve Limit Switch				NA	Electrical			Open Circuit
EX-CRS-01	Type ABC Handheld Fire Extinguisher	-	-	Shop Fire Extinguisher #1	Badger	17-1211B		NA	Powder			NA
EX-CRS-02	Type ABC Handheld Fire Extinguisher	-	-	Shop Fire Extinguisher #2	Badger	20MB-3H		NA	Powder			NA
EX-CR-01	Type ABC Handheld Fire Extinguisher	-	-	Control Room Fire Extinguisher	Amerex	423		NA	Powder			NA
EX-CRSP-01	Type ABC Handheld Fire Extinguisher	-	-	Sample Prep Fire Extinguisher	General	TGP-20F		NA	Powder			NA
EX-SS1-01	Type ABC Handheld Fire Extinguisher	-	-	SS-1 Fire Extinguisher	Badger	17-1211B		NA	Powder			NA
EX-LP-01	Type ABC Handheld Fire Extinguisher	-	-	Silo #1 Fire Extinguisher	Badger	17-1211B		NA	Powder			NA
EX-LP-02	Type ABC Handheld Fire Extinguisher	-	-	Silo #2 Fire Extinguisher	Badger	17-1211B		NA	Powder			NA
EX-BB-01	Type ABC Handheld Fire Extinguisher	-	-	MCC Room Fire Extinguisher	Badger	17-1211B		NA	Powder			NA
EX-BB-02	Type ABC Handheld Fire Extinguisher	-	-	Emergency Generator Room Fire Extinguisher	Badger	20MB-3H		NA	Powder			NA
EX-BB-03	Type ABC Handheld Fire Extinguisher	-	-	Blower Room Fire Extinguisher	Badger	20MB-3H		NA	Powder			NA
EX-SS2-01	Type ABC Handheld Fire Extinguisher	-	-	SS-2 Fire Extinguisher	Badger	20MB-3H		NA	Powder			NA
EX-SS3E-01	Type ABC Handheld Fire Extinguisher	-	-	SS-3E Fire Extinguisher	Badger	20MB-3H		NA	Powder			NA
EX-SS5-01	Type ABC Handheld Fire Extinguisher	-	-	SS-5 Fire Extinguisher	Badger	20MB-3H		NA	Powder			NA
EX-TS-01	Type ABC Handheld Fire Extinguisher	-	-	Traveling Screen Fire Extinguisher	Badger	20MB-3H		NA	Powder			NA
EX-PB-01	Type ABC Handheld Fire Extinguisher	-	-	Pump Station #1 Fire Extinguisher #1	Badger	20MB-3H		NA	Powder			NA
EX-PB-02	Type ABC Handheld Fire Extinguisher	-	-	Pump Station #2 Fire Extinguisher #2	Amerex	330		NA	Powder			NA
ESS-LP-1014	Emergency Stop	P&ID-1	C-9	Silo # 1 Emergency stop button				Stop	Electical			Open Circuit
ESS-LP-1015	Emergency Stop	P&ID-1	C-9	Silo # 2 Emergency stop button				Stop	Electrical			Open Circuit
POND-1	Earthen Embankment	-	-	Pond 1 Dam and Dike Embankments					Water			
POND-2	Earthen Embankment	-	-	Pond 2 Dam and Dike Embankments					Water			
POND-3	Earthen Embankment	-	-	Pond 3 Dam and Dike Embankments					Water			
YA-RDU8-2330	Emergency Siren	P&ID-2	A-5	RTU 1 Siren					Electrical			
YA-PB-2331	Emergency Siren	P&ID-2	A-6	Traveling Screen Siren					Electrical			
LT-PD3-2301	Level Indication	P&ID-2	B-2	Pond 3 Level Indication - Level Hi / Hi Hi / Dike Failure	Ametek	NA		4871 ft, 4871.5 ft, NA	Water			Open Circuit
LT-PD2-3201	Level Indication	P&ID-3	B-2	Pond 2 Level Indication - Level Hi / Hi Hi / Dike Failure	Ametek	NA		4835.35 ft, 4835.5 ft, NA	Water			Open Circuit
LS-PD1-3211	Level Switch	P&ID-3	B-5	Pond 1 Dry Closure Flood Level float switch	Omega	LVK-140			Water			Open Circuit

Denotes Critical Equipment

Revision Date	Description	Responsible Party
12/22/2014	EMOC. 239	Scott Sampson/ PSD Removal Request
5/11/2016	Added poppet PRVs, Revised some ID numbers, Added CE	Casey Briggs
11/5/2018	Removed ZT-PB-4409 per WSP Pumpback System Motor Control Upgrades (Nov 2017)	Casey Briggs

Warm Springs Ponds
Facility Identification
Remediation System Identification

25200 East Side Road
Anaconda, MT 59711

rm

Protective System Device Safe Chart

LEGEND

X = Action is Performed
S = System Shutdown Directly
C = Cascading Event

CAUSE TYPE = DIRECT ACTING, PLC BASED, OR ELECTRO-MECHANICAL BASED, AND DESCRIPTION

DEVICE ID	NAME	SET POINT	TIME DELAY (min)	DEAD BAND	TYPE	Description	Display Status on HMI Panel	Audible Control Panel Alarm	Visual Control Panel Alarm	Auto Dialer Notification	Local Alarm	Starts PLC Timer Interlock	Lime Feed System Shutodown	Lime Transfer (Startup)	Automatic Trasnfer Switch	Back-up Generator	Gravity Drain of Fluids	Vent to Atmosphere	Manual Alarm Activation By Operator
							Display	Activate	Activate	Activate	Display	Activate	Deactivate	Activate	Activate	Activate	Activate	Activate	Activate
PRV-LP-1001A	Air Compressor (AC-LP-1001) PRV (Head)	325 PSI	NA	325 PSI	DA	Allows pressurized flow relief												X	
PRV-LP-1001B	Air Compressor (AC-LP-1001) PRV (Tank)	200 PSI	NA	200 PSI	DA	Allows pressurized flow relief												X	
PRV-LP-1001C	Air Compressor (AC-LP-1001) PRV (Line)	80 PSI	NA	80 PSI	DA	Allows pressurized flow relief												X	
PRV-LP-1002A	Air Compressor (AC-LP-1002) PRV (Head)	325 PSI	NA	325 PSI	DA	Allows pressurized flow relief												X	
PRV-LP-1002B	Air Compressor (AC-LP-1002) PRV (Tank)	200 PSI	NA	200 PSI	DA	Allows pressurized flow relief												X	
PRV-LP-1002C	Air Compressor (AC-LP-1002) PRV (Line)	80 PSI	NA	80 PSI	DA	Allows pressurized flow relief												X	
PRV-LP-1102	Air Blower (B-LP-1) Air Relief		NA		DA	Allows pressurized flow relief												X	
PRV-LP-1202	Air Blower (B-LP-2) Air Relief		NA		DA	Allows pressurized flow relief												X	
PRV-LP-1302	Air Blower (B-LP-3) Air Relief		NA		DA	Allows pressurized flow relief												X	
PRV-LP-1402	Air Blower (B-LP-4) Air Relief		NA		DA	Allows pressurized flow relief												X	
ZI-LP-1721	Screw Feeder (SF-LP-1700) Zero Speed		NA		PLC	No speed dected on screw feeder	X		X		X		S						
ZS-LP-1013	ATS in Emergency Position		NA		DA	Automatic Transfer Switch engaged at Lime Plant.	X	X		C	X				X	X			
ZA-SS3E-2325	SS-3E Power Failure		10		PLC	No commerical power detected at SS-5.	X	X		C	X								
ZA-SS5-3220	SS-5 Power Failure		10		PLC	No commerical power detected at SS-3E	X	X		C	X								
LT-PB-4001	Groundwater Interception Trench Level	11 FT, 11.5 FT, 11.8 FT, 12 FT, 14 FT	NA		PLC	Level from ultrasonic groundwater trench level	X												
ZA-PB-4101	Pump Station #1 Pump #1 Failure		NA		PLC	Pump failure from Pump Station #1	X	X	X	C	X								
ZA-PB-4201	Pump Station #1 Pump #2Failure		NA		PLC	Pump failure from Pump Station #1	X	X	X	C	X								
ZA-PB-4301	Pump Station #1 Pump #3 Failure		NA		PLC	Pump failure from Pump Station #1	X	X	X	C	X								
ZA-PB-4401	Pump Station #1 Pump #4 Failure		NA		PLC	Pump failure from Pump Station #1	X	X	X	C	X								
ZA-PB-4003	Pump Station #1 Power Failure		10		PLC	No commercial power detected at Pump Station #1	X	X		C	X								
ZT-PB-4109	Plug Valve Limit Switch Transmitter		2		DA	Limit Switch on Plug Valve FCV-PB-4106						X							
ZT-PB-4209	Plug Valve Limit Switch Transmitter		2		DA	Limit Switch on Plug Valve FCV-PB-4206						X							
ZT-PB-4309	Plug Valve Limit Switch Transmitter		2		DA	Limit Switch on Plug Valve FCV-PB-4306						X							
EX-CRS-01	Shop Fire Extinguisher #1		NA		DA	Type ABC handheld fire extinguisher													
EX-CRS-02	Shop Fire Extinguisher #2		NA		DA	Type ABC handheld fire extinguisher													
EX-CR-01	Control Room Fire Extinguisher		NA		DA	Type ABC handheld fire extinguisher													
EX-CRSP-01	Sample Prep Fire Extinguisher		NA		DA	Type ABC handheld fire extinguisher													
EX-SS1-01	SS-1 Fire Extinguisher		NA		DA	Type ABC handheld fire extinguisher													
EX-LP-01	Silo #1 Fire Extinguisher		NA		DA	Type ABC handheld fire extinguisher													
EX-LP-02	Silo #2 Fire Extinguisher		NA		DA	Type ABC handheld fire extinguisher													
EX-BB-01	MCC Room Fire Extinguisher		NA		DA	Type ABC handheld fire extinguisher													
EX-BB-02	Emergency Generator Room Fire Extinguisher		NA		DA	Type ABC handheld fire extinguisher													
EX-BB-03	Blower Room Fire Extinguisher		NA		DA	Type ABC handheld fire extinguisher													
EX-SS2-01	SS-2 Fire Extinguisher		NA		DA	Type ABC handheld fire extinguisher													
EX-SS3E-01	SS-3E Fire Extinguisher		NA		DA	Type ABC handheld fire extinguisher													
EX-SS5-01	SS-5 Fire Extinguisher		NA		DA	Type ABC handheld fire extinguisher													
EX-TS-01	Traveling Screen Fire Extinguisher		NA		DA	Type ABC handheld fire extinguisher													

Warm Springs Ponds
Facility Identification
Remediation System Identification

25200 East Side Road
Anaconda, MT 59711

Protective System Device Safe Chart

LEGEND

X = Action is Performed
S = System Shutdown Directly
C = Cascading Event

CAUSE TYPE = DIRECT ACTING, PLC BASED, OR ELECTRO-MECHANICAL BASED, AND DESCRIPTION

DEVICE ID	NAME	SET POINT	TIME DELAY (min)	DEAD BAND	TYPE	Description	Display Status on HMI Panel (Display)	Audible Control Panel Alarm (Activate)	Visual Control Panel Alarm (Activate)	Auto Dialer Notification (Activate)	Local Alarm (Display)	Starts PLC Timer Interlock (Activate)	Lime Feed System Shutodown (Deactivate)	Lime Transfer (Startup) (Activate)	Automatic Trasnfer Switch (Activate)	Back-up Generator (Activate)	Gravity Drain of Fluids (Activate)	Vent to Atmosphere (Activate)	Manual Alarm Activation By Operator (Activate)
EX-PB-01	Pump Station #1 Fire Extinguisher #1		NA		DA	Type ABC handheld fire extinguisher													
EX-PB-02	Pump Station #2 Fire Extinguisher #2		NA		DA	Haylon handheld fire extinguisher.													
ESS-LP-1014	Silo # 1 E-Stop	Stop	NA		DA	Silo # 1 Emergency Stop Button	X		C	C	C		C						
ESS-LP-1015	Silo # 2 E-Stop	Stop	NA		DA	Silo # 1 Emergency Stop Button	X		C	C	C		C						
POND-1	Pond 1 Critical dam/dike embankments		NA			Eath and dam embankments													
POND-2	Pond 2 Critical dam/dike embankments		NA			Eath and dam embankments													
POND-3	Pond 3 Critical dam/dike embankments		NA			Eath and dam embankments													
YA-RDU8-2330	RTU 1 siren		NA		EMECH	Dam safety/ Emergency alert siren	X	X	X	C									X
YA-PB-2331	Traveling Screen Siren		NA		EMECH	Dam safety/ Emergency alert siren	X	X	X	C									X
LT-PD3-2301	Pond 3 Level Hi	4871 FT	5		PLC	Hi level alarm from level probe on pond 3	X	X		C	X								
LT-PD3-2301	Pond 3 Level HiHi	4871.5 FT	5		PLC	HiHi level alarm from level probe on pond 3	X	X		C	X								
LT-PD2-3201	Pond 2 Level Hi	4835.35 FT	5		PLC	Hi level alarm from level probe on pond 2	X	X		C	X								
LT-PD2-3201	Pond 2 Level HiHi	4835.5 FT	5		PLC	HiHi level alarm from level probe on pond 2	X	X		C	X								
LT-PD1-1001	Pond 1 Dry closure Level switch						X	X		C	X								

Denotes Critical Equipment

Revision Date	Description	Responsible Party
12/22/2014	EMOC. 239	Scott Sampson/ PSD Removal Request
5/11/2016	Added poppet PRVs, Revised some ID numbers, Added CE	Casey Briggs
11/5/2018	Removed ZT-PB-4409 per WSP Pumpback System Motor Control Upgrades (Nov 2017)	Casey Briggs

Warm Springs Ponds Operating Unit
Anaconda NPL

Anaconda, MT

INSPECTION AND TESTING PLAN

NUMBER	TYPE	DESCRIPTION	TEST	FREQUENCY	JOB PLAN	PROCEDURE	GMS	TEST DATE	NEXT DATE
PRV-LP-1001A	Poppet Style Pressure Relief Valve	Air Compressor (AC-LP-1001) Pressure Relief Valve (Head)	Inspect & Functional	Quarterly	IR-PSD-7-C	WSP-IM-QI-5	Relief Valves - Poppet		
			Replacement	Annual	IR-PSD-7-A	WSP-IM-SOP-R7	Relief Valves - Poppet		
PRV-LP-1001B	Poppet Style Pressure Relief Valve	Air Compressor (AC-LP-1001) Pressure Relief Valve (Tank)	Inspect & Functional	Quarterly	IR-PSD-7-C	WSP-IM-QI-5	Relief Valves - Poppet		
			Replacement	Annual	IR-PSD-7-A	BTL-IM-SOP-R7	Relief Valves - Poppet		
PRV-LP-1001C	Poppet Style Pressure Relief Valve	Air Compressor (AC-LP-1001) Pressure Relief Valve (Line)	Inspect & Functional	Quarterly	IR-PSD-7-C	WSP-IM-QI-5	Relief Valves - Poppet		
			Replacement	Annual	IR-PSD-7-A	BTL-IM-SOP-R7	Relief Valves - Poppet		
PRV-LP-1002A	Poppet Style Pressure Relief Valve	Air Compressor (AC-LP-1002) Pressure Relief Valve (Head)	Inspect & Functional	Quarterly	IR-PSD-7-C	WSP-IM-QI-5	Relief Valves - Poppet		
			Replacement	Annual	IR-PSD-7-A	BTL-IM-SOP-R7	Relief Valves - Poppet		
PRV-LP-1002B	Poppet Style Pressure Relief Valve	Air Compressor (AC-LP-1002) Pressure Relief Valve (Tank)	Inspect & Functional	Quarterly	IR-PSD-7-C	WSP-IM-QI-5	Relief Valves - Poppet		
			Replacement	Annual	IR-PSD-7-A	BTL-IM-SOP-R7	Relief Valves - Poppet		
PRV-LP-1002C	Poppet Style Pressure Relief Valve	Air Compressor (AC-LP-1002) Pressure Relief Valve (Line)	Inspect & Functional	Quarterly	IR-PSD-7-C	WSP-IM-QI-5	Relief Valves - Poppet		
			Replacement	Annual	IR-PSD-7-A	BTL-IM-SOP-R7	Relief Valves - Poppet		
PRV-LP-1102	Pressure Relief Valve	Air Blower (B-LP-1) Pressure Relief Valve	Function Test	Annual	IR-PSD-8-A	Service Contract	Relief Valves		
			External Inspection	Quarterly	IR-PSD-8-Q	WSP-IM-QI-8	Relief Valves		
PRV-LP-1202	Pressure Relief Valve	Air Blower (B-LP-2) Pressure Relief Valve	Function Test	Annual	IR-PSD-8-A	Service Contract	Relief Valves		
			External Inspection	Quarterly	IR-PSD-8-Q	WSP-IM-QI-8	Relief Valves		
PRV-LP-1302	Pressure Relief Valve	Air Blower (B-LP-3) Pressure Relief Valve	Function Test	Annual	IR-PSD-8-A	Service Contract	Relief Valves		
			External Inspection	Quarterly	IR-PSD-8-Q	WSP-IM-QI-8	Relief Valves		
PRV-LP-1402	Pressure Relief Valve	Air Blower (B-LP-4) Pressure Relief Valve	Function Test	Annual	IR-PSD-8-A	Service Contract	Relief Valves		
			External Inspection	Quarterly	IR-PSD-8-Q	WSP-IM-QI-8	Relief Valves		
ZI-LP-1721	PLC Based Fault Alarm	Screw Feeder (SF-LP-1700) Zero Speed	Inspect & Functional	Annual	IR-PSD-4-C	Service Contract	Interlocks		
ZS-LP-1013	PLC Based Fault Alarm	ATS in Emergency Position	Function Test	Annual	IR-PSD-2-A	Service Contract	4-20mA Transmitting		
			External Inspection	Quarterly	IR-PSD-2-Q	In Progress	4-20mA Transmitting		
ZA-SS3E-2325	PLC Based Fault Alarm	SS-3E Power Failure	Inspect & Functional	Annual	IR-PSD-4-C	Service Contract	Interlocks		
ZA-SS5-3220	PLC Based Fault Alarm	SS-5 Power Failure	Inspect & Functional	Annual	IR-PSD-4-C	Service Contract	Interlocks		
LT-PB-4001	Level Indication	Groundwater Interception Trench Level	Function Test	Annual	IR-PSD-2-A	Service Contract	4-20mA Transmitting		
			External Inspection	Quarterly	IR-PSD-2-Q	WSP-IM-QI-1	4-20mA Transmitting		
ZA-PB-4101	PLC Based Fault Alarm	Pump Station #1 Pump P-PB-1 Failure	Inspect & Functional	Annual	IR-PSD-4-C	Service Contract	Interlocks		
ZA-PB-4201	PLC Based Fault Alarm	Pump Station #1 Pump P-PB-2 Failure	Inspect & Functional	Annual	IR-PSD-4-C	Service Contract	Interlocks		
ZA-PB-4301	PLC Based Fault Alarm	Pump Station #1 Pump P-PB-3 Failure	Inspect & Functional	Annual	IR-PSD-4-C	Service Contract	Interlocks		
ZA-PB-4401	PLC Based Fault Alarm	Pump Station #1 Pump P-PB-4 Failure	Inspect & Functional	Annual	IR-PSD-4-C	Service Contract	Interlocks		
ZA-PB-4003	PLC Based Fault Alarm	Pump Station #1 Power Failure	Inspect & Functional	Annual	IR-PSD-4-C	Service Contract	Interlocks		
ZT-PB-4109	Limit Switch Transmitter	Plug Valve Limit Switch	Function Test	Annual	IR-PSD-1-A	Service Contract	Switches		
			External Inspection	Quarterly	IR-PSD-1-Q	WSP-SOP-IM-VI-1	Switches		
ZT-PB-4209	Limit Switch Transmitter	Plug Valve Limit Switch	Function Test	Annual	IR-PSD-1-A	Service Contract	Switches		
			External Inspection	Quarterly	IR-PSD-1-Q	WSP-SOP-IM-VI-1	Switches		
ZT-PB-4309	Limit Switch Transmitter	Plug Valve Limit Switch	Function Test	Annual	IR-PSD-1-A	Service Contract	Switches		
			External Inspection	Quarterly	IR-PSD-1-Q	WSP-SOP-IM-VI-1	Switches		

Warm Springs Ponds Operating Unit
Anaconda NPL

Anaconda, MT

INSPECTION AND TESTING PLAN									
NUMBER	**TYPE**	**DESCRIPTION**	**TEST**	**FREQUENCY**	**JOB PLAN**	**PROCEDURE**	**GMS**	**TEST DATE**	**NEXT DATE**
EX-CRS-01	Handheld Fire Extinguisher	Shop Fire Extinguisher #1	External Inspection	Monthly	IR-PSD-5-M	WSP-SOP-IM-MI-1	Fire Extinguishers		
			Re-Certification	Annual	IR-PSD-5-A	Service Contract	Fire Extinguishers		
EX-CRS-02	Handheld Fire Extinguisher	Shop Fire Extinguisher #2	External Inspection	Monthly	IR-PSD-5-M	WSP-SOP-IM-MI-1	Fire Extinguishers		
			Re-Certification	Annual	IR-PSD-5-A	Service Contract	Fire Extinguishers		
EX-CR-01	Handheld Fire Extinguisher	Control Room Fire Extinguisher	External Inspection	Monthly	IR-PSD-5-M	WSP-SOP-IM-MI-1	Fire Extinguishers		
			Re-Certification	Annual	IR-PSD-5-A	Service Contract	Fire Extinguishers		
EX-CRSP-01	Handheld Fire Extinguisher	Sample Prep Fire Extinguisher	External Inspection	Monthly	IR-PSD-5-M	WSP-SOP-IM-MI-1	Fire Extinguishers		
			Re-Certification	Annual	IR-PSD-5-A	Service Contract	Fire Extinguishers		
EX-SS1-01	Handheld Fire Extinguisher	SS-1 Fire Extinguisher	External Inspection	Monthly	IR-PSD-5-M	WSP-SOP-IM-MI-1	Fire Extinguishers		
			Re-Certification	Annual	IR-PSD-5-A	Service Contract	Fire Extinguishers		
EX-LP-01	Handheld Fire Extinguisher	Silo #1 Fire Extinguisher	External Inspection	Monthly	IR-PSD-5-M	WSP-SOP-IM-MI-1	Fire Extinguishers		
			Re-Certification	Annual	IR-PSD-5-A	Service Contract	Fire Extinguishers		
EX-LP-02	Handheld Fire Extinguisher	Silo #2 Fire Extinguisher	External Inspection	Monthly	IR-PSD-5-M	WSP-SOP-IM-MI-1	Fire Extinguishers		
			Re-Certification	Annual	IR-PSD-5-A	Service Contract	Fire Extinguishers		
EX-BB-01	Handheld Fire Extinguisher	MCC Room Fire Extinguisher	External Inspection	Monthly	IR-PSD-5-M	WSP-SOP-IM-MI-1	Fire Extinguishers		
			Re-Certification	Annual	IR-PSD-5-A	Service Contract	Fire Extinguishers		
EX-BB-02	Handheld Fire Extinguisher	Emergency Generator Room Fire Extinguisher	External Inspection	Monthly	IR-PSD-5-M	WSP-SOP-IM-MI-1	Fire Extinguishers		
			Re-Certification	Annual	IR-PSD-5-A	Service Contract	Fire Extinguishers		
EX-BB-03	Handheld Fire Extinguisher	Blower Room Fire Extinguisher	External Inspection	Monthly	IR-PSD-5-M	WSP-SOP-IM-MI-1	Fire Extinguishers		
			Re-Certification	Annual	IR-PSD-5-A	Service Contract	Fire Extinguishers		
EX-SS2-01	Handheld Fire Extinguisher	SS-2 Fire Extinguisher	External Inspection	Monthly	IR-PSD-5-M	WSP-SOP-IM-MI-1	Fire Extinguishers		
			Re-Certification	Annual	IR-PSD-5-A	Service Contract	Fire Extinguishers		
EX-SS3E-01	Handheld Fire Extinguisher	SS-3E Fire Extinguisher	External Inspection	Monthly	IR-PSD-5-M	WSP-SOP-IM-MI-1	Fire Extinguishers		
			Re-Certification	Annual	IR-PSD-5-A	Service Contract	Fire Extinguishers		
EX-SS5-01	Handheld Fire Extinguisher	SS-5 Fire Extinguisher	External Inspection	Monthly	IR-PSD-5-M	WSP-SOP-IM-MI-1	Fire Extinguishers		
			Re-Certification	Annual	IR-PSD-5-A	Service Contract	Fire Extinguishers		
EX-TS-01	Handheld Fire Extinguisher	Traveling Screen Fire Extinguisher	External Inspection	Monthly	IR-PSD-5-M	WSP-SOP-IM-MI-1	Fire Extinguishers		
			Re-Certification	Annual	IR-PSD-5-A	Service Contract	Fire Extinguishers		
EX-PB-01	Handheld Fire Extinguisher	Pump Station #1 Fire Extinguisher #1	External Inspection	Monthly	IR-PSD-5-M	WSP-SOP-IM-MI-1	Fire Extinguishers		
			Re-Certification	Annual	IR-PSD-5-A	Service Contract	Fire Extinguishers		
EX-PB-02	Handheld Fire Extinguisher	Pump Station #2 Fire Extinguisher #2	External Inspection	Monthly	IR-PSD-5-M	WSP-SOP-IM-MI-1	Fire Extinguishers		
			Re-Certification	Annual	IR-PSD-5-A	Service Contract	Fire Extinguishers		
ESS-LP-1014	E-STOP	Silo #1 E-Stop	External Inspection/Function Test	Quarterly	IR-PSD-3-C	WSP-SOP-IM-QI-4	Switch		
ESS-LP-1015	E-STOP	Silo #2 E-Stop	External Inspection/Function Test	Quarterly	IR-PSD-3-C	WSP-SOP-IM-QI-4	Switch		
POND-1	Embankment	Earth and Dam Embankments	Annual Inspection	Annual	NA	see OM&M IMPs	IMPs		
POND-2	Embankment	Earth and Dam Embankments	Annual Inspection	Annual	NA	see OM&M IMPs	IMPs		
POND-3	Embankment	Earth and Dam Embankments	Annual Inspection	Annual	NA	see OM&M IMPs	IMPs		

Warm Springs Ponds Operating Unit
Anaconda NPL

Anaconda, MT

INSPECTION AND TESTING PLAN									
NUMBER	TYPE	DESCRIPTION	TEST	FREQUENCY	JOB PLAN	PROCEDURE	GMS	TEST DATE	NEXT DATE
YA-RDU8-2330	Emergency alert siren	RTU 1 siren	External Inspection/Function Test	Quarterly	IR-PSD-3-C	WSP-SOP-IM-VI-1	Switch		
				Monthly					
				Semi Annual					
YA-PB-2331	Emergency alert siren	Traveling Screen siren	External Inspection/Function Test	Quarterly	IR-PSD-3-C	WSP-SOP-IM-VI-1	Switch		
				Monthly					
				Semi Annual					
LT-PD3-2301	Level Transmitter	Pond 3 Level Transmitter	Level check/ Alarm verfication	Quarterly		In Progress	4-20mA Transmitting		
							4-20mA Transmitting		
LT-PD2-3201	Level Transmitter	Pond 2 Level transmitter	Level check/ Alarm verfication	Quarterly		In Progress	4-20mA Transmitting		
							4-20mA Transmitting		
LS-PD1-3211	Level Switch	Pond 1 Dry Closure Level Switch	Alarm verification	Semi-Annual		In Progress	4-20mA Transmitting		
							4-20mA Transmitting		

Denotes Critical Equipment

Revision Date	Description	Responsible Party
12/22/2014	EMOC. 239	Scott Sampson/ PSD Removal Request
5/11/2016	Added poppet PRVs, Revised some ID numbers, Added CE	Casey Briggs
11/5/2018	Removed ZT-PB-4409 per WSP Pumpback System Motor Control Upgrades (Nov 2017)	Casey Briggs