CITY OF BEND

City Hall
710 NW Wall Street
Bend, OR 97703

RESOLUTION NO. 3473

A Resolution of the City Council adopting the Outback Facility Plan

Findings

A. The City of Bend ("City'") operates a public drinking water system within the City of Bend, that supplies reliable, high-quality water to its customers from both surface and groundwater sources.

B. The City's surface water delivery system starts with a diversion within the Bend Watershed in the Deschutes National Forest, delivering water by gravity to the Water Filtration Facility ("WFF") at a site known as Outback (the "Outback Site").

C. City Council goals for the 2025-2027 biennium include a goal for Transportation & Infrastructure, to "Ensure water, wastewater, and stormwater systems are aligned with the needs of a growing city and understand capacity for growth," with an action item to "Finish updating plans for the Water Reclamation and Filtration Facilities, focusing on environmental stewardship, wildfire resiliency, and clean energy opportunities."

D. City Council adopted a Water Public Facility Plan ("PFP") on December 1, 2021, to comply with Oregon Administrative Rules ("OAR") Chapter 660, Division 11 and Oregon State Planning Goal 11, which requires cities to develop a timely, orderly and efficient arrangement of public facilities and services to serve as a framework for urban development.

E. On October 6, 2021, the City Council adopted the Integrated Water System Master Plan ("iWSMP"). The iWSMP evaluated the ability of the City's water system to meet desired level of service standards under existing and future conditions and identified specific projects and timing for the development of the City's water infrastructure. The iWSMP identified the need for extensive investment at the Outback Site, and included as an addendum the Outback Siting Study, which identified the need to expand the Outback Site to accommodate future infrastructure needs.

F. The Outback Site is located on 15 acres owned outright by the City, and currently consists of infrastructure including a membrane filtration facility, reservoirs, and active groundwater wells. The City is currently going through the process of acquiring 48 additional acres of Forest Service land adjacent to the existing Outback Site, to provide room for additional facilities identified as needed in the iWSMP.

G. The Outback Facility Plan (the "Facility Plan") identifies and further refines improvements identified in the iWSMP and the Outback Siting Study, needed at the Outback site over the next 20 years to continue providing high quality reliable drinking water to the Bend community. The Outback Site is a critical piece of the City's water system infrastructure. The site contains the terminus of the surface water transmission pipeline, the WFF, seven

wells, four above ground reservoirs, and storage of essential equipment and related supplies.

H. The Facility Plan builds on previous planning efforts, including the iWSMP, and incorporates updated infrastructure needs, operational priorities, and long-term resiliency goals to identify future potential upgrades including a new groundwater production well, new water storage reservoirs, in-conduit hydropower generation, and miscellaneous site improvements to enhance water supply system resilience and efficiency. The Facility Plan also provides preliminary design for pretreatment facilities that will enable the existing WFF to continue operating after a wildfire if one were to occur in the watershed and addresses seasonal conditions that require the City to shut down the treatment plant several times each year.

I. The Facility Plan provides an integrated site plan for the Outback Site, identifies regulatory requirements, permitting pathways, and anticipated timelines for development, provides planning-level cost estimates for proposed improvements, and outlines a recommended approach for sequencing and prioritization of proposed improvements.

J. The planned improvements in the Facility Plan are sized for a maximum diversion and raw water transmission pipeline supply rate of 18.2 cubic feet per second (cfs) per the Forest Service Special Use Permit and City code. Neither the pretreatment facilities nor in-conduit hydropower are planned to enable an increase to this rate of diversion.

K. The Facility Plan was developed in close coordination with City Water Services and Engineering staff through a series of workshops and reoccurring coordination meetings.

L. The City of Bend is committed to efficient and responsible use of our water resources, including environmental stewardship, wildfire resiliency, and clean energy opportunities. The Facility Plan will help City Engineering staff and City Council responsibly plan for and execute needed site improvements and steward these water resources into the future, while continuing to provide reliable, high-quality water to its customers.

Resolution

Based on these findings, the City Council of the City of Bend resolves as follows:

1. The Outback Facility Plan, attached as Exhibit A, is adopted.
2. This resolution takes effect immediately upon adoption.

Adopted by the Bend City Council

May 20, 2026

Yes: Kebler, Franzosa, Méndez, Norris, Perkins, Platt, Riley

No:

Melanie Kebler, Mayor

Attest:

Ashley Bontje, City Recorder

Approved as to form:

Ian Leitheiser, City Attorney

City of Bend

Outback Facility Plan

April 2026

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Outback Facility Plan

City of Bend

April 2026

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Appendix

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Acronyms & Abbreviations

A

AACE	Association for the Advancement of Cost Engineering
AWIA	America's Water Infrastructure Act
AWWA	American Water Works Association

C

City	City of Bend
cfs	Cubic Feet per Second

D

DCC	Deschutes County Code
DCVA	Double Check Valve Assembly

E

EA	Environmental Assessment
ENR	Engineering News-Record
EPA	Environmental Protection Agency

F

FATO	Final Approach and Takeoff Area
FERC	Federal Energy Regulatory Commission

G

gpm	Gallons per Minute

H

HDPE	High-Density Polyethylene
HPRW	High-Pressure Raw Water Transmission
HVAC	Heating, Ventilating, and Air Conditioning

I

iWSMP	Integrated Water System Master Plan

K

kV	Kilovolt

L

LM	Landscape Management

M

MBTA	Migratory Bird Treaty Act
MF	Microfiltration
MG	Million Gallons
mg/L	Milligrams per Liter
MGD	Million Gallons per Day

N

NEPA	National Environmental Policy Act
NTU	Nephelometric Turbidity Units

O

O&M	Operations and Maintenance

OAR	Oregon Administrative Rule
ODFW	Oregon Department of Fish and Wildlife
OHA	Oregon Health Authority
OPCC	Opinions of Probable Construction Cost
ORS	Oregon Revised Statutes
OSHG	On-Site Sodium Hypochlorite Generation

P

PAC	Powdered Activated Carbon
PAX	Polyaluminum chloride
PDC	Project Design Criteria
PF	Public Facilities
PFAS	Per & Poly-Fluoroalkyl Substances
PRV	Pressure Reducing Valve
psi	Pounds per Square Inch

S

SCADA	Supervisory Control and Data Acquisition

T

TOC	Total Organic Carbon

U

USFWS	US Fish and Wildlife Service

V

VAC	Volt Alternating Current

W

WA	Wildlife Area
WFF	Water Filtration Facility
WSE	Water Surface Elevation

CHAPTER 1

Introduction

1.1 Project Background and Purpose

The City of Bend (City) is located east of the Cascade Mountains in Central Oregon and serves a population of approximately 109,000 people (2025). The City owns and operates a dual-source municipal water system that includes surface water from the Bend Municipal Watershed and groundwater from the Deschutes Regional Aquifer, supplying treated water to roughly 30,000 service connections (2025). As the City continues to grow and face evolving challenges including regulatory changes, aging infrastructure, and increasing exposure to natural hazards such as wildfires, drought, and seismic events, strategic planning is essential to ensure long-term reliability and resiliency.

The purpose of this Outback Facility Plan (Facility Plan) is to provide a comprehensive roadmap for future improvements at the City's Outback Site, a key water infrastructure location that houses the City's Water Filtration Facility (WFF) and seven active groundwater wells. It is planned for future upgrades including new groundwater production well(s), surface water pretreatment, new water storage reservoirs, in-conduit hydropower generation, and miscellaneous site improvements to enhance water supply system resilience and efficiency. This Facility Plan builds on previous planning efforts and incorporates updated infrastructure needs, operational priorities, and long-term resiliency goals. The plan includes a phased implementation strategy and preliminary design for key upgrades, optimizing operations, supporting future capacity demands, and improving the system's ability to respond to emergencies and maintain service during disruptive events.

1.2 Previous Studies Summary

Several studies provided the starting point for this Facility Plan. These efforts identified infrastructure needs such as pretreatment, reservoir upgrades, and in-conduit hydropower integration and are summarized below.

- September 2021 Integrated Water System Master Plan (iWSMP) developed by Consor
- 2021 Outback Siting Study (Outback Siting Study)
- January 2024 In-Conduit Hydropower Feasibility Study developed by Jacobs Engineering Group Inc. (In-conduit Hydropower Study)

1.2.1 iWSMP

On October 6, 2021 the City adopted the iWSMP. It documents key water system information and provides analysis and recommendations to inform infrastructure investments and system operations that will maintain high quality water for existing and future customers. The iWSMP identified needs for investment to address existing condition issues and additional future infrastructure at the Outback Site to serve system growth. Future needs at the Outback Site include potential replacement of some existing reservoirs, and construction of new storage and well infrastructure to serve future growth. The construction of pretreatment and in-conduit hydropower generation were also identified. The iWSMP discussed new pretreatment facilities to reduce raw water turbidity, improve WFF filter membrane life, and maintain WFF operation during post-fire events. It anticipated analysis of in-conduit hydropower to work in conjunction

with pretreatment and related facilities at the Outback Site. Specific projects identified in the iWSMP that are related to this Facility Plan are listed in Appendix A for reference.

1.2.2 Outback Siting Study – Appendix to the 2021 iWSMP

In September 2021, the Outback Siting Study was completed as an addendum to the iWSMP, to evaluate how recommended facilities, such as pretreatment, new and rebuilt reservoirs, wells, and other water-related infrastructure, could be accommodated on existing and potential expanded property of the Outback Site. The Outback Siting Study also considered space for a potential in-conduit hydropower generation building that could operate in conjunction with the pretreatment facilities to dissipate the energy of raw water supply while providing energy resilience of the Outback Site.

In addition to the projects summarized in Appendix A, the Outback Siting Study identified several potential long-term facility needs beyond the iWSMP's planning horizon. These conceptual improvements were developed collaboratively with City staff to support future operational efficiency, site security, and system resiliency as the City's water demands evolve.

The Outback Siting Study determined that approximately 48 to 50 acres of adjacent Forest Service land would need to be acquired to accommodate these long-term needs. A conceptual site plan was developed identifying an expansion area southwest of the existing site that maintains the current hydraulic gradient and provides secure, dedicated access from Skyliners Road while realigning Forest Service Road 4606 to improve safety, security, and operational control.

Table 1-1 provides a list of planned improvements that will be further discussed in this Facility Plan and which includes all projects identified in the Outback Siting Study.

1.2.3 In-Conduit Hydropower Feasibility Study

The In-Conduit Hydropower Study was completed and presented to Council in February 2024. It identified and evaluated potential locations for in-conduit hydropower generation within the City's municipal water system and provides a basis for consideration as well as recommended next steps. This effort was supported by the City's engineering and operations and maintenance (O&M) staff and included input and analyses by other City consultants regarding water rights, water system hydraulics, and economics of in-conduit hydropower development.

The WFF raw water pipeline was identified as a primary candidate for in-conduit hydropower to capture energy currently being wasted through existing energy dissipation facilities. The Outback site was identified to house these facilities, including the potential for energy storage, on-site interconnection, and interconnection with the public electric utility. On-site in-conduit hydropower generation and interconnection could provide energy resiliency benefits for both the WFF and regional electrical utility.

1.3 Planning Horizon

This Facility Plan is intended to guide improvements at the Outback Site over a long-term planning horizon consistent with the iWSMP. While specific design elements focus on near-term implementation, the overall plan considers infrastructure needs through 2045 and beyond, including future expansion, resiliency, and regulatory compliance.

1.4 Stakeholder Coordination

Development of this Facility Plan was completed in close coordination with City staff from Water Services and Engineering. A series of workshops and regular project meetings were held to review alternatives, confirm priorities, and align recommendations with operational goals. Engagement with external stakeholders occurred through a public open house held on August 27, 2025, which included participation from organizations such as Bend Park and Recreation District, Central Oregon Trail Alliance, Central Oregon LandWatch, and the Upper Deschutes Watershed Council.

1.5 Planned Improvements Overview

Building on the prior planning documents listed above, this Facility Plan identifies key improvement projects/elements to enhance system resiliency, reliability, and operational efficiency. **Table 1-1** summarizes the projects/elements in an unprioritized listing and subsequent chapters (**Chapter 3** through **Chapter 6**) refine these recommendations, advancing the highest-priority projects for preliminary design while retaining other long-term needs for future consideration. **Chapter 9** provides an implementation and phasing plan.

Table 1-1 | Key Improvement Projects/Elements of the Outback Facility Plan

Facility/Project	Description/Function	Facility Plan Chapter of Section References
Pretreatment Processes	New pretreatment facilities reduce raw water turbidity, improve WFF filter membrane life, and maintain WFF operation during post-fire events and high turbidity events.	Chapter 3
Solids Drying Beds	Concrete drying beds to manage solids generated from pretreatment and WFF operations.	Section 3.9
On-Site Sodium Hypochlorite Generation (OSHG)	Provide on-site generation of sodium hypochlorite for primary and residual disinfection, reducing reliance on delivered chemicals, improving safety and reliability, and enhancing resilience during supply chain disruptions and emergency operations.	Section 3.10
Pretreatment Building: Integrated Operations Complex	Combines operations center, staff facilities, training space, maintenance shop, warehouse, and parking in a unified hub that will support pretreatment building operations, workforce readiness, and emergency coordination.	Section 3.11
In-Conduit Hydropower System and Energy Dissipation	Recover energy from flow through the raw water transmission pipeline also referred to as the high-pressure raw water transmission (HPRW) pipe to offset operational costs and support sustainability and resiliency goals.	Chapter 4
Reservoir Improvements	Replace and/or rehabilitate existing reservoirs, and additional water storage to provide adequate storage and decommission aging infrastructure.	Chapter 5
Water Supply – Groundwater Expansion and Well Optimization	Expand groundwater supply at the Outback Site for redundancy and emergency operations during surface water shortages. Retrofit of existing wells to improve resiliency of existing groundwater infrastructure at the Outback Site.	Section 6.5

Facility/Project	Description/Function	Facility Plan Chapter of Section References
Outback Site Transmission Main Projects	New and replacement transmission pipelines to improve hydraulic performance, address aging infrastructure, and enhance system reliability at the Outback Site.	Section 6.6
Site Access and Security Improvements	Fencing, gates, and America's Water Infrastructure Act (AWIA)-compliant security infrastructure to address high public use in the area. Realign Forest Service Road 4606 to connect from Skyliners Road and divert public use away from the water facilities; part of new secure City access.	Section 6.7
Per & Poly-Fluoroalkyl Substances (PFAS) Treatment Space Allocation	Reserve space for potential future PFAS removal facilities to ensure regulatory flexibility.	Section 6.8
Forest Service Wildland Fire Fighting Infrastructure	Dedicated infrastructure to support Forest Service wildland firefighting operations, including a water fill station, dip pond, and helipad, to improve aerial and ground firefighting response, staging, and coordination during wildfire events.	Section 6.9

Together, the recommendations listed in Table 1-1 establish a framework for transforming the Outback Site into a fully integrated operations and water supply campus, enhancing reliability, operational flexibility, and resiliency for future generations.

1.6 Parallel Efforts and Future Considerations

Several related efforts are ongoing in parallel with this Facility Plan and may influence future design and implementation phases. These include:

- Bend WFF Energy Resiliency Study – An energy resilience and microgrid feasibility assessment for the Outback WFF campus was initiated in July 2025 in coordination with Energy Trust of Oregon. The assessment evaluates opportunities to improve power reliability and resilience through integration of battery energy storage, the existing photovoltaic system, and the planned in-conduit hydropower facility. The study includes campus-level load analysis, conceptual system sizing, interconnection considerations, and planning-level evaluation of outage-response capabilities. Results from this effort may inform future electrical design decisions but are not incorporated into the recommendations or cost opinions presented in this Facility Plan.

- Well Optimization Study – A parallel well optimization effort is underway to evaluate and design capacity upgrades to existing groundwater wells at the Outback Site. The study focuses on optimizing Wells No. 3 through 7, with design engineering to increase pumping capacity at Wells No. 3 through 6 by approximately 300 gallons per minute (gpm) per well through replacement of pumps, motors, and associated mechanical and electrical equipment. The work also includes evaluation of pump-to-waste piping, monitoring instrumentation, electrical load impacts, and backup power provisions, while maintaining existing well operations and disinfection practices. Findings and design outcomes from this effort will inform future groundwater supply capacity assumptions, electrical coordination, and implementation sequencing but are not fully incorporated into the planning-level recommendations presented in this Facility Plan.

- Coordination with the Forest Service – The City has initiated acquisition of 48 acres of adjacent Forest Service land under the Townsite Act, as identified in the Outback Siting Study. This Facility

Plan assumes the land will be acquired and incorporates planning-level accommodation for wildfire-resilience and firefighting infrastructure, as well as improved site access and circulation.

These efforts are being conducted concurrently and will inform final design decisions, implementation phasing, and long-term planning. Recommendations in this Facility Plan are based on current information and assumptions that will be refined as additional data becomes available.

1.7 Report Organization

The remainder of this report is organized as follows:

- **Chapter 2 – Existing Conditions at the Outback Site:** Provides a high-level overview of existing infrastructure and operations at the Outback Site.
- **Chapter 3 – Pretreatment Preliminary Design Development:** Details the preliminary design for pretreatment facilities, including supporting evaluations and design criteria.
- **Chapter 4 – In-Conduit Hydropower and Energy Dissipation Preliminary Design Development:** Outlines conceptual layout and planning for in-conduit hydropower generation, including turbine siting, electrical integration, and operational strategy.
- **Chapter 5 – Reservoir Siting and Integration:** Presents conceptual planning for additional storage through reservoir siting on the existing site, evaluates partial demolition of existing tanks, and develops an integrated layout that maintains operational levels, ensures chlorine contact time, and considers sequencing and timing of improvements.
- **Chapter 6 – Facility Site Plan:** Builds on work completed in previous chapters to develop a fully integrated site plan for the Outback Site. This chapter consolidates pretreatment facilities, in-conduit hydropower infrastructure, and reservoir concepts into a cohesive layout while addressing additional elements not fully detailed earlier, such as PFAS treatment footprint and constraints, security considerations, groundwater well siting, and other future improvements. The goal is to provide a holistic framework that aligns existing conditions, planned upgrades, and long-term objectives.
- **Chapter 7 – Permitting Strategy:** Identifies regulatory requirements, permitting pathways, and anticipated timelines.
- **Chapter 8 – Opinions of Probable Construction Cost (OPCC):** Provides planning-level cost estimates for proposed improvements and supporting assumptions.
- **Chapter 9 – Implementation and Phasing Plan:** Outlines the recommended approach for sequencing and prioritizing proposed improvements, including key criteria and schedule considerations.
- **Appendices**: Includes technical memoranda, conceptual drawings, and supporting documentation referenced throughout the report.

This comprehensive Facility Plan establishes a strong foundation for future design phases that builds upon work already completed and implementation of critical infrastructure improvements at the City's Outback Site. Active collaboration with the City throughout development ensured alignment with municipal priorities and long-term planning goals.

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CHAPTER 2

Existing Conditions at the Outback Site

2.1 Introduction

This chapter provides a high-level overview of the City's existing system at the Outback Site with a focus on elements that may be impacted by planned improvements. It is not intended to be a comprehensive summary of all infrastructure or operations at the site. Impacts resulting from the proposed improvements are addressed in subsequent chapters.

2.2 Existing Water System Description

The City has the capability to supply drinking water to customers by using groundwater and surface water sources. The Outback Site is a critical piece of the City's water system infrastructure. The site contains the terminus of the surface water transmission pipeline, the WFF, a key wellfield location with seven wells, four above ground reservoirs, and storage of essential equipment and related supplies.

The existing Outback Site is located on 15 acres owned outright by the City. The site has evolved over time as infrastructure has been constructed to meet evolving federal regulations and meet the demands as the City has grown. The City is currently going through the process of acquiring 48 additional acres adjacent to the existing site, as discussed in Section 1.6.

The following subsections provide a high-level overview of the City's existing water system at the Outback Site. This overview is intended to summarize current infrastructure and operations. Changes resulting from planned site improvements are addressed in subsequent chapters.

2.2.1 Source Discussion

2.2.1.1 Surface Water Supply

The City's primary year-round water supply originates at the Prowell Springs Diversion located in the Bend Municipal Watershed on land that is owned and managed by the Forest Service. Prowell Springs Diversion conveys surface water to Bridge Creek and then to the WFF via a 30-inch HPRW pipe as discussed in Section 2.2.2. Diversion and its operation are allowed in this location under a Special Use Permit with the Forest Service.

The City's original surface water system, built in 1926, was significantly upgraded in 2015 with the addition of the WFF, which provides filtration to meet modern drinking water standards including removal of pathogens such as Cryptosporidium and Giardia. Planning is based on a maximum diversion and raw water transmission pipeline supply rate of 18.2 cubic feet per second (cfs) per the Special Use Permit and City code.

2.2.1.2 Groundwater Supply at Outback Site

Groundwater wells were constructed at the Outback Site and throughout the city to supplement the City's surface water supply. The groundwater is supplied by the Deschutes Regional Aquifer, a regionally significant aquifer underlying the Outback Site. Static groundwater levels at the site are generally observed at depths ranging from approximately 477 to 486 feet below ground surface, and water quality within the aquifer is high. Groundwater is primarily used to supply water during peak demand periods and to provide operational redundancy when surface water is unavailable.

There are seven existing well facilities at the Outback Site, all serving the City's Pressure Zone 3 (PL-3). Water quality is high in the aquifer and there is no treatment provided at the well facilities other than flow-paced chlorine gas disinfection at the wellheads to meet required residual chlorine levels throughout the distribution system. Well facility operations for Wells 3, 4, 5, 6, and 7 are fully automated, responding to fluid level monitoring at Outback Reservoir 3. Wells 1 and 2 are manually operated as needed to supply water to PL-3 and are typically not in service unless the surface water is shutdown.

Standby power is supplied by two diesel engine-driven generators, which serve five of the seven groundwater wells. Well No. 3 diesel-fueled standby generator is mounted on a 250-gallon fuel tank, providing backup power to Wells No. 3, 4, and 5. Well No. 6's diesel-fueled standby generator is mounted on a 250-gallon fuel tank and provides power supply to Wells No. 6 and 7. The duration of available standby power is unknown. Well No. 2 control building has a plug connection for a mobile diesel engine generator that will run Wells No. 1 and 2. **Table 2-1** provides a list of the existing well facilities at the Outback Site and associated flow rates and other pertinent information.

Table 2-1 | Existing Groundwater Wells at the Outback Site

Well Name (Well Log)	Install year	Flow Rate[1] (gpm)	Motor HP	Pump Type	Casing Diameter (in)	Total Well Depth (ft)	Standby Power
Outback Well 1 (DESC 8509)	1993	700	150	Submersible	12	700	Y – Plug Connection
Outback Well 2 (DESC 50953)	1997	985	175	Submersible	12	751	Y – Plug Connection
Outback Well 3 (DESC 53735)	2001	1,100	250	VT	16	850	Y - Dedicated
Outback Well 4 (DESC 54252 & 55365)	2001	1,100	250	VT	16	845	Y - Dedicated
Outback Well 5 (DESC 56371)	2004	1,100	250	VT	16	861	Y - Dedicated
Outback Well 6 (DESC 65449)	2004	1,100	250	VT	16	864	Y - Dedicated
Outback Well 7 (DESC 57760)	2006	1,250	250	VT	16	860	Y - Dedicated

Notes:
1. Flow rates are from the City's Well Maintenance Plan.
2. VT = Vertical Turbine

Static groundwater elevation is 477 to 486 feet below ground surface at the Outback Site. Because well water production requires significant pumping energy, the City prioritizes the use of the gravity-fed surface water supply whenever conditions allow. The City's well system supplements surface water supply during high-demand periods, planned surface water intake, transmission, or filtration system maintenance, or

when surface water turbidity limits WFF operation. In addition to the wells at Outback, there are 20 active wells distributed throughout the water supply system.

2.2.2 Raw Water Transmission Pipeline and Flow Control Structure

The City's surface water supply is conveyed by gravity from the Bridge Creek intake to the WFF through a 9.5-mile, 30-inch HPRW pipe constructed in 2012. The HPRW pipe runs through Forest Service lands from the intake to the Tumalo Creek crossing, then continues along Skyliner Road. From Skyliner Road to the WFF, the HPRW main primarily follows Forest Service roadways until reaching the Outback Site property. The pipeline, composed of welded steel, high-density polyethylene (HDPE), and ductile iron, drops approximately 1,009 feet in elevation between the intake (water surface elevation (WSE): approx. 4,995 feet) and the control structure at the Outback Site (WSE: approx. 3985.75 feet), generating significant hydraulic energy and producing a pressure of roughly 440 pounds per square inch (psi) at the Outback Site. To safely dissipate this energy and maintain controlled flow into the WFF, the HPRW pipe discharges to a raw water flow control structure equipped with multiple sleeve valves and stilling wells that reduce pressure to atmospheric conditions prior to treatment.

Ahead of the control structure, the 30-inch pipe divides into two 18-inch and one 8-inch pipes. The dual 18-inch pipes flow through the control structure and ultimately feed the WFF microfiltration (MF) feed wet well through the stilling wells, providing redundancy. Each pipe includes an electrically actuated isolation ball valve (FCV-00-102B/102C), a flow meter (FIT-00-103B/103C), and a motor-operated sleeve valve (MOV-00-120A/120B) that modulates flow to the operator-defined setpoint entered in the supervisory control and data acquisition (SCADA) system.

The 8-inch pipe supplies fire protection water to site hydrants and the WFF fire sprinkler system. It includes a high-pressure isolation valve (FCV-00-102A), pressure reducing valve (PRV) (PCV-000-103A), and two sleeve valves (SLV-00-103A1/A2) controlled by a process loop to maintain pressure. Flow in this line is measured by a 6-inch flow meter (FE-00-103A1).

2.2.3 Overflow Pond

The exiting overflow pond constructed in 2015 is located south of the WFF and adjacent to the raw water flow control structure. The overflow pond is unlined and receives overflows from the raw water flow control structure, emergency overflows from the MF feed wet well, discharge from the backwash recovery feed tanks, pump to waste flows from the Outback wells, stormwater from the site storm drains, and discharge from the Outback Site reservoir drains and overflows. The overflow pond has a total volume of 1.22 million gallons (MG) and is sized for the volume of the raw water pipeline, in the event the pipeline needs emptied for maintenance. The water in the overflow pond percolates into the ground beneath the site.

The overflow pond has an emergency overflow that originates immediately south of and adjacent to the raw water flow control structure. The emergency overflow for the pond has a design flowrate of 18.2 cfs or 11.2 million gallons per day (MGD) and will flow across the site access road to the west into natural drainage pathways that lead to Tumalo Creek.

2.2.4 Water Filtration Facility

The City is required to provide treatment of the Bridge Creek surface water supply to comply with federal and state regulations, including compliance with the Long Term 2 Enhanced Surface Water Treatment Rule. This rule requires removal of microscopic parasites like Cryptosporidium and Giardia lamblia. The City currently uses Pall membrane filtration to meet the Long Term 2 requirements and produce high-quality

water with low turbidity. Disinfection and pH adjustment are also provided to comply with the Environmental Protection Agency (EPA) Revised Total Coliform Rule and control lead/copper leaching per the EPA Lead and Copper Rule.

Vertical turbine feed pumps located in the MF feed wet well deliver water from the wet well through strainers in the WFF before sending flow to the membrane filters. The strainers protect the filter system from large particles or debris in the raw water that could cause damage. After passing through the strainers the water enters the Pall membrane filter system. The system is composed of five membrane racks: three primary duty racks; one swing module rack; and one rack dedicated to filtering the backwash water from the other racks for recovery.

The WFF is designed for the raw water transmission pipeline flows identified in **Table 2-2.**

Table 2-2 | Filtration Facility Capacity

Feed Flow	cfs	MGD	gpm
Minimum	6.2	4.0	2,783
Maximum	18.2	11.8	8,169

2.2.5 Operations and Control

Surface water flows by gravity from the intake facility to the Outback Site, where sleeve valves at the raw water control structure modulate flow based on the level bands of the CT Basin. Water from the sleeve valves enters the raw water control structure and then overflows into the MF feed wet well, passing under a baffle between chambers to promote mixing of chemicals added for treatment. For water quality optimization, sulfuric acid may be added at the stilling wells to control pH, and polyaluminum chloride can be dosed ahead of the overflow basin for coagulation of fine particulates prior to filtration. An ultrasonic level instrument monitors the wet well depth and provides feedback to the programmable logic controller to regulate the microfiltration system's production rate and maintain a steady level.

Flow from the sleeve valves is further controlled by CT Basin level bands to maintain operational balance and protect processes. The control logic adjusts discharge rates according to basin fill percentage:

- 100–95% full: 0 GPM
- 94–91% full: 3,000 GPM
- 90–87% full: 4,800 GPM
- 86–83% full: 6,600 GPM
- 82–0% full: 8,200 GPM

This approach ensures consistent hydraulic control and maintains adequate chlorine contact time while optimizing raw water delivery to the filtration system.

From the MF feed wet well, four feed pumps deliver water to the membrane filtration system. These pumps ramp up and down to accommodate cleaning cycles and maintain a target level of approximately 70 percent within the raw water control structure. Within the membrane racks, flow control valves modulate open and closed to maintain a backpressure of approximately 20 psi on the feed pumps. This backpressure is critical for proper membrane performance and cleaning efficiency. Any excess water above the 20 psi setpoint is directed through the membranes and discharged to the CT Basin for chlorine contact time prior to entering finished water storage. This configuration ensures consistent hydraulic control, optimizes membrane operation, and maintains compliance with disinfection requirements.

2.2.6 Chemical Storage

Chemical storage tanks, totes, and metering pumps are provided for the following chemicals and purposes.

- Aluminum Chloride/Polyaluminum Chloride– raw water and backwash recovery coagulant
- Sulfuric acid – pH adjustment
- Calcium thiosulfate – membrane clean-in-place neutralization tank dechlorination
- Citric acid – membrane cleaning
- Caustic (sodium hydroxide) – membrane cleaning, neutralization tank pH adjustment, and filtrate pH adjustment
- 12.5 percent Sodium hypochlorite – membrane cleaning and finished water disinfection

Chemical storage is currently located in the WFF building. As noted above, groundwater is disinfected with chlorine gas that is stored in a separate building near the existing CT Basin.

2.2.7 Reservoirs and Chlorine Contact Facilities

The Outback Site includes four reservoirs that provide chlorine contact time and finished water storage for PL-3. These facilities store both surface water from Bridge Creek and groundwater from the Outback Wells. The following summarizes the reservoirs at the site:

- CT Basin – 1.5 MG capacity; provides chlorine contact time for filtered surface water prior to water storage and distribution.
- Outback Reservoir 1 – 2.0 MG capacity; surface water storage.
- Outback Reservoir 2 – 3.0 MG capacity; primary surface water storage.
- Outback Reservoir 3 – 3.63 MG capacity; groundwater storage.

Under normal operations, surface water flows through the CT Basin and Outback Reservoirs 1 and 2, while groundwater is stored in Outback Reservoir 3. The site piping and valving configuration allows surface water and groundwater storage to remain operationally isolated under typical conditions, while also providing flexibility to supplement surface water storage with groundwater when needed. This configuration supports redundancy and reliability during peak demand periods, maintenance activities, or interruptions to surface water supply, while maintaining controlled flow paths and operational separation between sources.

Combined flows enter the distribution system downstream of the reservoirs. Additional details regarding reservoir hydraulics, operational scenarios, piping interconnections, and control strategies are provided in Chapter 5.

2.2.8 Drainage and Residuals Handling Overview

The Outback WFF does not currently thicken or dry solids residuals captured on the membrane filters. Backwash water from duty membrane filter racks is captured and then routed through the backwash

recovery membrane filter. When the backwash recovery membrane filter is backwashed, all backwash water and solids are then conveyed to the City's wastewater collection system.

Other waste streams from the WFF include sanitary waste from restrooms, labs, washdown or spills to floor drains, membrane gallery trench drains, chemical containment area drains, waste from the membrane clean-in-place process following pH neutralization, and strainer backwash waste.

Sanitary waste from restrooms and lab floor drains are routed to a 20,000-gallon waste holding tank that is periodically pumped out and hauled to the City's Water Reclamation Facility. A separate 10,000-gallon chemical spill tank collects waste from chemical containment areas, clean-in-place neutralization tank overflows, and emergency spill events. Chemical waste is managed through a combination of off-site disposal and to the process water system for conveyance to the City's wastewater system, depending on waste type and operating conditions.

Process water, including backwash waste and clean-in-place neutralization waste, is routed to a dedicated process water tank that provides flow equalization prior to discharge to the City wastewater system. The process water tank is hydraulically connected to the chemical spill tank via an emergency overflow to provide additional protection during upset conditions.

The process waterline conveying wastewater from the Outback Site is an existing gravity pipeline that includes a siphon segment and ultimately discharges to the City's wastewater collection system. The existing system has been operated successfully under current WFF conditions and is adequate for existing process and drainage flows. However, the process water conveyance system was not originally designed to accommodate significant increases in treatment residuals or solids loading. As a result, any future increases in process waste flows, such as those associated with pretreatment solids removal, solids thickening, or drying, will require additional evaluation to confirm compatibility with the existing conveyance system and downstream collection capacity.

While planned upgrades at the site, including the addition of pretreatment facilities, are not expected to significantly impact existing drainage systems under normal operating conditions, documenting current residuals handling and conveyance infrastructure is necessary to support future design decisions. Potential impacts of pretreatment operations and additional solids-handling processes are discussed further in Chapter 3 (Pretreatment Preliminary Design) and will require confirmation during future design phases to ensure appropriate conveyance, operational reliability, and regulatory compliance.

2.2.9 Potable Water

Potable water from the City's distribution system is used for drinking, washing, safety showers, and trap primers. Service water (membrane filtrate) is used for process needs, such as flushing, cooling, and supplying clean-in-place systems. A water softener treats service water for use in caustic/chlorine systems to prevent scaling. Both potable and service water have hydropneumatic tanks to maintain supply during low flow.

2.2.10 Operator Requirements

All municipal water treatment facilities, including the WFF, are required to be operated by certified water treatment operators in accordance with applicable state regulations to ensure protection of public health and the environment. Operator certification and continuing education are required to maintain compliance with regulatory standards.

At Outback, operators are also required to maintain training for handling and storage of hazardous materials, including the 12.5 percent bulk sodium hypochlorite currently used as the facilities' disinfectant. Hazardous materials training is maintained in accordance with applicable safety, environmental, and occupational health regulations.

This discussion is provided to document existing operational requirements at the facility. Evaluation of potential changes to operator certification levels, staffing requirements, or training needs associated with future facility modifications is outside the scope of this level of planning and would be addressed in subsequent project phases, if applicable.

2.3 Outback Electrical Power Service and Communications

Electric power to the Outback Site is provided by PacifiCorp. Overhead utility transmission lines cross along the north edge of the existing Outback Site, and this service represents the sole public electric utility connection serving the facility. Power is distributed onsite to support the WFF, groundwater well facilities, reservoirs, and supporting infrastructure. The reliance on a single utility service connection is an important consideration for operational reliability and long-term resiliency planning and is addressed further in subsequent chapters of this Facility Plan.

Electric service within the Outback Site supports both large process loads and auxiliary building loads. Major equipment is typically served by three-phase, 480-volt alternating current (VAC) power, while smaller loads are supplied by 120-volt VAC power. A utility-owned transformer is located near the northwest corner of the WFF and provides power to the site distribution system.

Standby power is provided through multiple onsite generation assets to support continued operation during utility outages. A 1,000-kilowatt diesel-fueled standby generator is located outdoors at the southeast corner of the WFF and is housed within a sound-attenuating enclosure to minimize offsite noise. The generator is mounted on a 1,900-gallon double-wall fuel tank that provides approximately 35 hours of operation at 75 percent load and includes level monitoring and leak detection. Additional standby generators are located at well facilities as discussed in previous sections.

The Outback Site also includes onsite renewable energy assets. Solar photovoltaic panels are installed on the roof of the WFF building, and a ground-mounted solar array is located on the north end of the Outback Site. These systems offset a portion of onsite electrical demand under normal operating conditions.

Fiber optic communications service has been extended to the Outback Site from Skyliners Road and supports operational communications and connectivity for the WFF and associated facilities. Fiber optic communications also extend west to the raw water intake facility on Bridge Creek, approximately 10 miles from the Outback Site, and east into the City's communications network, approximately 0.5 miles from the site. This connectivity supports monitoring, data transmission, and coordination across the intake, treatment, storage, and distribution system infrastructure.

2.4 Outback Site Constraints & Considerations

The following section is not exhaustive. Additional discussions will be provided in later sections as necessary.

2.4.1 Site Access and Circulation

Primary access to the Outback Site is provided from Skyliners Road, a paved arterial maintained by Deschutes County. From Skyliners Road, access proceeds along Forest Service Road 4606, which is approximately 100 feet of gravel roadway and is manually gated. Beyond this point, access transitions to City-owned and controlled roadways serving the WFF and associated infrastructure.

Within the Outback Site, access roads are paved and secured with automated gates and perimeter fencing. These internal access routes provide controlled entry for City O&M staff while also supporting emergency response access. The access configuration reflects the site's location within an area of high recreational use and its role as critical water supply infrastructure.

2.4.2 Zoning Considerations

The Outback Site is located within the Deschutes County and is currently zoned RR-10 (Rural Residential – 10-acre minimum) under a conditional use permit that authorizes its existing use. A 50-foot landscape buffer is maintained along the east, north, and west boundaries of the site as part of the land sales agreement. In addition, a designated wildlife corridor runs along the south fence line of the City-owned parcel. This wildlife corridor was required by the County and the Forest Service to ensure that the perimeter fence around the WFF compound does not impede deer migration.

A portion of the acquired Forest Service land is located within one-quarter mile of a designated roadway, which triggers applicability of the Landscape Management (LM) overlay zone under Deschutes County Code (Chapter 18.84). The LM overlay zone is intended to protect scenic views from designated roadways and waterways. New construction within this area may be subject to LM review depending on its visibility from the roadway and site-specific conditions. Based on the underlying zoning, a building height limitation of approximately 35 feet is assumed to apply within the LM overlay area.

Permitting pathways, land use approvals, and coordination requirements associated with these zoning and overlay constraints are discussed further in Chapter 7.

2.4.3 Environmental Setting

The Outback Site is located on gently sloping terrain that is generally suitable for facility development. The portion of the site being acquired by the City includes localized areas of steeper slopes near the site boundaries, while the majority of the site remains relatively flat and favorable for construction and long-term operations. Overall site topography does not present a significant constraint to planned facility improvements.

Based on available Federal Emergency Management Agency and Deschutes County floodplain mapping, the Outback Site near Skyliners Road is not located within a designated Special Flood Hazard Area. Flood risk at the site is considered minimal, as mapped flood hazard zones in the City are primarily associated with the Deschutes River and its immediate floodplain.

Additional site-specific analyses related to grading, drainage, geotechnical conditions, and environmental permitting are addressed in subsequent chapters of this Facility Plan and will be refined during future design phases.

2.4.4 Geotechnical

The site is characterized by dense to very dense consolidated cinder deposits overlying basalt bedrock, as documented in the Geotechnical Engineering Report by Shannon & Wilson, Inc. in December 2010 titled Watershed Source Water Improvement Project. Seismic hazards associated with the Metolius Fault Zone indicate a low risk of fault rupture and a low ground motion amplification factor. The potential for liquefaction, lateral spread, tsunami, or seiche is considered minimal. Based on the 2010 Oregon Structural Specialty Code, the site is classified as Site Class C with the following seismic design parameters: Ss = 0.40g, S1 = 0.17g, Sms = 0.48g, and Sm1 = 0.27g.

2.4.4.1 Coordinate System

This project will utilize NGVD29 as the vertical datum, consistent with the City's 2024 Standards and Specifications and recent survey data. For horizontal control, the project will follow the Central Oregon Coordinate System, which aligns with the Deschutes County Coordinate System and matches the coordinate system used by HWA in the latest survey. This approach ensures consistency across all project deliverables and compatibility with existing City infrastructure data.

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CHAPTER 3

Pretreatment Preliminary Design Development

3.1 Introduction

The purpose of this chapter is to define planning and preliminary design criteria for the pretreatment processes, associated site infrastructure, and the pretreatment building at the Outback Site.

3.2 Pretreatment Objectives

Pretreatment processes will occur ahead of filtration and serve to reduce contaminant loads, protect membrane performance, and improve overall water quality. At the Outback Site WFF, raw water from Bridge Creek is typically high quality (low turbidity and low color) and therefore does not require pretreatment under normal conditions.

However, extreme events such as a wildfire can significantly degrade source water quality. Wildfires in the watershed are expected to cause severe spikes in turbidity, total organic carbon (TOC), color, and "taste and odor" compounds, along with large particulate debris from runoff. After a wildfire or extreme runoff event, it is expected that the membrane filters alone will not provide adequate treatment.

Historically, seasonal rain events have also produced turbidity spikes exceeding 100 nephelometric turbidity units (NTU), overwhelming the membranes and forcing shutdowns of the WFF, requiring reliance on groundwater supply. The City also experiences seasonal high color events, particularly after rain-on-snow events in the watershed, which cannot be successfully treated with the limited max coagulant dose ahead of the membrane filters and causes high chlorine demand in the City's finished water reservoirs.

To address these risks and to maintain reliable water quality during wildfires and seasonal storms, pretreatment should be incorporated at the Outback Site. Pretreatment will protect membrane filtration, reduce downtime, and improve operational resilience.

Key objectives of the pretreatment facilities include:

- Reduce turbidity and solids loading prior to membrane filtration to maintain performance and reliability.
- Minimize operational disruptions caused by extreme weather or high turbidity runoff events.
- Extend membrane life by reducing fouling and cleaning frequency.
- Provide flexibility to bypass pretreatment when raw water quality is favorable for efficient operations.
- Manage seasonal high color events by enhancing coagulant effectiveness and reducing chlorine demand in finished water reservoirs.

- Maintain raw water gravity flow to the WFF, leveraging existing hydraulic head to eliminate the need for additional pumping capacity.

This chapter advances the preferred alternative identified in the Outback Siting Study, which is a combination of a pre-sedimentation pond and a plate settler facility, to a near preliminary design phase (pre-30%). Detailed descriptions of the process configuration, flow routing, and proposed solids handling are provided in subsequent sections. Pre-treatment and In-Conduit Hydropower Conceptual drawings are located in Appendix B.

3.3 Project Planning Criteria

The initial design criteria for pretreatment were developed during the Outback Siting Study using input from City staff and typical industry goals for pretreatment facilities using coagulation and sedimentation ahead of filtration. These criteria were used to develop three alternatives that were evaluated as part of the Outback Siting Study, resulting in the preferred alternative that includes a pre-sedimentation pond and a plate settler facility ahead of the existing WFF.

For this project, the same criteria have been reviewed and confirmed as the preferred option. Table 3-1 summarizes the criteria as the basis for preliminary design.

Table 3-1 | Project Planning Criteria

Parameter	Goal
TOC Removal	Remove dissolved organic carbon
Turbidity Removal	< 1 NTU 95 percent of time. Maintain effective turbidity control under normal conditions and provide robust treatment capability during extreme raw water quality events. See additional narrative.
Color Removal	< 5 color units
Fire Resiliency	Maximize ability to treat runoff after fire in watershed: elevated dissolved organic carbon, turbidity, taste & odor issues, change in water chemistry
Operational Intensity	Minimize amount of regular maintenance and operator skill level required for new equipment
In-Conduit Hydropower Generation Compatibility	Compatible with in-conduit hydropower generation
Pretreatment Bypass	Design facilities so that they can be bypassed during times of high-quality raw water, minimizing complications from outdoor operations in adverse weather. They shall also be capable of being quickly returned to service during water quality events. Refer to Section 3.13 for additional discussion on site piping integration and bypass strategies.

Turbidity Treatment Intent: Pretreatment facilities are intended to provide resiliency during extreme raw water quality conditions, such as post-wildfire runoff or severe storm events that can produce rapid increases in turbidity and associated contaminant loads. For planning and preliminary design purposes, the pretreatment system is evaluated for its ability to manage high-turbidity events that significantly exceed typical operating conditions, recognizing that the specific magnitude and duration of these events will vary. Quantitative turbidity values used for internal evaluation and preliminary sizing reflect wildfire and heavy runoff scenarios and are discussed further in subsequent sections, however, they are not intended to represent guaranteed treatment limits or routine operating targets.

3.4 Hydraulic Modeling

One of the City's main primary objectives was to maintain gravity flow to WFF, utilizing the existing hydraulic head and avoiding the capital, maintenance, and ongoing electrical costs associated with a new pump station. During preliminary design, hydraulic modeling was performed using Visual Hydraulics to verify that source water could be delivered by gravity through the new pretreatment facilities to the WFF membrane filter feed pumps under all evaluated conditions.

Five operating scenarios were analyzed to represent potential system operations and confirm gravity flow through the pretreatment components. Results verified that gravity flow to the WFF membrane filter feed pumps are maintained under all scenarios, regardless of pretreatment bypass conditions or in-conduit hydropower generation facility status.

The following scenarios were modeled:

1. Scenario 1A: In-conduit hydropower facility on; pretreatment on (pre-sedimentation pond, at design level WSE and plate settlers)
2. Scenario 1B: In-conduit hydropower facility on; pretreatment on (pre-sedimentation pond, at high level WSE and plate settlers)
3. Scenario 2: In-conduit hydropower facility on; pretreatment on (plate settlers only)
4. Scenario 3: In-conduit hydropower facility off; pretreatment off
5. Scenario 4: In-conduit hydropower facility on; pretreatment off

This modeling effort informed the maximum WSE in the combined in-conduit hydropower generation and energy dissipation facility wet well, as well as gate sizing, weir setpoints, and other critical elevations for the pre-sedimentation pond and the plate settler facility. Existing facilities after the MF feed wet well were not included in the model. They are controlled by the membrane feed pumps and are not expected to change as part of this project.

Hydraulic profiles for the modeled scenarios are included in Appendix B, Drawings G-005 through G-010.

3.5 Preliminary Design Criteria

During the Outback Siting Study, the initial sizing of each pretreatment unit process was determined. As part of this project, those sizes were reviewed and updated to reflect recent design decisions and feature requests from the City.

The design criteria used for unit process sizing are summarized in Table 3-2 The overall process flow diagram is provided in Appendix B, Drawing G-004. The following sections provide detailed narratives for each pretreatment process.

Table 3-2 | Design Criteria

Criteria	Value
Plant Flows	
Design Flow, Max	11.8 MGD (18.2 cfs)
Design Flow, Min	4.0 MGD (6.2 cfs)
Design Flow, Avg	9.0 MGD (13.9 cfs)
Treatment Process: Pre-Sedimentation	
No. of Pre-Sedimentation Pond Basins	2, parallel
Pond Water Depth	6 feet (design) 10 feet (max)
Volume	1.25 MG at 6 feet deep 2.35 MG at 10 feet deep
Detention Time	2.5 hrs at 11.8 MGD (18.2 cfs) and 6 feet deep 3.3 hrs at 9.0 MGD (13.9 cfs) and 6 feet deep 4.8 hrs at 11.8 MGD (18.2 cfs) and 10 feet deep
Treatment Process: Rapid Mix	
Type and Design Intensity	Vertical Mixer, G = 500-900 1/second
No. Stages	2
Detention Time	32 seconds at 11.8 MGD (18.2 cfs) (16 seconds per stage)
Volume	2,200 gallons per stage
Motors	0.85 to 1.0 hp/MGD
Chemical Additives	pH adjustment: Sodium hydroxide, sulfuric acid Coagulant: Kemira PAX polyaluminum chloride[(1)]
Treatment Process – Flocculation	
Type	Horizontal paddle
Detention Time	16 minutes at 11.8 MGD (18.2 cfs) (5 minutes per stage)
No. Stages	3
Mix Design Intensity, G	60, 45, 30 1/second
Treatment Process – Sedimentation	
Sedimentation Type	Plate Settlers
Material	Stainless Steel
No. of Basins	3, parallel
Basin Redundancy	2 + 1
Plate Packs Per Basin	3
Sludge Removal System	Sludge Vacuum System

Notes:

1. Kemira PAX is the City's current coagulant. The City is completing jar testing independently to consider alternative coagulants, including alum for potential benefits for future solids dewatering processes.

In developing the pretreatment planning criteria, several site civil considerations were identified that future designers should be aware of when advancing the project into detailed design. These include anticipated clearing and grubbing within the pretreatment footprint, establishing workable site grades for access and construction, addressing areas that may require soil improvement or replacement, and incorporating temporary erosion and sediment control measures appropriate for the site's slopes and proximity to natural drainage paths. Initial assumptions also include the need for localized drainage improvements and access road modifications to support long-term operations.

3.6 Pre-Sedimentation Pond Narrative

The proposed pre-sedimentation pond consists of a rectangular, earthen berm structure with sloped interior walls and a concrete liner. A central wall divides the pond into two parallel basins, allowing one basin to remain in service while maintenance is performed on the other basin. The pond is located after the in-conduit hydropower generation facility and ahead of the plate settler facility.

The pond is designed to remove large particles and debris that are anticipated to be in the source water following a high turbidity runoff event. Specifically, the pond targets particles with settling times of three hours or less, based on Stoke's Law.

Capturing these coarse solids ahead of the plate settlers and membrane filters helps prevent clogging and mechanical damage. The pond does not include an automatic scraper system so solids will accumulate and require periodic dredging when levels reach thresholds established by City staff. Accumulated solids are typically trucked away from the site for landfill disposal but ultimate fate of solids will be determined by City coordination with the dredging contractor. Because the pond is intended primarily for extreme events, routine cleaning is not expected under normal conditions.

Underdrains have been provided in the early design for draining of the pond as needed for basin cleaning or regular maintenance. It should be determined in final design where the basins drain to and how to send flows to that location (sewer, overflow pond, solids pump station, etc.).

Each basin is designed to provide operational flexibility during high-flow or emergency conditions, with normal and maximum operating depths, volumes, and detention times summarized in Table 3-2 under the pre-sedimentation treatment process criteria. As shown, the available storage supports detention times sufficient for settling coarse particles and debris, though it will not significantly reduce turbidity during typical or seasonal high turbidity events.

Inlet and outlet structures utilize sluice gates and baffles to control flow and minimize short-circuiting. Vehicle access ramps to the bottom of the pre-sedimentation pond are provided, as shown on Sheet C-110, allowing maintenance vehicles and mechanical equipment (e.g., skid-steer or compact loader) to access the pre-sedimentation pond bottom for sediment removal and routine maintenance. A 12-foot-wide perimeter access road is provided at the top of pre-sedimentation pond slopes, with additional access provided adjacent to inlet and outlet structures for O&M activities. Walkways with guardrails are included at structures to provide safe pedestrian access for inspection and servicing. Key benefits of the pre-sedimentation pond include:

- Protect membrane filters and plate settlers from clogging and damaging during high turbidity runoff events.
- Reduce coagulant demand and associated chemical costs.
- Enhance system resilience during extreme watershed conditions.

Development of the pre-sedimentation pond will require establishing stable working grades, constructing access pathways around the pond, and incorporating localized drainage features to manage stormwater around the berms and roadways. Designers should anticipate the need for a prepared subgrade, a suitable liner interface, and durable access surfaces to support maintenance vehicles. These elements should be confirmed early in design through geotechnical evaluations, survey, and detailed site layout.

Conceptual drawings for the pre-sedimentation pond are provided in Appendix B (Drawings C-110 through C-501). A perspective view of the inlet and outlet structures is shown on Drawing C-901.

3.7 Water Quality Sampling and Jar Testing

Although the primary goal of addition of pretreatment at the Outback Site is to provide resiliency after a wildfire, the plate settlers are also expected to improve removal of color and turbidity during seasonal rain events. Currently, the City can only dose 3-4 milligrams per liter (mg/L) of Kemira PAX coagulant without risking membrane fouling because dosing occurs ahead of the MF feed wet well at the energy dissipation structure. With the addition of plate settlers, the dosing point will shift to the rapid mix portion of the plate settler facility, maximizing the efficiency of the coagulant doses without impacting membrane performance. The pretreatment facility is designed so all dosed coagulant will settle out before reaching the membrane filters.

To determine the optimal coagulant dose ahead of the plate settlers, the City began preparing for jar testing in June 2025. The objective was to capture a seasonal runoff event and identify the best coagulant dose and pH for treating high turbidity and potential color. Color in drinking water sources is categorized as either “apparent” or “true” color. True color occurs when water has been in contact with organic debris, typically humic substances, in various stages of decomposition. This color exists in the water as negatively charged colloidal particles that require intentional selection of treatment methods to remove, such as pre-oxidation, selection of a coagulant with a trivalent metallic ion, or adsorption with powdered activated carbon. Apparent color is typically caused by colored suspended matter which can be removed via selection of an appropriate dose of the plant’s current coagulant.

Outback Site operators have experience using pre-chlorination for color removal at other plants, but this approach is generally discouraged due to the risk of forming disinfection byproducts when raw water TOC is present. Pretreatment sampling in March 2025 showed TOC concentrations below 1 mg/L under normal conditions; however, TOC is expected to rise significantly during and after wildfire events. Pre-chlorination may be used during normal low-TOC operating conditions, but to avoid creating disinfection byproducts, Consor does not recommend pre-chlorination during high-TOC conditions.

As an alternative to address color in high-TOC water, the final design should consider adding powdered activated carbon (PAC) storage and slurry dosing ahead of the plate settlers. The City has opted not to pursue the addition of ozone or chlorine dioxide systems as other color treatment due to the higher complexity and cost compared to PAC or pre-chlorination.

The City was not able to capture a seasonal high-turbidity/high-color event in 2025 but has procured equipment and developed a jar testing protocol for future events, likely in spring 2026. In winter 2025, the City tested a backwash recovery sample (~100 NTU) using Kemira PAX at doses from 5 to 20 mg/L and observed maximum turbidity removal and minimum UVT at approximately 15 mg/L.

The City is also interested in evaluating alum as a potential coagulant due to its ability to produce dewaterable solids. The preliminary design allows flexibility for future chemical selection and should be refined during final design.

3.8 Plate Settler Facility Narrative – Treatment Processes

The plate settler facility is designed to provide enhanced clarification following chemical coagulation and flocculation. The system is divided into three major process areas: rapid mix, flocculation, and

sedimentation, with each configured to optimize particle destabilization, floc formation, and solids removal prior to membrane filtration at the WFF.

Integrating these three process areas in the plate settler facility should improve the overall WFF performance by maintaining compliance with regulatory turbidity standards, providing operational flexibility for variable raw water conditions, and reducing the frequency of membrane fouling and associated plant shutdowns.

Conceptual drawings for the plate settler facility are provided in **Appendix B** (Drawings D-101 through D-301). Drawing D-901 includes a perspective view of the plate settler area.

3.8.1 Configuration of Plate Settler Facility

The plate settler system is shown below grade to satisfy hydraulic constraints and maintain gravity flow through the pretreatment process. A below-grade configuration also improves hydraulic performance by reducing head losses and limiting the need for additional pumping or pressurized conveyance. This approach is consistent with the overall design goal of maintaining gravity flow to the maximum extent practicable while providing reliable system operation.

The plate settler facility is shown enclosed within a building rather than located outdoors. Both indoor and outdoor configurations were considered viable; however, locating the facility indoors provides improved control of environmental conditions, including protection from weather, temperature extremes, wind, and precipitation. An enclosed facility also improves access conditions for inspection and maintenance, and facilitation of year-round operations without weather-related constraints. It also supports co-location with administration and operational spaces, improving staff safety, coordination, and oversight.

Locating the plate settler indoors does introduce additional considerations related to noise generation and moisture control, particularly due to the proximity of administration and other occupied spaces within the same building. These impacts will be further evaluated during final design, and appropriate acoustic separation, ventilation, dehumidification, and related mitigation measures will be incorporated as necessary. Overall, the indoor configuration was selected to balance operational efficiency, staff safety, and long-term facility performance while allowing detailed noise and moisture control measures to be addressed during final design.

3.8.2 Rapid Mix System

The rapid mix area will include chemical additives for pH adjustment (acid or base) and coagulant dosing. Depending on raw water quality, additional treatment may be applied for color (e.g., pre-oxidation or powdered activated carbon) and taste and odor control (e.g., potassium permanganate).

Located at the inlet of the plate settler facility, the rapid mix system consists of two stages of high-speed vertical mixers. Estimated G-values (velocity gradient) for flows ranging from 4.0 MGD (6.2 cfs) to 11.8 MGD (18.2 cfs) are within 500–900 sec^{-1}, with final values to be confirmed by the mixer manufacturer. At 11.8 (18.2 cfs) MGD, each stage provides approximately 16 seconds of detention time, for a total of 32 seconds across both stages.

At low flows (approximately 4.0–8.0 MGD or 6.2-12.4 cfs), the second stage should be bypassed by closing the slide gate between the two stages and opening the gate to the flocculation influent channel. This prevents excessive detention time that could lead to overmixing and floc destabilization.

Immediately after the rapid mix basins, flow passes through a baffle wall to evenly distribute flow and dissipate energy prior to entering the flocculation basins. This configuration promotes uniform hydraulic conditions and minimizes short-circuiting for optimal floc formation.

The rapid mix chambers include mud valves with above-grade operators for basin draining. Future design phases should route drain piping to a future solids/process recirculation pump station, which is not included in the current design. This pump station will allow recycling of drain flows to the pretreatment train, discharge to the overflow pond for infiltration, or discharge to the sanitary sewer (subject to City confirmation of sewer capacity).

3.8.3 Flocculation System

Flow from the rapid mix chambers enters a common influent channel that hydraulically splits into three flocculation basins. The basins are designed for a two plus one redundancy, meaning two basins will operate together at the maximum flow of 11.8 MGD (18.2 cfs) while the third remains available for maintenance or standby. Under normal operations, all three basins are not required to be in service simultaneously.

Operators will control flow into the basins using manually operated slide gates, with two gates at each basin entrance to allow isolation for drawdown, cleaning, and maintenance. Gate operation is expected to be infrequent and limited primarily to basin outages or full plant shutdown conditions. Motor-actuated gates are a feasible alternative and may be considered in future design phases. However, given the low operational frequency, manual operation is considered acceptable. Routine maintenance practices will include periodic exercising of the slide gates to ensure reliable operation when needed.

The flocculation system consists of three stages of horizontal paddle mixers arranged in series. Each stage provides progressively lower mixing intensity to promote floc growth while minimizing shear forces. At 11.8 MGD (18.2 cfs), total detention time is approximately 16 minutes (about five minutes per stage). At the minimum design flow of 4.0 MGD (6.2 cfs), detention time increases to 47 minutes.

Mixing intensity decreases across the stages, with estimated G-values of 60, 45, and 30 sec^{-1} for stages one, two, and three, respectively. Final G-values should be confirmed by the flocculator manufacturer. Baffle walls between stages control flow and prevent short-circuiting, creating optimal conditions for floc formation prior to sedimentation.

Each basin is equipped with mud valves for draining, with extension stems routed to the top of the basins. Drain piping will be routed to the future solids/process recirculation pump station, as described previously.

3.8.4 Sedimentation System

From the flocculation basins, water enters the sedimentation basins through inlet diffusers and flows upward through inclined plate packs. As water rises through the plate packs, flocs collide with the inclined plates and slide downward, settling at the bottom of the basin. This configuration accelerates solids removal compared to conventional sedimentation. Each basin contains three plate settler cartridges designed to maximize settling efficiency within a compact footprint.

Settled water cascades over effluent weirs and into a common plate settler effluent channel. Slide gates at each basin outlet allow isolation for maintenance. From the effluent channel, flow is conveyed through a new 30-inch pipe to the existing MF feed pump wetwell ahead of the WFF.

Sedimentation basins were sized in coordination with plate settler manufacturers to accommodate equipment and maintain adequate detention times. At the maximum flow of 11.8 MGD (18.2 cfs), detention time is approximately 17 minutes; at the minimum flow of 4.0 MGD (6.2 cfs), detention time increases to 50 minutes.

Sludge that accumulates beneath the plates is removed using a dedicated sludge vacuum system for each basin. The system is designed to operate once per day, with flow rates and duration optimized for efficient solids removal. A common control panel located on the basin walkways provides centralized operation and monitoring of sludge removal equipment. Solids will be transferred to the process pump station as noted in Section 3.9.

3.8.5 Deep Excavation and Subsurface Considerations

The plate settler, flocculation, and rapid-mix basins require deep excavations to achieve the necessary operating elevations. Planning materials indicate the potential to encounter competent native material and possible bedrock beneath the recessed basin areas. These conditions will influence excavation methods, support-of-excavation needs, and subgrade preparation. Final excavation limits and subsurface requirements will be confirmed through geotechnical investigation during detailed design.

3.9 Solids Handling and Residuals Management

Implementation of pretreatment at the Outback Site will result in the generation of solids waste streams, particularly during periods of elevated turbidity, color, or post-wildfire runoff conditions. This section describes the planning-level approach to residuals management for pretreatment, including baseline assumptions, operational considerations, and future infrastructure needs. Detailed solids handling design and process selection will be refined during subsequent design phases.

3.9.1 Solids Generation and Need for Solids Handling

While the pre-sedimentation pond is expected to be needed only during wildfire conditions, the plant will likely benefit from operating the plate settler facility more frequently year round during high-turbidity and high-color events. Therefore, the most regular source of solids generation will be the accumulation of sludge over time beneath the plate settlers. These solids will include settled inorganic material, organic matter, coagulant residuals, and PAC media, if used. Under normal raw water conditions, solids production is expected to be limited due to the naturally low turbidity and high quality of the City's influent water. However, during storm events or post-wildfire runoff, solids loading may increase significantly and persist for extended durations.

Effective solids handling is required to maintain pretreatment process performance, protect downstream treatment processes, and support reliable operation during extreme water quality events.

3.9.2 Baseline Operating Assumption – Solids/Process Pump Station

The baseline assumption for pretreatment solids handling includes construction of a solids/process recirculation pump station. This pump station will convey sludge from the sludge vacuum collection system at the bottom of the plate settler basins and discharge it to the same sewer infrastructure currently used for membrane backwash recovery waste, clean-in-place residuals, and other non-sanitary waste streams at the WFF. The pump station should also have the capability to alternately recirculate water from a drained basin to the head of the plant, if needed and if the plant's chemical dosing strategy permits recirculation.

Electrical power, controls, and instrumentation for the pump station are assumed to be included as part of the pretreatment process systems and integrated with plant-wide SCADA for monitoring and alarm functions.

This approach leverages existing infrastructure and minimizes near-term capital investment; however, it relies on compatibility with the existing downstream wastewater collection system.

3.9.3 Limitations of Existing Sewer Infrastructure

As documented in Chapter 2, the existing wastewater conveyance from the Outback Site consists of a 6-inch gravity pipeline with a siphon segment. While this infrastructure has proven adequate for existing WFF waste streams under current operating conditions, it was not originally designed to accommodate sustained, high-solids loading associated with pretreatment operation under extreme raw water quality scenarios.

Preliminary solids loading evaluations indicate that:

- Typical operating conditions and seasonal runoff events may result in residual flows that are potentially compatible with the existing wastewater line capacity; however,
- Wildfire-driven raw water conditions, particularly under high turbidity assumptions (on the order of hundreds of NTU) and elevated coagulant and PAC dosing rates, could generate residual flows and solids loading that exceed reasonable conveyance and system capacity expectations.

Initial coordination discussions with the City's collection system staff indicate that additional pretreatment-related residual flows may not be accommodated in the downstream sewer system without further evaluation and potentially significant upgrades to the sewer system. Preliminary assessments completed to date have focused primarily on the onsite connection to the sewer and have not evaluated downstream collection system constraints.

Accordingly, while discharge of pretreatment residuals to the existing sewer system is assumed for planning purposes under typical operating conditions, this approach presents increased risk under high-solids scenarios, particularly following wildfire events. These limitations underscore the need to evaluate supplemental or alternative solids handling strategies, such as onsite solids drying or temporary handling measures, as discussed in later sections of this chapter.

3.9.4 Future Solids Handling Infrastructure – Solids Drying Beds

To provide long-term operational resiliency and reduce reliance on the existing sewer system, the Facility Plan identifies a future solids drying bed system as a potential supplemental solids-handling strategy for pretreatment residuals. The drying beds are intended to support typical operating conditions and seasonal runoff events, rather than full wildfire-emergency scenarios, which present fundamentally different solids handling challenges.

Planning-level site civil layouts reserve space and access for a drying bed facility consisting of two rectangular concrete lined basins, each approximately 250 feet by 100 feet, with a nominal operating fill depth of approximately 2 feet. The beds are envisioned as shallow, lined structures with controlled inlet piping from the solids/process recirculation pump station. The beds will facilitate decanting supernatant back to the treatment stream, while accumulated solids would be allowed to dewater over time prior to

removal. No gravity thickening is assumed ahead of the plate settlers for planning sizing purposes, and incoming sludge is conservatively assumed as 0.5 percent solids.

Under this conservative basis, the two-bed configuration is sized to support alternating operation under worst-case typical operating conditions at maximum plant flow through the pretreatment system. At sustained maximum flow, one bed could be filled over an operational period on the order of several weeks, after which flow would be diverted to the second bed while the first bed undergoes passive drying. Periodic dredging or solids removal would be required once adequate drying has occurred. At lower operating flows (e.g., reduced seasonal demand), the time between bed clean-out events would increase accordingly. Additional drying bed capacity could be added in the future if extended solids storage or longer drying cycles are desired.

The drying beds are not sized to accommodate worst case wildfire conditions, during which turbidity, organic carbon loading, coagulant dosing, and potential powdered activated carbon usage could generate solids volumes that would fill drying beds within hours. Designing beds large enough to handle those conditions would result in excessive unused infrastructure during normal operation, as well as beds that cannot be dredged fast enough to impact the high fill rate possible under wildfire conditions. Instead, wildfire conditions are recognized as an operational and emergency planning challenge that may require alternative strategies, such as added gravity thickeners ahead of the beds, temporary solids handling measures, mobile equipment, or process adjustments, rather than permanent oversizing of drying beds.

Preliminary evaluation indicates that under typical operating conditions, discharge of pretreatment residuals to the existing 6-inch process water sewer would be modest (on the order of 10 gpm), while seasonal rain-on-snow events may increase flows but remain potentially manageable. Wildfire-driven residuals, however, would rapidly exceed reasonable conveyance capacity and are not considered feasible for discharge to the existing sewer system without major downstream system upgrades.

Accordingly, the Facility Plan reserves footprint area, access, and conveyance corridors only for solids drying beds. Detailed evaluation of solids thickening options, alternative emergency solids handling approaches, downstream sewer capacity, and operational triggers for transitioning between handling strategies will be completed during preliminary and detailed design. This conservative planning approach intends to reserve sufficient space on site for long-term solids management while maintaining flexibility to refine the final strategy as additional data and operational preferences are developed.

3.9.5 Coagulant Selection Considerations

Solids quantity and dewatering characteristics are influenced by coagulant selection. Preliminary planning assumes solids production rates based on the plant's existing Kemira PAX product but does not take into account solids drying behavior or moisture retention characteristics based on chemical selection. Further evaluation during design should confirm compatibility between selected solids handling method and selected coagulant, including the implications of coagulant selection on drying bed performance, residuals handling logistics, and disposal requirements.

3.9.6 Assumptions, Open Questions, and Future Evaluation Needs

The following assumptions and considerations apply to the pretreatment solids handling concept presented in this Facility Plan.

- Sludge collected from plate settlers is assumed to have 0.5 percent solids concentration.

- Sludge density is assumed to be 8.55 pounds per gallon, consistent with published industry references.
- PAC usage is assumed for worst case solids production scenarios.
- Downstream wastewater collection system capacity has not yet been evaluated.
- The solids/process recirculation pump station is assumed to be the initial solids conveyance method.
- Onsite solids drying beds are assumed to be a future, additive infrastructure option rather than part of the base pretreatment scope.

Key questions to be addressed during subsequent design phases include:

- Confirmation of acceptable pretreatment residual discharge rates to the existing sewer system.
- Evaluation of downstream wastewater collection system capacity and operational impacts.
- Final selection of coagulant type and associated solids characteristics.
- Determination of trigger conditions under which onsite solids drying or storage would be required.
- Consideration of alternative solids handling methods, such as gravity thickening, mechanical dewatering, or offsite hauling, if warranted.

3.10 On-Site Sodium Hypochlorite Generation

The City is evaluating the use of OSHG as an alternative to bulk high strength sodium hypochlorite for surface water treatment to increase daily operational safety and support resiliency during extended treatment events or potential supply disruptions. This Facility Plan evaluates the planning-level feasibility, siting, and integration of an OSHG system at the Outback Site to support surface water disinfection.

The evaluation focuses on conceptual footprint reservation, delivery access, and coordination with pretreatment facilities and site utilities to accommodate a system in the future without reconfiguration of adjacent process systems. Final system configuration, detailed sizing, and equipment selection will be confirmed during subsequent design phases. At this planning stage, inclusion of OSHG in the Facility Plan is not intended to establish final design criteria or operational parameters.

3.10.1 Location and Operations

The planned OSHG system will have interior and exterior components to the new pretreatment building. Hypochlorite generation equipment, solution storage tanks, metering pumps, and associated chemical feed systems are planned to be inside the new pretreatment (plate settler) building, within a dedicated chemical room. Locating these components indoors allows controlled environmental conditions, enhanced safety, and direct integration with pretreatment chemical systems, electrical service, ventilation, and plant-wide SCADA.

The brine (salt) storage tank serving the OSHG system is planned to be outside the pretreatment building, immediately adjacent to the chemical room wall. This exterior placement allows direct truck access for salt delivery and supports larger quantities of brine storage without the need to increase building footprint or

height. Brine transfer piping will pass through the exterior wall and connect directly to the interior generation skids via short, protected runs.

This configuration places OSHG within the same secured operational zone as pretreatment chemical systems while allowing shared use of delivery routes, staging areas, and service corridors. The arrangement supports efficient O&M while maintaining separation from public-facing areas of the Outback Site and minimizing operational disruptions during deliveries.

3.10.2 Conceptual Capacity and Footprint Reservation

The Facility Plan reserves sufficient space for an OSHG system sized to meet planning-level surface water disinfection demand at the design MDD of 11.8 MGD, producing low strength sodium hypochlorite solution (approximately 0.8 percent NaOCl). For planning purposes, the system is evaluated at a target chlorine dose of 2.0 mg/L under MDD conditions.

Based on this planning basis, the conceptual OSHG footprint includes:

- Interior space within the pretreatment building for:
  - Two hypochlorite generation units, each rated at approximately 300 pounds of Cl_2 per day. The units are intended to operate as duty/standby at 11.8 MGD and 2.0 mg/L dose.
  - Product storage tanks sized to provide chemical storage on the order of days, to balance storage capacity with minimal degradation of product concentration over time.
  - Chemical feed pumps, softeners, electrical panels, and control equipment as required by the OSHG manufacturer.
  - Secondary containment, maintenance clearances, and safe access for equipment servicing.
- Exterior space adjacent to the pretreatment building for:
  - A brine/salt storage tank sized to support approximately 30 days of operation at MDD.
  - Delivery vehicle access, hose connection space, and containment features.
  - Short, direct piping connections to the interior generation equipment.

The Facility Site Plan preserves both interior and exterior footprint areas, access aisles, and utility corridors so OSHG equipment can be installed and maintained without modification to adjacent pretreatment process equipment or building layout. Final confirmation of generator ratings, tank volumes, skid configuration, and ancillary systems (including water softening) will be completed during subsequent design phases.

Electrical service for OSHG is planned to connect to the electrical distribution infrastructure developed for pretreatment and in-conduit hydropower improvements, with localized step-down as required. Ventilation, heating ventilating and air conditioning (HVAC), secondary containment, safety equipment (including eyewash and safety showers), and SCADA integration will be addressed during detailed design. The Facility Plan ensures that utility corridors and service access points are reserved so these systems can be incorporated without reconfiguration of major process equipment.

3.11 Maintenance and Operation Considerations

The selected pretreatment processes are relatively low maintenance. As part of this project, the City toured and/or talked with operators of other plate settler facilities, including the Green River Water Filtration Facility (Tacoma Water) and the Hargesheimer Water Treatment Plant (Abilene, Texas). Staff at both facilities reported minimal daily maintenance requirements but noted the need for periodic tasks such as annual cleaning of bio-growth from plate settlers during warm weather, and occasional draining and washdown of basins to manage sludge blanket buildup.

To support O&M activities, final design should include a hydrant system around the basins for hose connections. Based on similar facilities, annual maintenance is estimated at approximately 48 hours per year, assuming two days for draining, washdown, and inspection of each basin.

Because the plate settlers and flocculation basins are planned to be enclosed within the pretreatment building, additional maintenance considerations related to building systems should be incorporated into final design. These include providing adequate ventilation and HVAC capacity to manage humidity, odors, and condensation associated with enclosed settling processes, as well as access for inspection and maintenance of ventilation equipment. While these requirements are not expected to materially increase operational intensity, they are important for maintaining safe working conditions and protecting structural and electrical systems.

For the pre-sedimentation pond, maintenance will primarily involve dredging after significant solids accumulation. Given the City's typically high-quality water, dredging is not expected annually but may be required following a wildfire event in the watershed.

Daily maintenance for both the pre-sedimentation pond and plate settlers will include visual inspections during operation to monitor equipment and process performance. While not essential for treatment, observing floc formation in the flocculation basins can help optimize chemical dosing, reduce sludge production, and improve efficiency. Similarly, monitoring the sludge vacuum system is important to maintain proper operation frequency; insufficient vacuuming can allow sludge to resuspend, causing turbidity issues.

The O&M requirements for chemical feed systems at the plate settler facility will be similar to those for the existing systems at the WFF.

Locating the pretreatment facilities near the existing WFF building provides operational efficiencies, including convenient chemical deliveries and minimized piping, electrical, and control connections to existing infrastructure.

Equipment Access and Lifting Requirements: The pretreatment building will include an overhead bridge crane to facilitate installation and long-term maintenance of mixers, plate settler components, pumps, and other heavy equipment. Crane coverage and hook height requirements should be incorporated early into structural and architectural design to confirm clear access to major process areas. A skylight system could also be considered to provide overhead access to heavy equipment in areas where bridge crane coverage may be limited.

3.12 Pretreatment Building Narrative

3.12.1 Pretreatment Building Layout and Support Spaces

The plate settler facility is designed as a one-story structure to house the pretreatment processes and provide operational support spaces in a safe, efficient, and maintainable layout. The structure integrates the rapid mix, flocculation, and clarification basins within a large open process bay, along with chemical storage areas and administrative spaces, under one roof to optimize functionality and protect critical equipment from environmental exposure. Development of the pretreatment building also addresses existing space limitations at the Outback Site, which currently does not provide adequate administrative, control, training, or staff support space to meet ongoing and future operational needs. Accordingly, the administrative and operational spaces included in this building are required as part of the pretreatment project implementation rather than deferred to a future phase.

3.12.2 Process Areas and Building Organization

The southern portion of the building contains the primary process area, which includes the rapid mix basins, flocculation basins, and three parallel plate settlers. This area is designed with adequate overhead clearance to support equipment installation, removal, and long-term maintenance. Access walkways and platforms with guardrails and non-slip surfaces are provided throughout the process bay to allow for safe observation and servicing of mixers, plate cartridges, sludge removal systems and associated equipment.

Along the eastern side of the building, dedicated rooms are provided for chemical storage and feed systems, including sodium hydroxide, sulfuric acid, PAX (or other selected coagulant), and miscellaneous other treatment chemicals that should be selected by the City for final design. Each chemical room will be equipped with secondary containment as required and ventilation systems for compliance with safety and environmental standards. The rooms were preliminarily sized to account for chemical tanks, totes, feed pumps, safety equipment, and necessary maintenance clearances.

Additional utility support spaces include a small-voltage electrical room and laundry facilities equipped with two washers, two dryers, and a folding table to support plant operational requirements.

3.12.3 Administrative and Operational Support Spaces

The northern portion of the building houses administrative and operational spaces, which were updated based on City direction as part of this project. The control room will be located adjacent to the server room to optimize connectivity and operational efficiency. Office areas and operational workspaces are sized to accommodate ten operators, providing adequate workspace, visibility, and ergonomic layouts to support continuous operations.

Because the administrative, office, and control spaces are located immediately adjacent to the plate settler process bay, final design shall incorporate appropriate acoustical separation and sound attenuation measures, such as acoustically rated wall assemblies, doors, and ceiling systems. These measures are intended to mitigate elevated noise levels generated by mixers, sludge collection equipment, and process hydraulics, and to provide a safe, functional, and comfortable working environment for staff while maintaining close operational proximity to pretreatment processes.

A dedicated conference and training room is included and sized for 20 people to support staff meetings, training sessions, and larger coordination activities. This space is located adjacent to office areas for accessibility and near the breakroom for convenience. A flex room has been identified and the adjacent

breakroom provides a full kitchenette with a sink, refrigerator, and range to support daily staff needs and is positioned to conveniently serve both administrative and training functions.

The control room and associated office areas are sized to accommodate 10 operators, which provides adequate workspace and ergonomic layouts for continuous operations. Three office spaces are also provided.

3.12.4 Building Systems, Access, and Code Considerations

Building access features will include multiple entry points and overhead doors to facilitate equipment delivery and removal, as well as roof access with appropriate fall protection measures, such as a parapet wall or equivalent system, to meet safety requirements. Walkways, platforms, and stairways with guardrails and nonslip surfaces are provided throughout the process area to ensure safe access to mixers, plate packs, and sludge removal systems. Emergency egress routes and safety showers are strategically located near chemical storage and handling areas.

The pretreatment building will include a full fire suppression sprinkler system consistent with code requirements. Based on the current conceptual layout and square footage allocations for administrative, operational, mechanical, and storage spaces, the estimated maximum building occupancy is approximately 100 people, assuming 150 square feet per person and the number of gender-neutral toilet facilities planned. Code interpretation may vary; if a 100 square feet per person standard were applied, maximum occupancy could increase to approximately 170 people, which would require additional toilet facilities. While this scenario is considered unlikely, it remains a consideration for final design.

The building is constructed with reinforced concrete walls and structural steel framing to provide durability and support for overhead loads. The roof design incorporates sloped sections to facilitate efficient drainage. The building is positioned to align with raw water transmission and finished water piping corridors, minimizing conveyance distances and optimizing hydraulic efficiency. Exterior access roads provide vehicle circulation to support chemical deliveries and maintenance activities.

The pretreatment building includes concrete masonry unit exterior walls around the process area and a combination of concrete masonry unit and metal stud walls in the administrative portion of the facility. The building frame and roof system accommodate the process equipment layout, ventilation needs, and maintenance access requirements. Storefront glazing provides visibility between selected interior spaces, such as the control room and laboratory, and exterior canopies protect key building entrances. These architectural elements represent the anticipated form of the facility and will be refined as the building layout is finalized.

Architectural conceptual drawings are provided in Appendix B (Drawings A-001 through A-122).

3.12.5 Supporting Site Civil Requirements

Construction of the plate settler facility will require establishing finished grades that support safe access, equipment loading, and effective drainage around the structure. Designers should anticipate that site civil elements such as access road connections, pedestrian routes, and stormwater conveyance features will need to be integrated into the final layout. These elements will be defined during the next phase of design once the building footprint, elevations, and site circulation requirements are finalized.

3.12.6 Alternatives Considered

The project team evaluated a two story building configuration as an alternative to the proposed single story design. The City noted that a two story option could provide additional space for future growth and flexibility in accommodating expanded operations or administrative functions. However, this approach was determined to have several drawbacks. A two story layout would introduce excess circulation space, including stairwells, landings, and wider hallways, which would reduce the efficiency of the floor plan and result in significant areas of unused or underutilized space. Additionally, the added complexity of vertical circulation would increase construction cost and operational challenges, particularly for equipment access and maintenance activities that benefit from direct, ground level entry.

The single story configuration was selected as the preferred approach because it provides a more efficient layout for process and support spaces, simplifies equipment movement and installation, and reduces long-term operational complexity. While the two story option offered theoretical capacity for future expansion, the project team determined that the additional cost and inefficiencies outweighed the potential benefits, especially given that future growth can be accommodated through other site development strategies if needed.

3.13 Pretreatment Facility Integration

Raw water will enter the pretreatment facility through a 30-inch inlet pipe from the pre-sedimentation pond, and treated water will discharge through a 30-inch outlet pipe to the existing MF feed wet well. These connections are designed to maintain hydraulic continuity with existing infrastructure while accommodating the design flow of 11.8 MGD (18.2 cfs).

While the pretreatment facility is the focus of this chapter, its hydraulic performance is closely linked to the in-conduit hydropower facility described in Chapter 4. The pretreatment design ensures compatibility with gravity flow conditions managed by the in-conduit hydropower system, supporting reliable operation under varying watershed conditions.

In addition, the pretreatment facility is a critical element of the overall site integration strategy presented in Chapter 6.

Access to the pretreatment building will be provided by a paved driveway that loops around the structure, allowing safe and efficient delivery of chemicals, maintenance access, as well as fire department access. The design assumes OSHG for disinfection, and an exterior brine tank will be installed adjacent to the building to support this process. Parking for staff will be provided near the pretreatment facility, including ADA-compliant spaces in accordance with applicable codes. The parking layout and pedestrian access will align with the overall site circulation plan to maintain site safety and operations. While this section focuses on pretreatment-related improvements, all elements will be integrated with the broader Outback site build-out described in Chapter 6, which addresses additional site-wide infrastructure improvements.

3.13.1 Raw Water Conveyance and Site Piping

New 30-inch raw water piping will originate at a connection to the existing 30-inch HPRW line and will first convey flow to the new in-conduit hydropower facility, described in Chapter 4. From there, the 30-inch line will route to the pre-sedimentation pond and then to the plate settler facility. The conveyance design incorporates provisions that allow each pretreatment component to be isolated or bypassed individually or the entire pretreatment system to be bypassed altogether, preserving operational flexibility during

construction, commissioning, and maintenance. Multiple scenarios for different bypassing operations can be found in **Appendix B** (Drawings G-005 through G-009)

Under the current configuration, the existing 30-inch HPRW line delivers flow to the energy dissipation facility and then to the WFF. With the addition of in-conduit hydropower and pretreatment, the normal operating sequence will be in-conduit hydropower → pretreatment → MF feed wet wells → WFF. The existing dissipation valves will be removed because pressure control and energy dissipation functions will be relocated and consolidated at the new in-conduit hydropower facility. The MF feed wet well at the existing dissipation facility will remain in service to utilize the existing wet well that pumps water to the WFF.

To support the new pretreatment facilities and maintain reliable operations during construction, a new 30-inch conveyance pipeline is recommended. This new alignment is offset from, but hydraulically parallel to, the existing 30-inch HPRW line. The new pipeline provides critical operational flexibility, allowing the pretreatment system to be brought online incrementally while minimizing plant shutdowns and construction risk. It also reduces the number of large-diameter tie-ins required, streamlining startup and performance testing.

To mitigate future water quality risks associated with stagnant water, the segment of the existing 30-inch HPRW line between the new in-conduit hydropower facility tie-in and the existing energy dissipation structure is planned to be removed where practical. Removal of this segment reduces the potential for dead end conditions and long-term water quality degradation.

Where complete removal is not practical, remaining segments would be abandoned in place, capped, and disconnected from active use to eliminate stagnation while preserving the alignment for potential future use. One potential future consideration for retaining a portion of the existing pipe is its possible reuse as a controlled drain or bypass conduit, such as conveying raw water from the 30-inch transmission main to an onsite pond or drainage feature during maintenance, emergency drawdown, or operational transitions. This concept has not been evaluated in detail and would require additional hydraulic, water quality, and operational analysis.

At this planning stage, no operational reliance on the existing line is assumed. Final determination of whether to fully remove or retain portions of the existing HPRW line will be made during subsequent design phases based on constructability, cost, operational flexibility, and water quality considerations.

The Outback Site has a dedicated fire service line that currently tees off from the HPRW line at the energy dissipation facility. Planned changes to the existing 30-inch HPRW will impact this fire service line, requiring its relocation to the new energy dissipation facility. During final design, the fire service line will be evaluated to confirm pressure and flow requirements and determine the best strategy for maintaining code-compliant fire protection during construction and after relocation. The approach will likely maintain a similar setup as the current configuration: a tee off the new HPRW with its own PRV and a dedicated line serving site hydrants and sprinklered buildings. This evaluation will also consider temporary fire line arrangements during tie-ins, permanent pressure-control devices (e.g., PRVs or boosters if needed), and any rerouting required to maintain code-compliant fire protection for all affected buildings, yard hydrants, and new facilities.

3.13.2 Raw Water Conduit Drainage Considerations

Removal of the existing energy dissipation structure as part of the pretreatment and in-conduit hydropower improvements will alter how the 30-inch HPRW transmission main can be drained for maintenance,

operational transitions, or emergency conditions. Under existing conditions, controlled draining of the raw water conduit can be accommodated through discharge to the onsite overflow pond, as described in Chapter 2.

With the removal of the energy dissipation facility and construction of pretreatment components, a new approach for draining the 30-inch raw water conduit will be required. Potential concepts include conveying drained flow to the existing overflow pond, directing flow to a new or modified drainage feature, or a combination of both approaches. These options could be implemented through construction of new piping, reuse of portions of the existing 30-inch pipeline alignment, or selective retention of existing pipe segments to provide operational flexibility.

At the Facility Plan level, no specific drainage configuration is assumed. The intent of this Plan is to identify the need to explicitly evaluate conduit draining requirements as part of subsequent design phases, including consideration of hydraulic performance, water quality, operational logistics, constructability, and cost. Final determination of whether to remove, retain, or repurpose segments of the existing pipeline for drainage purposes will be made during preliminary and final design.

3.13.3 Site Civil Considerations for Piping Installation

Installation of the new raw water conveyance piping will require designers to account for trench access, restoration of disturbed surfaces, and construction staging near the existing HPRW. Early coordination will be needed to verify feasible tie-in locations, confirm access points for equipment, and identify any areas where protective measures or modified sequencing will be required due to proximity to existing critical infrastructure. Surface and roadway restoration requirements should be incorporated into the design to ensure long-term site functionality.

3.13.3.1 Alternatives Considered

The project team evaluated the option of utilizing the existing 30-inch HPRW line for the new conveyance. While technically feasible, this approach would require multiple additional tie-ins to provide the necessary bypassing of the new pretreatment facilities. These tie-ins would need to occur at specific elevations along the existing line, which would significantly limit hydraulic flexibility and reduce operational “wiggle room” for future adjustments. This complexity would also increase construction risk and extend outage frequency and durations. In comparison, installing a new 30-inch pipeline was determined to be a relatively minor cost addition when viewed against the overall project scope, making the new alignment a more practical and cost-effective solution.

The team also considered an alternative that retained the existing energy dissipation facility in its current location while locating the new in-conduit hydropower facility as planned. Under this scenario, if in-conduit hydropower were bypassed and the energy dissipation vault remained after the plate settler facility, water would need to be pumped from the dissipation vault back to the front of the pre-sedimentation ponds. This arrangement was deemed less efficient due to the added pumping requirement of 11.8 MGD (18.2 cfs) to meet peak flow, increased operational complexity, and higher energy costs. For these reasons, the recommended approach consolidates energy dissipation at the new in-conduit hydropower facility and maintains gravity flow through pretreatment to the existing MF feed wet well, which will continue to serve the WFF.

3.14 Final Design Considerations

Because this chapter represents a pre-30% design, the final design phase should confirm all selections and sizing develop in preliminary design. Key elements requiring verification and refinement include:

- Hydraulic Components: Hydraulic grade line, facility elevations, weir design, baffle wall configuration, and sizing of sluice and slide gates.
- Chemical Feed Systems: Detailed design of chemical dosing and storage facilities.
- Evaluation of adding PAC storage and slurry dosing ahead of the plate settlers to avoid pre-chlorination & disinfection byproduct formation during seasonal runoff or wildfire events.
- Instrumentation: Selection of water quality monitoring equipment for operational control and compliance.
- Operational Protocols: Seasonal and emergency startup/shutdown procedures.
- Building Systems: HVAC design for moisture control and architectural measures for noise mitigation in indoor treatment areas.
- Hydraulic Modeling: Revision of hydraulic profiles to reflect any changes made during final design.

CHAPTER 4

In-Conduit Hydropower & Energy Dissipation Preliminary Design Development

4.1 Introduction and Planning Basis

As noted in Section 2.2.2, the City's 30-inch HPRW pipeline delivers water to the Outback Site under approximately 1,000 feet of static head, energy that is currently dissipated through sleeve valves prior to entering the WFF MF feed pump wetwell. While energy recovery was considered during planning and design of the WFF in 2010, in-conduit hydropower was not pursued at that time.

In 2024, the City revisited this opportunity through the In-Conduit Hydropower Study, which evaluated hydraulic conditions, turbine configurations, and energy recovery potential at the Outback Site. That study established the hydraulic and operational basis used for preliminary hydropower planning.

The basis of design flow rate for in-conduit hydropower at the Outback Site is a maximum flow of 18.2 cfs (11.8 MGD), which corresponds to the City's permitted surface water diversion limit from Bridge Creek. While certain facilities may be hydraulically capable of conveying higher instantaneous flows, all planning and design is governed by this regulatory diversion limit. At this maximum flow condition, the anticipated gross static head is approximately 1,017 feet, with a net available head on the order of 940 to 950 feet after accounting for head losses through the conveyance system and control structures. This condition governs turbine sizing and represents the maximum power generation scenario evaluated.

The average design operating condition reflects typical year-round surface water use, with flows generally ranging between 10 to 12 cfs under normal demand conditions. Under these flows, the anticipated net head remains relatively constant but slightly reduced compared to the maximum flow condition due to incremental head losses, providing a stable and efficient operating range for a Pelton-type turbine.

The minimum anticipated design flow condition is approximately 5 cfs, representative of lower winter demand and operational constraints. Even at this minimum flow, substantial available head remains, allowing continued turbine operation at reduced output without adversely affecting water treatment or delivery requirements.

Energy recovery planning and turbine selection are therefore based on accommodating a broad operational envelope, from minimum to maximum flow, while maintaining required downstream pressures and treatment process performance. Additional detail regarding hydraulic modeling, flow duration assumptions, head conditions, and turbine performance curves is provided in the In-Conduit Hydropower Study and is incorporated herein by reference.

With planned expansion at the Outback Site and the need to modify the raw water transmission system to accommodate new pretreatment processes, the City has determined that integrating in-conduit hydropower is both technically feasible and consistent with boarded resilience and sustainability objectives. This chapter summarizes key features and considerations for implementing in-conduit hydropower at the Outback Site, based on the established planning and design framework.

4.2 Facility Layout and Equipment Configuration

Building on the conceptual location identified in the iWSMP and recommendations from the In-Conduit Hydropower Study, the preliminary design effort focused on advancing the in-conduit hydropower concept and defining infrastructure requirements for the Outback Site. The goal was to confirm a feasible location and layout that integrates with planned pretreatment facilities while meeting hydraulic and operational constraints.

Detailed hydraulic analysis was completed as part of this project under the pretreatment preliminary design which included yard piping sizing and updates to hydraulic boundary conditions. These refinements allowed evaluation of the turbine centerline elevation and informed the updated in-conduit hydropower facility layout. The selected location provides adequate grade to provide sufficient head for reliable conveyance to pretreatment facilities.

To validate equipment configuration, multiple vendors were contacted for proposals. Two vendors provided general arrangement drawings suitable for evaluating layout and vertical positioning. A key criterion for turbine elevation, confirmed by both vendors, was maintaining sufficient clearance for free discharge to atmospheric conditions in the tailbay, resulting in a centerline approximately six feet above maximum tailwater level.

Energy dissipation was incorporated to provide reliable raw water conveyance. Two sleeve-type valves were selected to provide redundant energy dissipation and positioned adjacent to the turbine, discharging through submerged perforated diffusers. Each sleeve valve will be designed to convey the max flow of 18.2 cfs (11.8 MGD) to provide redundant energy dissipation for maintenance needs.

Hydraulic design established minimum and maximum water surface levels in the drop box and defined weir configurations to maintain submergence of dissipation valves and accommodate turbine flows at both design (18.2 cfs or 11.8 MGD) and minimum conditions as noted above.

Flow measurement and control requirements were addressed by specifying magnetic flow meters ahead of each device (turbine and dissipation valves). Updated turbine conceptual drawings, including siting relative to pretreatment facilities, are provided in Appendix B. Current sizing of piping, valves, and instrumentation supports cost estimating and serves as the basis for final design, where precise arrangement and material specifications will be confirmed.

4.2.1 Hydraulic Layout Details

Hydraulic conditions at the in-conduit hydropower facility's outlet determined the minimum and maximum WSE in the drop box. At a design flow rate through the turbine of 18.2 cfs, a weir was designed to separate a dissipation valve clearwell from the drop box, maintaining sufficient depth to keep the dissipation valves fully submerged. Flow from the turbine tail bay enters the clearwell via a second weir. These hydraulic conditions at 18.2 cfs set the maximum water elevation in the turbine tailbay while accommodating minimum flow conditions. This configuration allows proper turbine discharge, maintains submergence for

dissipation valves, and provides operational flexibility for full-flow bypass, maintenance, and turbine outage conditions.

4.3 Building and Facility Features

4.3.1 Grading and Accessibility

Based on existing topography and proposed hydraulic requirements, the in-conduit hydropower facility will likely need to be perched slightly above surrounding ground to achieve the turbine centerline elevation required for gravity flow through the pretreatment facilities. While grading will be determined during final design, preliminary observations indicate that some will be necessary. To maintain safe and efficient maintenance access, retaining walls may be required to create level areas around the facility for personnel and equipment. The in-conduit hydropower facility conceptual drawings depict a retaining wall system with built-up grading to allow at-grade personnel access to the facility.

Accessibility is critical for long-term O&M. The facility must accommodate removal, replacement, and servicing of major components such as the turbine, generator, and associated piping. This requires adequate space for lifting equipment, clear paths for moving heavy parts, and safe working areas for maintenance crews. Proper grading and site layout will ensure that cranes, hoists, and other equipment can be deployed without excessive setup or risk. These considerations will be refined during final design to balance hydraulic requirements with operational practicality.

A 6-ton bridge crane providing near full coverage of the floor area is proposed for long-term maintenance of heavy turbine components and piping. Crane design requires integration with the building structure and consideration of hook height, runway positioning, and access to all equipment. Crane capacity, type, and layout will be refined during final design.

4.3.2 Yard and Facility Piping

Connection of the new in-conduit hydropower facility to the existing 30-inch HPRW pipe will require a tie-in and routing of new piping to the in-conduit hydropower facility. Within the facility, piping is preliminarily shown above slab level to facilitate maintenance access. Final design will evaluate potential benefits and risks of below-slab trench installation. Isolation valves are proposed as cone or ball type with hydraulic actuation for reliable operation under high-pressure conditions.

4.3.3 Electrical Equipment

The generator is expected to produce power at medium voltage (4160 volts) and will require a step-down transformer to deliver power at 480 volts for on-site distribution. The generator requires new switchgear at the facility, and a control panel which incorporates a programmable logic controller for process control, and protective relays as required by the power utility. Specific electrical configuration is subject to the requirements of the interconnection agreement with the power utility. A battery bank is typically included to provide resilient control power to the unit. A hydraulic power unit provides motive force to control all components of the system, during normal and emergency operation. The hydraulic power unit is a small package system with small hydraulic oil reservoir, accumulator, and hydraulic switches to actuate turbine and energy dissipation valves, turbine needle valves, and turbine deflector plate.

4.3.4 Sediment and Debris Protection

The raw water intake on Bridge Creek includes a drum screen with an opening of approximately 3/32-inch, which serves as the primary barrier to exclude rocks and larger debris from entering the raw water pipeline. Based on the intake configuration and the presence of multiple siphon segments along the raw water conduit, the likelihood of larger rocks or gravel reaching the in-conduit hydropower facility is considered low, as heavier materials would be screened out or captured within the system before reaching the Outback Site.

Suspended sediment and fine grit in the raw water may still be present during certain flow conditions and could contribute to long-term increasing the likelihood of abrasive wear of turbine components and the consequences of such damage would lead to potentially costly repairs and equipment downtime. Specialty coatings and material selections may be available to resist erosion damage from suspended sediment, and consideration of the costs/benefits of coatings should be considered in final design.

The in-conduit hydropower facility design process should include engagement with candidate turbine vendors to provide recommendations for turbine construction materials and specific metallurgy for the turbine nozzles and runner considering anticipated raw water conditions. It is notable that the in-conduit hydropower industry includes applications in streams containing seasonal glacial silt, including facilities that City staff toured in the Hood River Valley (Oregon). Consultations with vendors and owners of installations with similar expected water quality provide the City with good framework to make decisions regarding materials selection.

4.4 Operations, Control, and Maintenance

The new in-conduit hydropower facility will operate similarly to existing WFF operations. During normal operations, operators will select the desired flow rate for treatment, and the turbine will adjust needle valves on each nozzle to achieve that flow. The raw water transmission pipeline will typically run full, with the turbine experiencing the hydraulic grade line from the Bridge Creek intake, minus pipeline and intake losses.

When the turbine is offline, energy dissipation valves will operate in a lead/standby mode, with one valve conveying all flow into the facility. Automatic sequences will transfer flow from the turbine to the energy dissipation valves if the turbine trips offline (e.g., during load rejection when the generator loses connection to the electrical load). Similarly, automated controls will bring the turbine back online after an outage.

The O&M requirements for the in-conduit hydropower system are minimal and include periodic inspections, annual maintenance, operator training, and occasional third-party support.

- Daily: One-hour walkthrough to record bearing and generator temperatures, water flow, oil levels, and power output.
- Annual: One to two weeks for mechanical checks (oil sampling and changes), electrical testing, transformer insulation testing, and transmission cable assessments.
- Training: Operator education through programs such as Building Operator Certification and Energy Management Technician courses. The City may outsource specialized tasks like relay analysis to qualified contractors.

Startup, commissioning, and initial training will be provided by the turbine manufacturer as part of the capital cost. Estimated annual O&M costs include daily operations ($24,570), yearly maintenance ($7,200), third-party consulting ($2,000), and one-time operator training ($7,500), as detailed in the economic evaluation, Section 5 of the In-Conduit Hydropower Study. More detailed O&M requirements were outlined in the In-Conduit Hydropower Study and will be further evaluated and refined during final design to ensure alignment with operational needs and resilience objectives.

4.5 Electrical and Interconnection

One of the key features identified in the In-Conduit Hydropower Study for the Outback Site in-conduit hydropower implementation is the potential for the turbine-generator to operate independently of the electrical grid during outages or catastrophic events such as earthquakes. This capability would allow the facility to continue producing energy to power essential water treatment processes and select well production, providing significant resilience benefits to the community.

The In-Conduit Hydropower Study evaluated multiple electrical configuration scenarios to achieve this objective. Scenario 3, which consolidates utility connections across the entire site, was identified as the most resilient option for maintaining operations during grid failures and remains the planning basis for site electrical design until detailed discussions with the electric utility are finalized.

Under Scenario 3, power from the hydro unit (4,160-volt, 3-phase) and the utility (stepped down from 12.47 kilovolt (kV) to 4,160-volt) will be interconnected through a new medium-voltage switchgear lineup. This switchgear will provide protection, control, and source transfer capability. From there, power will be stepped down to 480 volts via a transformer and distributed through new low-voltage switchgear to multiple buildings, including control and engine buildings (i.e., facilities housing onsite power-generation equipment such as diesel standby generators), with spare capacity for future loads. Electrical planning will also consider integration with existing 480-volt generators distributed throughout the site and the existing photovoltaic generation system.

Interconnection agreements and approvals from the electric utility are critical for implementation. Determining the most beneficial interconnection agreement for the City will influence design decisions and long-term operational flexibility. The In-Conduit Hydropower Study provided background on interconnection alternatives, and as of December 2025, the City continues to evaluate these options. Additionally, a Bend WFF Energy Resiliency Study initiated in 2025 by Energy Trust of Oregon may help define specific facilities and investments that could impact interconnection decisions. While these decisions have been deferred from the Facilities Plan process, it is prudent to continue carrying out the cost of electrical facility modifications associated with Scenario 3 in project budgets.

Appendix C provides the different electrical configurations as identified in the In-Conduit Hydropower Study which have not been progressed any further than what was completed as part of that study. Appendix C (Figure 6/8 and 8/8) provide the Scenario 3 interconnection scheme that integrates two sources.

4.6 Additional Considerations

4.6.1 Environmental Impact and Benefits

Implementation of in-conduit hydropower facilities at the Outback Site would not increase diversions from Bridge Creek and therefore no additional environmental impact due to its construction or operation is anticipated. Because the proposed in-conduit hydropower facility is located on a pipeline to a water treatment facility, land disturbance is already accounted for in the construction of the other infrastructure.

Per the In-Conduit Hydropower Study, anticipated environmental benefits include reduced greenhouse gases due to offsetting the City's energy consumption with carbon-free in-conduit hydropower. This reduces fossil fuel consumption and promotes renewable energy production. Implementation could make meaningful progress in alignment with the City's Community Climate Action Plan, including reduction of community-wide fossil fuel use by 40 percent by 2030, and 70 percent by 2050. 2,343 metric tons of CO2 could be offset annually by the renewable energy generated at the Outback site. The carbon offset mass was estimated as part of the In-Conduit Hydropower Study using the EPA estimated carbon emission rates in the Northwest Power Pool. Pacific Power literature indicates that coal fired power sources make up 56 percent of the utility's basic service resource.

4.7 Summary of Recommendations

Recommendations for this Facilities Plan pertaining to in-conduit hydropower remain largely the same as the In-Conduit Hydropower Study and include the following.

- Proceed to implement in-conduit hydropower facilities (1.3 megawatts, dual nozzle horizontal Pelton turbine and 4160-volt generator) facilities.
- Continue to evaluate and determine the most appropriate interconnection agreement. As part of this decision, evaluate and determine most appropriate electrical configuration, such as Scenario 3 from the Feasibility Study.
- For all turbine/generator purchases, consider an evaluated bid equipment proposal including life-cycle costs, minimum performance standards, and power production performance testing requirements. Consider operating performance guarantees with incentives or penalties associated with meeting specified requirements in field testing after startup.
- Continue to pursue economic incentives for project implementation.
- Establish and maintain an in-conduit hydropower implementation schedule, including permitting and licensing.
- Final design should conduct a hydraulic transient analysis to thoroughly examine the risks associated with normal and emergency shut down conditions of the in-conduit hydropower generation systems at Outback WFF.
- A hydraulic transient analysis was previously completed for the Raw Water Conduit at flows up to 36 cfs (23.3 MGD), with minimum valve closure times identified in the record drawings (Note 1 on Sheet 00G-07 of the Raw Water Conduit drawings). This prior analysis provides important baseline information and should be reviewed and referenced during design of the in-conduit hydropower facilities. However, because the new hydropower facility will introduce different terminal valve types, valve locations, and operating sequences, final design should include a project-specific hydraulic transient analysis to evaluate normal and emergency shutdown conditions associated with the in-conduit hydropower generation systems at the Outback WFF.

CHAPTER 5

Reservoir Siting and Integration

5.1 Introduction

This chapter provides a long-term strategy for water storage at the Outback Facility. The plan is intended to guide future reservoir improvements so that storage capacity supports both operational reliability and regulatory compliance. In addition to providing usable storage for distribution system customers, this strategy incorporates considerations for contact time within new or reconfigured reservoirs to maintain disinfection performance. The chapter expands on the existing storage overview presented in Chapter 2 and documents the current understanding of existing reservoir conditions. It establishes design criteria, including contact time requirements, hydraulic constraints, and storage objectives, and summarizes decisions made with the City regarding siting, sizing, and phasing of storage improvements.

While improvements described in this chapter may be phased due to capital and operational constraints, Operations emphasized that each phase must contribute to a coherent long-term configuration rather than a series of isolated or stop gap fixes. Accordingly, the proposed reservoir strategy maintains a clear progression toward a fully integrated, resilient, and redundant storage and contact time system.

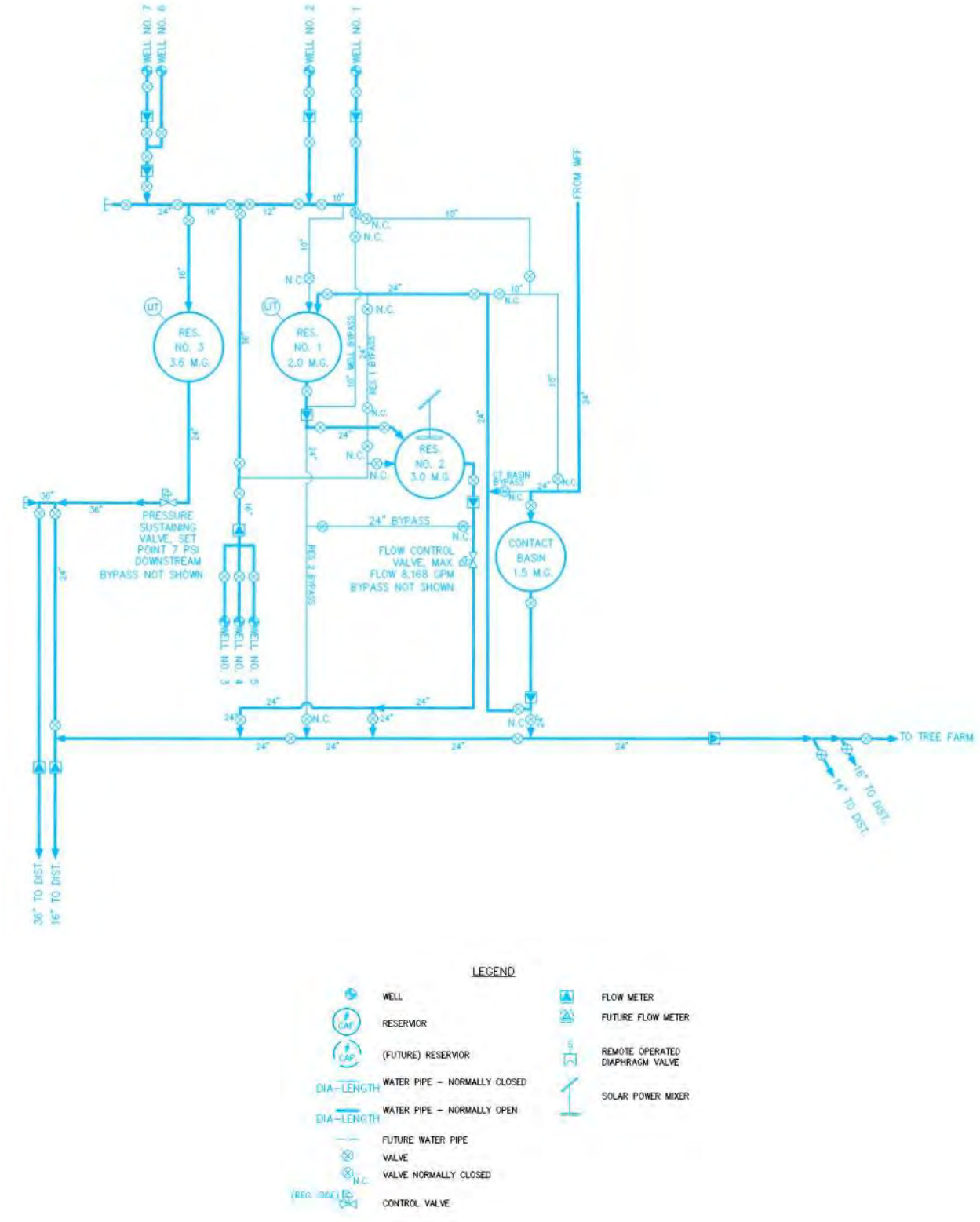
Existing projects identified in the iWSMP, including Outback Reservoir No. 1 (T-1), Outback Reservoir No. 2 (T-18), Outback Reservoir No. 3 (T-3), and the CT Basin (T-4), provide the foundation for this evaluation. The City does not intend to upgrade the existing CT Basin (T-4). Instead, this plan evaluates how the required contact time volume could be incorporated into future reservoir or clearwell configurations at a planning level, with the expectation that final concepts will maintain regulatory compliance while improving long-term efficiency and resiliency.

Because expansion within the existing fence line is constrained, this plan also considers opportunities for new or replacement storage on the future expansion area (southwest parcel). Concept-level siting and sizing scenarios were developed to compare multiple approaches to determine the most cost-effective, operationally flexible, and resilient configuration. This chapter introduces concepts, evaluates the feasibility, and provides a comparative analysis to support selection of a preferred approach. Reservoir planning is coordinated with other planned improvements at the Outback Site, including pretreatment facilities and in-conduit hydropower integration, to establish a cohesive long-term site strategy. Final recommendations are documented later in this chapter and incorporated into the overall Outback Site plan.

5.2 Current Operations of Reservoirs

Four reservoirs (CT Basin and Reservoirs 2, 3, and 4) at the Outback Site together provide chlorine contact time and water storage for the City's PL-3 pressure zone. The existing configuration maintains separation between surface water and groundwater storage, while allowing operational flexibility to transfer supply between tanks as needed. Figure 5-1 provides a process flow diagram for reference and detailed operations specific to storage are further detailed below.

Figure 5-1 | Outback Site Water flow Diagram – Existing Conditions



5.2.1 Surface Water/Disinfection and Contact Time

For the surface water supply, 12.5 percent bulk sodium hypochlorite is injected after filtration at the WFF to achieve disinfection. Filtered water flows via residual pressure from the membrane filter feed pumps from the WFF to the CT Basin and then through Outback Reservoir 1 and Outback Reservoir 2 in series (filling in that order). The Surface Water Treatment Rule and the Long Term 1 and Long Term 2 Enhanced Rules require the City to meet 2-log removal of Cryptosporidium, 3-log removal or inactivation of Giardia, and 4-log removal or inactivation of viruses. The City has confirmed that the WFF meets these disinfection requirements under its current operating conditions.

How the City currently calculates CT (Daily Rounds Method):

For daily operational compliance tracking, the City calculates contact using its Daily Rounds methodology, which estimates total contact time as the sum of effective contact time in the CT Basin and Outback Reservoir 1 under peak hourly demand conditions. Operations computes individual reservoir contact time based on the reservoir water level at maximum flow and the associated peak hourly demand flow in the Daily Rounds formulas, see **Appendix D**.

Total Contact Time is Calculated As:

- Contact Time (minutes) = CT Basin contact time + Outback #1 contact time (when both are online)

Operations Then Computes:

- Actual CT = Contact Time × minimum free chlorine residual measured at the "first customer" compliance point

The "first customer" point depends on operating status. When both the CT Basin and Outback Reservoir 1 are online, Outback Reservoir 1 outlet is treated as the first customer. When Outback Reservoir 1 is offline (or when operating levels during peak hourly demand fall below the City's operational thresholds), the CT Basin outlet becomes the first customer point.

Required CT (Historical Basis): Required contact is determined from EPA regression equations for log inactivation of Giardia using free chlorine. This regression equation relates the target log inactivation, water temperature, free chlorine residual, and pH during peak hourly demand. The Daily Rounds template includes a Giardia log inactivation parameter (L) in the required contact time equation; the City has confirmed they calculate the required contact time targeting a 0.5-log inactivation of Giardia via free chlorine.

Direction From The City: The City confirmed that its current required contact time calculation method for achieving an additional 0.5-log inactivation of Giardia is a legacy approach that is conservative now that the Pall membrane filters at the plant have been established and successfully operated for many years. The City has also confirmed they will rely on the membranes moving forward to achieve the required 2-log Cryptosporidium removal and 3-log Giardia removal. As such, future contact time sizing and evaluation will focus solely on achieving 4-log virus inactivation.

This clarification does not change current Daily Rounds calculations but informs the planning-level contact time evaluation for new clearwell concepts later in this chapter. The City will be required to complete a tracer study on the selected and constructed clearwell concept to confirm contact time is achieved for 4-log inactivation of viruses before changing the current method of calculations.

Monitoring And Baffling: Inline chlorine residual analyzers on CT Basin (inlet/outlet) and Outback Reservoir 1 (inlet/outlet) are monitored in SCADA for real-time control and verification. The CT Basin is baffled with hypolon curtains with valving to allow bypass of CT Basin to Reservoir #1, when required. A tracer study conducted on August 8, 2023, provides confirmation of contact time performance under the tested operating conditions and serves as a basis for understanding the effective hydraulics/baffling of the current CT Basin configuration. The 2023 Tracer Study is provided in **Appendix E**. The tracer study confirmed a rated baffling factor of 0.64 through the CT Basin with its baffling curtains based on current operating practice.

5.2.2 pH Adjustment

Sodium hydroxide dosing infrastructure is already in place at the outlet of the WFF and may be used to adjust pH prior to achieving contact time and before storage or distribution. Following disinfection, water flows sequentially through CT Basin, Outback Reservoir 1 and Outback Reservoir 2, which operate in series and fill in that order from the WFF.

5.2.3 Surface Water Flow Control and Distribution

Flow from Outback Reservoir 2 enters the distribution system through a flow control valve which consists of a globe valve, which is set up with flow control trim to regulate the flow of surface water not to exceed a maximum set point to meet proper contact time and achieve a maximum withdrawal flow from Bridge Creek of 18.2 cfs (11.8 MGD). Maximum surface water flows into the facility are 11.8 MGD (18.2 cfs), therefore the flow control valve is currently set up to maintain a maximum flow rate of 8,168 gpm (11.8 MGD or 18.2 cfs).

5.2.4 Groundwater Supply and Blending

On the groundwater supply side, Reservoir 3 is supplied with water from Outback Wells No. 1 through 7 and the outlet flow from the reservoir to the distribution system is regulated by globe style pressure sustaining valve. The pressure sustaining valve maintains pressure within PL-3 and is designed to prioritize the use of surface water before groundwater by operating at a set pressure that can be adjusted as needed. Currently, the pressure sustaining valve is set at 7 psi, which corresponds to a hydraulic grade just below the working grade line of Outback Reservoir 2. This configuration prioritizes the use of surface water under normal operating conditions. The pressure sustaining valve maintains pressure within Pressure Zone PL-3 by maintaining its setpoint of 7 psi and opening to allow groundwater to supplement surface water supply. This arrangement provides operational flexibility and helps maintain pressure stability during peak demand periods.

Surface water from Outback Reservoir 2 and groundwater from Outback Reservoir 3 blend as they are conveyed via transmission piping into Pressure Zone 3. **Table 5-1** provides a summary of the existing storage reservoirs at the Outback Site.

Table 5-1 | Existing Reservoirs at Outback Site

Full Reservoir Name	Install Year	Reservoir Type	Nominal Capacity (MG)	Overflow Height (Feet) [Elevation (feet)]	Floor Elevation (Feet)	Diameter (Feet)
Outback CT Basin	1991	Bolted steel with membrane curtain wall baffle	1.5	31.0 [4011]	3,980	92.32
Outback Reservoir 1	1993	Bolted steel with membrane curtain wall baffle	2.0	35.0 [4011]	3,976	98.91

Full Reservoir Name	Install Year	Reservoir Type	Nominal Capacity (MG)	Overflow Height (Feet) [Elevation (feet)]	Floor Elevation (Feet)	Diameter (Feet)
Outback Reservoir 2	2000	Welded steel	3.00	35.4 [4011]	3,976	120
Outback Reservoir 3	2006	Welded steel	3.63	29.4 [4011]	3,982	146

5.3 Existing Reservoir Conditions

A water storage tank condition assessment completed in 2019 as part of the iWSMP established baseline conditions and maintenance needs for the Outback reservoirs. The summaries below consolidate: (1) Condition Assessment 2019 iWSMP (2019 CA) findings, (2) maintenance or issues observed since 2019, (3) recommended near-term maintenance to keep assets safe and serviceable, and (4) planning notes that relate to the siting concepts. Remaining service life references are planning-level as of 2025.

CT Basin: The 2019 CA indicated that CT Basin is in very poor condition and cannot be rehabilitated. The basin has reached the end of its service life but remains in operation to maintain regulatory compliance; however, long-term planning will address replacement or integration of required CT volume within new or reconfigured reservoir storage. The iWSMP identified Project ID T-4 for decommissioning; the following items summarize existing reservoir condition elements for reference.

- Leakage and structural: Embedded base ring leak rate of ~13 MG per year; floor cracking with unknown leak rate. In early 2026, Operations observed a new substantial leak approximately 8-12 inches from an existing crack; basin remains in service with monitoring.
- Seismic/standards: Tank shell and roof do not meet current American Water Works Association (AWWA) seismic standards; interior coatings are in poor condition with bolt hole corrosion and degraded sealants; exterior coatings fair with degraded caulk and bolt corrosion; 24-inch side hatch is non-standard and restricts access.
- Safety/access: Roof fall protection relies on vacuum mount anchors that require special procedures; instrument vault has experienced flooding; several older valve/meter vaults are abandoned.
- Ventilation & appurtenances: Roof vent damaged/displaced with inadequate base-flange seal; vents do not meet AWWA standard; risk of rainwater/insect intrusion.
- Piping and equipment: Corrosion noted on inlet/outlet and overflow fittings/supports; portions of 24-inch yard piping include dead ended elements (abandoned flow meter and actuated valve).
- Baffling: Curtain wall (membrane) baffles are degraded; corrosion of attachment hardware; historical replacement challenges
- Drainage: Site grades, asphalt concrete, and catch basins require improvement to control ponding, icing, and uncontrolled surface drainage.
- Electrical/Instrumentation & Controls: Non-standard water level transducer and nonfunctional temperature probe noted at time of assessment; select 120 volt circuits at the instrument vault require upgrade for reliability and safety.

Outback Reservoir 1: The 2019 CA indicated that Outback Reservoir 1 is in poor condition with age-related wear; ongoing capital maintenance is necessary to sustain operation until broader site improvements occur. While the original condition assessment anticipated ~18 years remaining service life, subsequent discussions during this project concluded that less than 10 years remain. The iWSMP identified Project ID T-1 for capital maintenance.

- Tank foundation/floor: Cracking present; leak rate uncertain.
- Seismic/standards: Limited seismic resiliency relative to current AWWA standards.
- Coatings/seals: Interior coating in poor condition (bolt hole corrosion; degraded caulk/sealants); exterior coating in fair condition with degraded seals/bolt corrosion.
- Access/safety: Two 24-inch side hatches (access constraint) with corrosion; no fall protection system in place; interior ladder shows corrosion and lacks fall protection.
- Piping/instrumentation: Corrosion noted at inlet/outlet piping and supports; outlet flow meter is non-standard; isolation valves exhibit incomplete sealing/leakage; vault access is constrained and lacks safety grates/adequate lighting/heat/grounding.
- Baffling: Fabric baffles are degraded; attachment hardware shows corrosion.

Planning note: Reservoir 1 is a substandard (originally grain-storage-style) tank with limited seismic capacity and leakage history; reservoir concepts assume phased decommissioning once replacement contact time/storage facilities are operational.

Outback Reservoir 2: The 2019 CA indicated that Outback Reservoir 2 is in fair condition with a planning-level remaining service life of approximately 50 years.

- Coatings: Interior coating was in poor condition in the 2019 CA and associated with water quality issues; exterior coating is fair. In spring/summer 2025, the interior was fully recoated and the exterior had spot repairs. During the outage for tank recoating, Operations installed a temporary piping bypass so Reservoir 1 could maintain contact time through the flow control valve while Reservoir 2 was isolated.
- Vaults/Mechanical/Instrumentation & Controls: Instrument and flow meter vault access is constrained (undersized lids; lack of safety grates/ladders); several 24-inch isolation valves were replaced in 2024; the 24-inch flow meter was replaced in 2025; a level sensor tank connection was replaced in 2024; the ultrasonic transducer was replaced in 2024; the mechanical level gauge was replaced in 2025.
- Surfacing/security: AC surrounds show cracking/vegetation and need restoration; intrusion alarm switches are not installed at key hatches.
- Reservoir 2 has a SolarBee mixer, SB100000PW unit installed in 2006 which is a floating solar-powered potable storage tank mixer.

Outback Reservoir 3: The 2019 CA indicated that Outback Reservoir 3 is in excellent condition with a planning-level remaining service life of approximately 60 years. The iWSMP identified Project ID T-3 for long-term maintenance activities.

- Coatings/inspection: Interior and exterior coatings were noted as fair; no credible dive report was on hand at the time of the 2019 CA (future inspection recommended). As of early 2026, top coat of exterior coating and interior primer and top coating are failing.

- Vaults/access/security: Replace/upgrade select vault lids; add access ladder and fall protection; add intrusion switches/alarms at instrument vault, meter vault, and roof hatch.

- Surfacing/coatings/vents: Restore asbestos cement surrounds; plan exterior spot repairs/overcoat and long-term interior recoating; replace roof vents with AWWA compliant frost-free units.

- Planning note: Reservoir 3 is a long-lived asset across concepts. If repurposed for contact time redundancy or converted to surface water service in some concepts, incorporate baffling/mixing upgrades and plan for tracer verification under the selected operating mode.

Overall, the CT Basin and Outback Reservoir 1 are in poor condition; both are substandard tank types not intended for potable water service and have a history of leakage. Accordingly, concepts assume phased decommissioning of these facilities as replacement contact time and storage are commissioned. In contrast, Outback Reservoirs 2 and 3 are in materially better condition with long remaining service life and are therefore assumed to remain in service with targeted maintenance and any concept-specific retrofits (e.g., baffling/mixing, analyzer or vault adjustments).

5.4 Existing Site Piping – High-Level Summary for Siting and Integration

The Outback Site contains two primary finished-water piping networks: the surface water header conveying filtered water from the WFF through the CT Basin and surface water reservoirs, and the groundwater header conveying wellfield production to Outback Reservoir 3. These systems connect to the PL-3 transmission main at the northeastern and southeastern boundary of the site. Isolation valves are provided at each tank inlet and outlet, along primary piping corridors, and at transition points between the surface water and groundwater systems.

- Surface Water Piping: Filtered water exits the WFF and is conveyed through a dedicated finished-water pipeline to the CT Basin, then routed to Outback Reservoir 1 and Outback Reservoir 2 in series through hard-piped inlet and outlet connections. The surface water header at the outlet of Reservoir 2 ties into the site's main distribution connection to PL-3. A flow control valve on this header limits the outflow rate (gpm) to a setpoint to maintain contact time operating conditions and comply with surface water withdrawal limits. The surface water piping network includes multiple isolation valves and bypass connections that allow individual facilities to be taken offline for maintenance.

- Groundwater Piping: The groundwater piping network conveys water from Outback Wells 1-7 to Outback Reservoir 3 through a dedicated header. The reservoir outlet connects to the PL-3 system through a pressure sustaining valve vault located near the site's main distribution line. Isolation valves at the well manifold, reservoir inlet/outlet, and pressure sustaining valve vault allow operational flexibility and support temporary shutdowns for maintenance.

- Interconnections: The surface water and groundwater headers include select interties, controlled by normally closed valves, that allow manual cross connections during special operating conditions, plant outages, or maintenance. These interties do not provide routine blending but provide operational resilience. Future reconfiguration of reservoirs may require modification of these interties.

- Site Layout and Piping Constraints: The existing pipe corridors run between the filtration building, CT Basin, and the three storage reservoirs, creating geometric constraints that will directly influence new reservoir siting. Because these corridors contain major buried infrastructure, any future relocation, demolition, or replacement of reservoirs will require partial rerouting of the finished water header and potentially relocating valve vaults and analyzer taps.

- Implications for Future Siting: Any new reservoir footprint, whether on the existing footprints or within the expansion area, will necessitate new inlet/outlet piping connections to the finished-water headers. Depending on final elevations, new piping may be required to maintain preferred flow direction, turnover, and hydraulic performance. Relocation of analyzer taps, access vaults, and control valves should be anticipated as part of reservoir siting and integration.

5.5 Reservoir Concepts Evaluation

Integration of new or modified contact time and reservoir facilities is a critical component of addressing aging infrastructure, ensuring long-term reliability, regulatory compliance, and operational flexibility within the City's pressure zone PL-3. This section establishes the design criteria that govern reservoir sizing, siting, and configuration, including chlorine contact time requirements, hydraulic constraints, and storage objectives. These criteria form the foundation for evaluating concepts that address aging infrastructure, optimize system performance, and maintaining compliance with disinfection standards.

5.5.1 Design Criteria

Table 5-2 summarizes the design criteria for the development of the reservoir concepts. Additional narratives are provided where necessary to explain key criteria and the background.

Table 5-2 | Design Criteria

Description	Criteria	Requirement Source
System Wide Storage Additional Volume	5.74 MG	Long term storage identified in iWSMP, See Design Criteria Note 1 below.
Maximum WSE	4,011 Feet	Controlling overflow elevation, specifically for the groundwater system, can be higher if valving is added to reduce pressure prior to distribution to the PL-3 zone. Surface water delivery from the WFF is limited by the existing pumping capacity. The current system can support pumping to a maximum WSE of 4,011 feet under existing conditions.
Minimum WSE	3,992 Feet (Results in 10 feet dead storage in existing Reservoir 3 and 16 feet in existing Reservoir 2)	Driven by Tree Farm minimum pressure requirements See Design Criteria Note 2 below.

Description	Criteria	Requirement Source
Redundant CT Capacity	Provide sufficient CT capacity to meet disinfection requirements under peak flow conditions with the largest unit out of service.	Operations requirement. System must maintain required CT values during maintenance and operational scenarios. See Design Criteria Note 3 below.
Surface Water and Groundwater Connectivity	To prioritize use of surface water (less expensive) over groundwater to meet average and peak demands.	Connectivity required by operations to provide operational flexibility for blending groundwater with surface water in the event of plant issues

5.5.1.1 Design Criteria Notes

1. Water Storage Volume: The 2021 iWSMP identified 2040 average-day and peak-day demands which are considered relatively conservative for use as a build-out calculation, because there isn't significant area outside the current water service area to expand. Other water purveyors such as Avion and Roats currently serve portions of the City limits and the City serves approximately 75 percent of customers within the Urban Growth Boundary. Some infill and redevelopment may occur in portions of the service area, however this type of development typically tempers the impact on future summer peaks due to the loss of irrigable area. Therefore, the 2040 iWSMP water demand projections are used, unchanged, as part of this project.

    - Storage volumes include Operational, Equalizing, Standby and Fire components as described in the iWSMP.

    - The iWSMP assumes CT and Outback 1 does not contribute to the overall system storage and are dedicated to providing contact time. Max operating reservoir volume at Outback Site is 6.51 MG however, approximately 3.08 MG of this volume is unavailable for system use because it constitutes dead storage required to maintain minimum operating WSE needed to meet downstream pressure and hydraulic grade requirements. As a result, the useable storage at the Outback Site is 3.43 MG while maintaining 21 feet of storage in the CT Basin for contact time.

    - The capital projects identified in the iWSMP assume that standby power can help offset standby storage requirements and that an additional 5.74 MG of future usable storage will be needed system wide. The City has flexibility in where this storage is located, as noted in the iWSMP capital improvement program, though it was preliminarily identified between Outback and Overturf. Positioning this storage high in the system (EG PL 3) allows it to be utilized across lower zones.

        - 5.74 MG assumes useable storage at the Outback Site of 3.43 MG.

    - The storage analysis completed as part of the iWSMP is based on Washington Department of Health requirements which are currently more stringent than Oregon requirements.

2. Minimum WSE: The iWSMP indicates that the current minimum operating depth is based on maintaining 21 feet of storage in the CT Basin for contact time. Going forward, however, the minimum WSE at the Outback Site will be controlled by pressure requirements at Tree Farm rather than contact time. Previously a minimum WSE of 4,005 feet was required to meet contact time needs, but contact time will be addressed separately through the final tank and clearwell configurations and therefore is no longer the controlling factor for minimum WSE.

- There are currently no agreements with the Tree Farm development specifying minimum pressure requirements, so the intent for any improvements is to maintain existing service pressure of 7 psi at the highest service elevation which is understood to be the minimum pressure needed for each residential's individual inline booster pump.

- Highest service elevation at Tree Farm is roughly 3,969 feet and minimum service pressure required is 7 psi, assuming no headloss in transmission mains, minimum WSE at Outback Site is 3,985 Feet.

    - The highest service elevation has not been fully confirmed in the field. Consor was directed by the City to assume the elevation was correct, which should be confirmed as part of preliminary design of any reservoir.

- Conservatively, a minimum of 10 psi is assumed to allow for some headloss and a safety factor resulting in a WSE at Outback site of 3,992 feet.

3. Existing Reservoir Contact Time Capability - Planning Assumptions: As noted previously, future contact time sizing and evaluation for the Outback Site will focus solely on achieving 4-log virus inactivation, because Giardia credit is anticipated to be fully provided by the membrane filtration process, which will need to be confirmed by the State. Although the Daily Rounds methodology currently used by Operations reflects the legacy configuration of the CT Basin and Outback Reservoir 1, planning-level evaluation completed for this project demonstrates that Outback Reservoirs 2 and 3 each have sufficient volume to individually meet 4-log virus inactivation contact requirements under peak-flow conditions.

    - To evaluate the contact time capability of Reservoirs 2 and 3, planning-level calculations were performed using:

        - Estimated minimum available volume in each tank, based on drawdown to the assumed minimum water service elevation (3,992 feet).

        - Peak surface water flow of approximately 8,168 gpm, consistent with tracer-study operating conditions and City operating information.

        - A conservative baffling factor of 0.05 (i.e., very low credit for baffling), representing hydraulics in an unbaffled welded steel reservoir.

        - A minimum free chlorine residual of 1.0 mg/L at cold-water conditions (6°C) and pH 7.6, consistent with EPA contact time tables and City operating norms.

    - Using these assumptions, each reservoir was evaluated independently. Results show:

        - Reservoir 2 provides approximately 10.3 minutes of effective contact time, which is adequate to satisfy the required contact time for 4-log virus inactivation at the operating conditions evaluated.

        - Reservoir 3 provides approximately 10.5 minutes of effective contact time, also sufficient to meet the required 4-log virus contact time.

- In both cases, virus inactivation requirements are satisfied even under conservative assumptions, and without relying on baffling, multiple-tank series operation, or modifications to inlet geometry.

- These findings indicate that neither Reservoir 2 nor Reservoir 3 requires structural baffling upgrades or other modifications to meet 4-log virus contact time requirements for planning purposes. Operational enhancements such as mixing systems are still recommended to mitigate potential dead zones, improve turnover, and enhance water quality, but these are not required for contact time compliance.

- This conclusion is an important input to the reservoir concepts evaluation and forms the basis of the planning assumption that existing reservoirs can satisfy contact time needs individually, allowing reservoir improvements to focus on long-term resiliency, redundancy, and operational optimization rather than mandatory contact time driven retrofits.

5.5.2 Design Considerations

Although these are not specific design requirements, the following considerations were taken into account during concept development:

- Tank Construction: The City indicated that concrete tanks are preferred for any future clearwell construction. The City also noted that welded steel is preferred over prestressed concrete for larger storage tanks due to long-term maintenance concerns.

- Baffles: Permanent baffles are preferred over membrane (HDPE curtain wall) baffles based on extensive operational challenges with the existing system. Operations reported that the membrane baffles are not durable, require frequent repair or replacement, and have historically resulted in significant maintenance burdens. In 2023, the City was required to reconduct its Contact Time Tracer Study because one of the membrane baffles in the CT Basin could not be replaced. This event demonstrated that reliance on non-rigid membrane baffles carries operational and regulatory compliance risks. For these reasons, permanent baffle systems are strongly preferred for future facilities to increase reliability, reduce maintenance needs, and minimize disruption to system operations.

- Mixers: The City currently has a SolarBee mixer in Outback Reservoir 2 which floats around in the tank and has to be serviced every year. The City has indicated that they do not prefer this type of mixer due to the maintenance required.

- Utilization of Outback Reservoirs 2 and 3: These reservoirs are in good condition and have significant remaining service life, justifying continued operation and investment rather than decommissioning.

- Optimization of Surface Water: Maximum use of surface water up to 18.2 cfs (11.8 MGD) will continue to be the priority for all concepts evaluated.

- Separate Contact Time: Achieving contact time independent of storage reservoirs is preferred by Operations.

- Decommissioning CT Basin and Outback Reservoir 1: All future scenarios assume that Outback CT and Outback Reservoir 1 are decommissioned due to the current condition and substandard tank type.

5.5.3 Planning-Level CT Methodology for Future Concepts

Because the future concepts will modify the CT Basin and/or reservoir configuration (including baffling, flow paths, and use of new clearwell facilities), the 2023 tracer study results cannot be directly applied to those configurations. For concept screening, required contact time will be based on virus-only inactivation, consistent with City direction to rely on the membrane filters for the 3-log Giardia removal credit. This planning-level approach provides a consistent comparison among concepts; however, a new tracer study will be required for the final preferred concept once geometry, baffling, and operating conditions are established.

5.6 Concepts – Comparative Analysis

This section presents a comparative analysis of two primary reservoir concepts developed in collaboration with City staff to enhance operational reliability and improve system resiliency at the Outback Site. Each concept includes slight variations to address different operational and site considerations. The analysis evaluates these concepts against key performance, cost, and operational criteria to identify the most effective solution. Potential implications of each concept on future PFAS treatment configuration and site layout are not evaluated in detail in this chapter, these considerations are addressed in Chapter 6 and illustrated in the associated full site plan. The recommended concept will be discussed in detail in a subsequent section following this comparison. A Comparative Matrix Table, Table 5-3, is provided at the end of this section that provides a summary of details and comparative analysis between the concepts.

5.6.1 Concept 1: New Groundwater Reservoir: Conversion of Outback Reservoir 3 to Surface Water and New Outback Reservoir for Groundwater

Concept 1 proposes designating Outback Reservoirs 2 and 3 as dedicated surface water storage while constructing a new reservoir within the expansion area for groundwater storage with an overflow elevation of 4,011 feet. The existing CT Basin and Outback Reservoir 1 would be decommissioned; however, Outback Reservoir 1 may remain in service temporarily to provide both volume redundancy and contact time redundancy while improvements are implemented at Outback Reservoirs 2 and 3. Although Reservoirs 2 and 3 are each capable of independently meeting 4-log virus contact time requirements without structural baffling, replacing Outback Reservoir 2's mixing system is recommended to reduce maintenance requirements that are currently required for the exiting mixing system. A tracer study would be required to validate contact-time performance under the new configuration. Figure 5-2 and Figure 5-3 provide an overview of this concept and are provided at the end of this chapter.

Current Tank Operational Changes: The CT Basin would be decommissioned in the near-term, and Outback Reservoir 1 would remain in service temporarily to provide contact time and volume redundancy while improvements are completed on Outback Reservoirs 2 and 3. Outback Reservoir 2 remains operational as a surface water storage tank. Outback Reservoir 3, which currently operates as groundwater storage, would be converted to surface water service; this conversion will require new inlet piping and modifications to existing valving to integrate the reservoir into the surface water supply header while preserving the ability for groundwater to supplement surface water storage when needed.

In the final configuration, Outback Reservoirs 2 and 3 could be configured to operate in parallel or in series, depending on the selected piping arrangement and final operational preferences. Under a parallel configuration, either reservoir could independently meet contact time requirements, providing redundancy with relatively simpler piping modifications. Under a series configuration, water would flow sequentially

between the reservoirs, providing increased operator flexibility for managing detention time, reservoir utilization, and hydraulic performance.

The series configuration would require additional interconnecting piping and valving to maintain the ability to fully isolate either reservoir for maintenance while preserving continuous operation of the remaining reservoir. Conceptual piping differences between the parallel and series configurations are illustrated in the schematics, with additional piping required for the series arrangement.

Outback Reservoir 1 would then be decommissioned once the selected configuration is implemented and redundancy is confirmed. Although neither Reservoir 2 nor Reservoir 3 requires baffling upgrades to meet 4-log virus contact time requirements, mixers are recommended in both reservoirs in both reservoirs to improve hydraulic performance, reduce dead zones, and support long-term operational resiliency under either operating configuration.

Outback Site and System Wide Storage Considerations: Reservoirs 2 and 3 have a combined useable storage volume of 4.07 MG based on a minimum WSE of 3,992 feet and an overflow WSE of 4,011 feet. This accounts for an increase of 0.59 MG of useable storage volume than the iWSMP identified, strictly due to the difference in allowable minimum WSE. Assuming the City wants to provide additional system wide storage at the Outback Site instead of elsewhere in the system (i.e. Overturf), the new reservoir would be sized to provide a useable storage of 5.1 MG to eliminate the deficiency identified in the iWSMP in system wide storage for the 2040 planning horizon. Otherwise, the tank could be significantly smaller if only focused on providing Outback Site deficiencies if the City provides system wide storage improvements at other facilities.

- Important Note: The new tank size recommendation assumes full drawdown to 3,992 feet in Reservoirs 2 and 3. Operations may hesitate to draw down this far under normal conditions due to concern of drawdown but maintaining maximum 18.2 cfs flows, so sizing should remain adaptable. To convert Reservoirs 2 & 3 to surface water will require upsizing piping.

Contact Time Considerations: Planning-level contact time calculations completed for this study confirm that Outback Reservoirs 2 and 3 each provide sufficient effective volume to independently achieve 4-log virus inactivation at peak surface water flow rates, using minimum operating volume assumptions and without baffling or other contact time driven retrofits. As a result, parallel operation of the two reservoirs provides full contact time redundancy under this concept. A tracer study will be required for any modifications to plant disinfection operations to verify contact time performance once the final inlet piping configuration for surface water service is established.

- Important Note: Existing conditions of both Reservoir 2 and 3 should be taken into account when evaluating this concept, given that using either or both of them to achieve contact time means the City will continue to rely on aging infrastructure to achieve critical treatment operations.

Land Use Considerations: Land use impacts associated with this concept are expected to be minimal for the existing reservoirs, as Outback Reservoirs 2 and 3 already occupy established utility parcels and the planned decommissioning of the CT Basin and Outback Reservoir 1 does not trigger notable land use constraints. However, construction of the new reservoir within the expansion area will require compliance with land use requirements associated with the City's planned rezoning of the parcel to a Public Facilities (PF) zone, as directed by the City. This concept also assumes successful acquisition of the expansion parcel from the Forest Service, which is a prerequisite for siting and constructing new storage facilities in this area.

Placement of the new reservoir will need to comply with applicable PF-zone development standards, including site-specific setback requirements, maximum structure height allowances, and other zoning-related conditions that may apply at the time of design. Final siting and orientation of the reservoir will be refined during preliminary design to confirm compliance with these requirements and to minimize impacts on surrounding land uses and natural resources.

Major Infrastructure Improvements – High Level Planning for Cost Estimating Development:

- Mobilization and Demobilization.
- Modified Mixing System at Outback Reservoir 2:
  - Replacement of existing mixer system, including removal and disposal of the current floating surface-mounted mixer and associated cabling.
  - Installation of new GridBee GS-12 submersible mixer, including weighted power cable, support chain to the access hatch, and required mounting hardware.
  - Electrical and SCADA integrations, including new electrical feed and conduit to the reservoir, terminations at the control panel at the WFF, and basic SCADA programming for mixer operation and status.
  - Preferred approach is installation of a hydrodynamic mixing system—a dedicated mixing line installed along the bottom of the reservoir that uses directional "duckbill" valves to promote continuous circulation and turnover of stored water. A separate cost is provided for this recommendation and includes draining and cleaning the reservoir, installation of the mixing pipe and concrete anchors, installation of three duckbill valves, refilling and chlorination of the reservoir, testing, and installation labor. The assumed system consists of approximately 100 feet of 20-inch HDPE pipe with three duckbill valves.
- New Groundwater Reservoir (5 MG):
  - Approximate wall height: 19 feet, based on overflow of 4,011 feet and assumed tank floor at 3,992 feet.
  - Approximate diameter: 216 feet, consistent with the required footprint for a 5 MG welded steel reservoir.
  - Tank material: Welded steel (per Operations preference; final material selection to be confirmed during preliminary design, see additional discussion in Section 5.8).
  - Tank appurtenances: Includes access hatches, roof vent, overflow and drain piping, interior piping and pipe supports/blocks, ladders, and fall prevention/safety equipment meeting current standards.
  - Site work: Grading and foundation preparation on the expansion parcel to support tank construction.
  - Site access road (24-foot wide drive-around): A 24-foot gravel drive-around road is included for operations, maintenance, and safety access around the new tank.

- New reservoir overflow piping routed to a new stormwater dispersion/pond area, as determined during design.

- Groundwater System Piping (for new tank):
  - New 30-inch groundwater supply pipeline connecting the new 5-MG tank to the existing groundwater header. See additional discussion on pipe sizing in Section 5.8.
  - New 24-inch return pipeline from the reservoir to the distribution system, including a pressure sustaining valve and associated appurtenances.

- Reservoir 3 Conversion to Surface Water Service:
  - Installation of a new 24-inch tank inlet at Reservoir 3, requiring draining the tank, cutting a new wall penetration, installing a double plate, and performing interior and exterior coating repairs at the penetration. Recommended installing a flexible connection for tank movement or seismic requirements.
  - Installation of a new 24-inch surface water inlet pipeline to Reservoir 3, including associated valving and interconnections to support either parallel or series operation with Reservoir 2.
  - Preferred approach is installation of a hydrodynamic mixing system, a dedicated mixing line installed along the bottom of the reservoir that uses directional "duckbill" valves to promote continuous circulation and turnover of stored water. A separate cost is provided for this recommendation and includes draining and cleaning the reservoir, installation of the mixing pipe and concrete anchors, installation of three duckbill valves, refilling and chlorination of the reservoir, testing, and installation labor. The assumed system consists of approximately 100 feet of 20-inch HDPE pipe with three duckbill valves.

- Decommissioning CT Basin and Outback Reservoir 1: The CT Basin would be decommissioned in the near-term, and Outback Reservoir 1 would remain in service temporarily to provide contact time and volume redundancy while improvements are completed on Outback Reservoir 3.
  - Demolition and removal of the existing bolted steel CT Basin and Outback Reservoir 1, including tank structures and associated appurtenances.
  - Removal and abandonment of associated inlet, outlet, and site piping and appurtenances.
  - Demolition and remove of existing concrete ringwall foundations.
  - Backfilling of former tank sites, final grading, and surface restoration.
  - Appurtenances & Sitework:
  - Relocation/extension of site utilities (electrical, fiber/SCADA, drainage) as required for new facility layout.
  - Removal of large diameter trees near new reservoir location.
  - Security fencing or site access adjustments as needed for the expansion area. Covered under other elements of Outback Facility Plan.

Cost Estimate: A preliminary cost estimate for this concept is approximately $13 million. This estimate is based on Association for the Advancement of Cost Engineering (AACE) Class 5 guidelines and reflects a conceptual level of accuracy (-50 to +100 percent). It includes the elements listed above but excludes land acquisition and permitting. The estimate is intended for planning and comparative analysis only and will be refined as design progresses. See **Chapter 8** for additional cost information.

Operational Considerations: Operational changes under this concept include revised level management and SCADA control strategies to support parallel operation of Reservoirs 2 and 3, integration of new mixer controls for Reservoir 2, and updated flow routing once Reservoir 3 is converted to surface water service. Additional instrumentation and operational rules will be required to maintain groundwater-to-surface water cross feed capability under the selected operating configuration. Updates to chlorine injection locations, water quality monitoring locations, and Daily Rounds procedures will be required to reflect expanded contact time capacity. Integration of the new groundwater tank will require modifications to well pump sequencing, groundwater header operations, and seasonal drawdown management. Long-term maintenance planning will also need to reflect the revised outage sequencing once Reservoir 1 is fully decommissioned.

5.6.2 Concept 2: Construct a Dedicated Clearwell for Contact Time

This concept achieves chlorine contact time in new dedicated and redundant clearwells, while Outback Reservoir 2 remains the surface water storage tank and Outback Reservoir 3 remains the groundwater storage tank. Two identical clearwell trains are provided for redundancy and operate concurrently in normal service: filtered water from the WFF splits to both clearwells, passes through internal baffles, and recombines at a common outlet header before flowing to Reservoir 2. Basins are sized to accommodate full 11.8 MGD (18.2 cfs) plant flow with full isolation of either basin, and a bypass around the clearwells is also included for maintenance and contingencies. (Giardia and Cryptosporidium credit continues to be provided by membranes; planning contact time focuses on 4-log virus.)

This concept improves reliability by separating contact time functions from storage, which simplifies disinfection management and enhances operational flexibility. Dedicated clearwells provide more predictable and controllable hydraulics than storage reservoirs, allowing contact time performance to be maintained independent of reservoir levels and without relying on mixing in aging tanks. The use of paired clearwells with permanent baffle walls also provides high-confidence, superior-quality contact time performance, reduces operational variability, and supports easier maintenance and redundancy compared to relying on large multi-use storage reservoirs for contact time duty. Maintaining Reservoir 2 and Reservoir 3 in their existing roles preserves current operational patterns, minimizes site piping modifications, and maintains cross feed flexibility between surface water and groundwater. **Figure 5-4** through **Figure 5-6**, provide an overview of this concept and are provided at the end of this chapter.

Outback Site and System Wide Storage Considerations: Under this concept, Outback Reservoir 2 (surface water) and Outback Reservoir 3 (groundwater) continue to provide the onsite storage volume; the new clearwells are dedicated CT basins and are not counted toward usable storage. As a result, the system-wide storage deficiency identified in the iWSMP remains unchanged under the base Concept 2 configuration. To address system storage within this concept framework, a Concept 2C may be considered to construct an additional groundwater storage tank on the expansion parcel; however, adding groundwater storage without careful control logic can reduce surface water priority during normal operations. If Concept 2C is pursued, control setpoints and valving will be configured to maintain surface water priority while allowing the added groundwater storage to meet standby/equalizing objectives.

Outback Site and System Wide Storage Considerations: Under this concept, Outback Reservoir 2 (surface water) and Outback Reservoir 3 (groundwater) continue to provide the onsite storage volume; the new clearwells are dedicated CT basins and are not counted toward usable storage. As a result, the system-wide storage deficiency identified in the iWSMP remains unchanged under the base Concept 2 configuration. To address system storage within this concept framework, a Concept 2C may be considered to construct an additional groundwater storage tank on the expansion parcel; however, adding groundwater storage without careful control logic can reduce surface water priority during normal operations. If Concept 2C is pursued, control setpoints and valving will be configured to maintain surface water priority while allowing the added groundwater storage to meet standby/equalizing objectives. It is also assumed that under Concept 2C the existing Outback Reservoir 3 would be converted to a surface water storage tank as discussed in Concept 1.

Clearwell Configuration (Two Concepts): Two clearwell layout concepts are presented to address how basin WSE is controlled during low-system levels. Concept 2A sizes the clearwells to "float" with the system, for example, contact time volume is provided even when the distribution system is at the minimum WSE of 3,992 feet, which drives a larger plan footprint because only the active depth below the minimum level is credited for contact time. Concept 2B adds a control valve at the clearwell outlets so the clearwells can hold a near constant WSE at 4,011 feet independent of system drawdown; this reduces basin plan dimensions by preserving effective depth for contact time. Both concepts use paired, baffled, reinforced concrete basins operating concurrently for redundancy; the choice between them balances footprint and structure cost (Concept 2A) versus added control complexity and valve cost (Concept 2B).

Common to both Concepts:

- Two identical clearwells. Concurrent operation of both clearwells is preferred to keep both basins active and disinfected so that redundancy is available without reconditioning a basin that has been left offline for any period of time.
- Reinforced concrete basins with cast-in-place baffle walls (permanent, rigid baffles).
- Baffling factor (T10/T) = 0.7 for planning, reflecting superior hydraulic performance from multi-pass baffles and providing conservative contact time credit. In practice, approximately 70 percent of theoretical detention is credited for contact time with this configuration.
- Inlet split from WFF → baffled serpentine flow though both basins in parallel → isolated dual outlets to a common outlet header to Reservoir 2; full clearwell bypass provided.
- Contact time basis is virus-only disinfection credit (membranes provide Giardia removal).
- Clearwell Sizing Basis: Planning-level contact time calculations completed for this project indicate that each clearwell must provide approximately 150,000 gallons of effective volume to achieve 4-log virus inactivation at the peak WFF flow of approximately 8,200 gpm, assuming a 0.7 baffling factor for a multi-pass baffled basin. This volume reflects the contact time basin volume only, independent of storage reservoirs, and represents the minimum basin volume needed to reliably meet virus contact time requirements under cold-water, low-residual operating conditions.
- Clearwell configuration details (planning level): To support the sizing basis of 150,000 gallons per clearwell, the configuration assumes a multi-pass serpentine layout with cast-in-place baffle walls sized to achieve a $T_{10}/T \approx 0.7$ (EPA "superior" baffling classification). Each clearwell is proportioned with a minimum length-to-width ratio of 25:1 per EPA guidance to encourage plug flow conditions.

A nominal 31-foot operating water depth is assumed for both concepts, but the credited active depth will depend on whether the clearwell floats with system WSE (Concept 2A) or is level controlled (Concept 2B). Inlet and outlet zones are positioned to promote even distribution into the first pass and stable withdrawal from the final pass; isolation is provided at each basin inlet and outlet, with a full clearwell bypass in the outlet header.

- Phasing Considerations: As a potential implementation strategy, the City may construct one clearwell initially and rely on Outback Reservoir 2 to provide interim contact time redundancy until the second clearwell is constructed. This phasing approach allows the project to achieve the long-term target configuration of two concurrent clearwell trains while deferring capital investment if needed. Final phasing feasibility, including operational procedures and contact time compliance requirements during the interim period, will be confirmed with Operations during preliminary design.

Concept 2A (Hydraulically floats with system WSE):

- The clearwells track the system water level and therefore must be sized to provide 150,000 gallons of effective contact time volume within the 12 feet of active depth available at the minimum WSE of 3,992 feet, assuming the tanks will be placed near the existing CT Basin. Based on this requirement, the resulting plan dimensions are approximately 62 feet wide by 38 feet long with a nominal 31-foot water depth to support the contact time operating envelope.

- Per-tank planning geometry: 31-foot water depth, 62 feet wide by 38 feet long to meet contact time at peak WFF flow with a 0.7 baffling factor when the system is at minimum WSE.

- Two tanks at this size; both operate in parallel under normal conditions. Each tank is individually sized to meet contact time requirements with the other out of service.

Concept 2B (Level-Controlled Clearwells):

- Uses an actuated butterfly valve or pressure sustaining valve at the outlet of the clearwells to maintain the operating level near 4,011 feet, allowing the full interior depth to contribute to contact time. Under this configuration, a 150,000-gallon CT Basin can be achieved with a reduced plan footprint of approximately 44 feet wide by 24 feet long, with a similar 31-foot water depth and the same assumed baffling factor of 0.7. Bypass pumping would be required around the level-controlled valve.

- Per-tank planning geometry: 31-foot water depth, 44 feet wide by 24 feet long with a 0.7 baffling factor.

- Two tanks at this size; both operate in parallel under normal conditions. Each tank is individually sized to meet contact time requirements with the other out of service.

- Operational Level and Freeboard Allowance (Concept 2B). For planning and comparison, Concept 2B assumes a clearwell overflow elevation of 4,011 feet; however, final design will confirm an operational freeboard and level fluctuation allowance (typically on the order of 1-2 feet below operational freeboard) to accommodate control variability and routine drawdown. Clearwell net contact time volume shall be maintained under these fluctuations, and tank dimensions will be verified to confirm the required 150,000-gallon effective volume is satisfied at the minimum controlled water level, not just at the nominal operational freeboard. Final control setpoints and

the control valve behavior will be established during preliminary design to preserve the required T_{10} while providing operational safety margin.

Pipeline Clearwell Concept (Screening-Level Note): This concept achieves contact time in a buried pipeline configured as a compact serpentine within the site. Reservoir 2 remains surface water storage and Reservoir 3 remains groundwater; contact time credit is provided ahead of Reservoir 2, consistent with the dedicated clearwell intent of Concept 2. For screening-level planning, a conservative baffling factor (T_{10}/T) of 0.6 is assumed to reflect plug-flow conditions within the pipeline. This differs from assumptions used for reservoir-based concepts because the pipeline operates under controlled, unidirectional flow with limited longitudinal mixing, rather than the more dispersed hydraulic conditions typical of reservoirs. Based on this assumption, the required contact time volume is 150,000 gallons, which equates to approximately 400 linear feet of 96-inch welded steel pipe. This is an atypical implementation relative to reinforced concrete clearwell basins and would require further evaluation if advanced, particularly regarding redundancy strategy, pipe fitting geometry, and acceptance pathway. The City has noted that this is not a preferred approach.

Current Tank Operation Changes: CT Basin – decommissioned near-term. Outback Reservoir 1 – decommissioned following commissioning of the clearwells and verification of redundancy. Outback Reservoir 2 – remains dedicated surface water storage (minor header tie-ins from the clearwell outlet). Outback Reservoir 3 – remains groundwater storage (no conversion to surface water service under this concept).

Contact Time Considerations: Under this concept, chlorine contact time is provided entirely within the new dedicated clearwells, allowing contact time performance to be controlled independently of reservoir operating levels. Clearwell trains operate in parallel during normal conditions to maintain turnover and keep both basins active to provide full contact time compliance at any time. Complete isolation of either clearwell and a full bypass are included to support maintenance or emergency operations without interrupting disinfection requirements. A tracer study will be required once the final clearwell geometry and baffling configuration are established to verify T_{10} performance and confirm the planning-level contact time assumptions. Clearwell volumes are treated as contact time basin volume only and are not credited as usable distribution storage under this concept.

Major Infrastructure Improvements:

- Mobilization and Demobilization.
- Decommissioning CT Basin and Outback Reservoir 1 (Separate bid items since they will be completed on a different timeframe). The CT Basin would be decommissioned in the near-term, and Outback Reservoir 1 would remain in service temporarily to provide contact time and volume redundancy while new clearwells are constructed.
    - Demolition and removal of the existing bolted steel CT Basin and Outback Reservoir 1, including tank structures and associated appurtenances.
    - Removal and abandonment of associated inlet, outlet, and site piping and appurtenances.
    - Demolition and remove of existing concrete ringwall foundations.
    - Backfilling of former tank sites, final grading, and surface restoration.

- Two New CT Clearwells (Reinforced Concrete, Baffled):
  - Concept 2A (floating WSE): Approx. 31-foot operating water depth with clearwell dimensions of 62 feet wide by 39 feet long per basin, sized to provide 150,000 gallons of contact time volume at minimum WSE with an assumed baffling factor of 0.7.
  - Concept 2B (level-controlled): Approx. 31-foot operating water depth with clearwell dimensions of 44 feet wide by 25 feet long per basin, sized to provide 150,000 gallons of contact time volume with a constant clearwell WSE. Includes downstream control valve to maintain clearwell WSE.
  - Cast-in-place reinforced concrete multi-pass baffle walls, internal wall coating, access hatches, overflow, drain piping, and required safety equipment.
  - Structural components and appurtenances including foundations, structural slab, internal walkways, access platforms, hatches, and associated mechanical and structural appurtenances.
- Clearwell Site Piping and Valving:
  - Split finished water pipeline from WFF routed to provide isolated inlet connections to each clearwell basin.
  - Dual isolated outlets connections from each clearwell basin routed to a common clearwell outlet header.
  - Full clearwell bypass line with isolation valves to maintain system operation during clearwell maintenance.
  - Concept 2B only: Control valve provided for maintaining clearwell operating WSE.
  - Header Tie-ins connecting new clearwell inlet and outlet piping to the existing Reservoir 2 yard piping.
- Appurtenances & Sitework:
  - Relocation/extension of utilities (electrical, fiber/SCADA, drainage) as required for clearwell siting.
- Concept 2C – Additional Groundwater Storage
  - One new groundwater storage tank (size to address system-wide storage shortfall at the chosen planning horizon; coordinate with iWSMP target).
  - Welded steel tank (City preference).
  - New 24-inch to 30-inch groundwater header connection with isolation valves, vault modifications, and level/pressure controls. See additional discussion on pipe sizing in Section 5.8.
  - Control strategy updates to preserve surface water priority in PL-3 under normal operations.

- Conversion of Outback Reservoir 3 to surface water storage, similar to Concept 1. Would include existing tank modifications and additional site piping reconfigurations.
- Note: Concept 2C is optional and independent of clearwell sizing; it can be phased to align with broader system storage investments.

- Potential Modifications: Modified Mixing System at Outback Reservoir 2 and 3 as discussed in Concept 1.

Land Use Considerations: Land use considerations for this concept are expected to be limited, as the new clearwell facilities are anticipated to be located within the existing Outback Site footprint. No rezoning is anticipated for the existing reservoirs or clearwell locations under this concept. If Concept 2C is pursued, construction of an additional storage tank on the expansion parcel will require the City to complete acquisition of that parcel from the Forest Service and proceed with the planned rezoning of that property to PF. Final siting of clearwells and any optional storage facilities will need to comply with applicable height, setback, and site development requirements in effect at the time of design.

Cost Estimate: A preliminary cost estimate for this concept is approximately $4 million to $4.6 million. This estimate is based on AACE Class 5 guidelines and reflects a conceptual level of accuracy (-50 to +100 percent). It includes the elements listed above but excludes land acquisition and permitting. The estimate is intended for planning and comparative analysis only and will be refined as design progresses. See **Chapter 8** for additional cost information.

- **Costing Approach for Comparison:** To facilitate a comparison with Concept 1, the planning-level cost for Concept 2 will be presented with and without the optional Concept 2C storage tank. The base Concept 2 estimate includes the two clearwells and associated piping/controls and assumes no net new storage. Concept 2C is an additive project coats that adds the new groundwater storage tank sized to the same planning basis used in Concept 1, enabling a like-for-like comparison of lifecycle and capital costs independent of contact time approach.

Operational Considerations: Operational changes under this concept center on the introduction of two new dedicated clearwell trains for chlorine contact time and the integration of corresponding inlet, outlet, and bypass control into the existing surface water system. Both clearwells are intended to operate concurrently, which will require updates to SCADA logic, flow splitting controls, chlorine injection points, and level monitoring to manage parallel basin operation and maintain stable contact time performance. Because Reservoir 2 and Reservoir 3 retain the existing functional roles as surface water and groundwater storage, respectively, the primary operational modifications involve routing filtered water through the clearwells before entering Reservoir 2 and ensuring that bypass and isolation valves are configured to support maintenance while maintaining treatment compliance. Water quality monitoring locations, including chlorine residual and temperature points, may need to be adjusted to reflect the new contact time location. Long-term maintenance planning will also need to account for clearwell outage sequencing and the decommissioning of the CT Basin and Outback Reservoir 1 once the new contact time infrastructure is commissioned.

Project: Oubtack Facility Plan
Client: City of Bend
Date: 27-Apr-26
Task: Reservoir Siting Task - Concept Matrix
Developed By: Heather Pina
Reviewed By: Ongoing: David Prull (Technical Review) & Bob G (Cost Review) & David Stangel (PIC)

Task Description: Assess conceptual reservoir and clearwell alternatives, including site integration, CT performance, storage capacity, constructability, operations, risks, and land-use factors, to support selection

Reservoir and Contact Time Alternatives for Long-Term System Configuration

	Concept 1 - New Groundwater Reservoir; Convert Res 3 to Surface Water	Concept 2a — Dedicated "Floating" Clearwells for CT (Res 2 = Surface water storage; Res 3 = GW storage)	Concept 2b - Dedicated Level-Controlled Clearwells (Hold High WSE)	Concept 2c - Dedicated "Floating" Clearwells for CT plus Add New Groundwater Storage
Purpose/Intent	Create parallel, redundant CT capability using Res 2 and Res 3 as surface-water tanks; add a new groundwater tank to replace Res 3's GW function.	Provide dedicated CT using two baffled concrete clearwells operating in parallel. Clearwell water level floats with system WSE, requiring larger basins sized to achieve CT even at minimum WSE.	Provide dedicated CT using two baffled concrete clearwells while maintaining a fixed clearwell operating level independent of system drawdown via downstream control valve.	Combine floating clearwells (Concept 2a) with a new groundwater storage tank on the expansion parcel to address the system-wide storage shortfall while keeping dedicated CT separate from storage.
CT Strategy	Planning calcs indicate each of Res 2 or Res 3 can independently achieve 4-log virus CT under peak flow using conservative assumptions; mixers recommended; a tracer study will validate T_{10} after piping changes.	Floating clearwells follow system water level; basins must provide ~150,000 gallons below min WSE (3,992 ft). Each basin independently meets 4-log virus CT with $T_{10}/T \approx 0.7$ under peak flow. CT performance varies with system level.	A downstream sustaining valve maintains clearwell WSE near 4,011 ft, allowing full depth to count toward CT. Each basin meets ~150,000-gal CT requirement with smaller plan dimensions; provides stable CT performance regardless of system WSE.	Same as 2a: Clearwells float with system WSE, each basin sized for ~150,000 gallons of effective volume at min WSE. CT varies with system level but remains compliant; no level-control valve.
Storage Implications	Combined usable storage in Res 2 & Res 3 ≈ 3.98 MG with min WSE 3,996 ft (≈+0.5 MG vs iWSMP assumption); new GW tank can be sized to close the iWSMP system storage gap (planning ≈ 5.2 MG).	Clearwells remain CT-only and do not add usable storage. System storage deficit unchanged unless paired with optional 2c.	Clearwells remain CT-only and do not add usable storage. System storage deficit unchanged unless paired with optional 2c.	New GW tank sized to close system storage gap (planning basis ≈ 5.2 MG). Adds significant system-wide standby/equalization storage while keeping Reservoir 2 as SW storage.
Operational Considerations	Parallel operation of Res 2/3 for CT redundancy; update SCADA/levels, chlorine residual monitoring, and cross-feed logic to preserve SW priority while integrating the new GW tank. Temporary use of Res 1 for redundancy during cutovers.	Parallel basin operation requires CT split/merge controls, updated SCADA logic, and monitoring upstream of Reservoir 2. Operations maintain existing surface water/GW roles with minimal header changes.	Additional level-control valve logic and bypass pumping needs. Parallel operation of clearwells requires SCADA upgrades. Reservoir 2/3 retain existing functions.	Requires valving and setpoints to preserve surface-water priority when adding GW storage. Integration of new tank into GW header; updates to well pump control logic.
or Infrastructure Elements	- Res 3 conversion: new 24-in SW inlet penetration, coating/structural details, flexible connection. - Mixers at Res 2 & 3; power/SCADA. - New 24-in GW header to the new tank. - Demo CT Basin and Res 1; site restoration.	- Two reinforced-concrete baffled clearwells (≈31-ft depth; ~62 ft × 39 ft each). - Dual isolated inlets/outlets; clearwell bypass line. - Piping tie-ins to Reservoir 2 header. - E&IC upgrades. - Demo CT Basin and Res 1; site restoration	- Two reinforced-concrete baffled clearwells (≈31-ft depth; ~44 ft × 25 ft each). - Downstream level-control valve. - Dual isolated inlets/outlets; clearwell bypass line. - Piping tie-ins to Reservoir 2 header. - E&IC upgrades. - Demo CT Basin and Res 1; site restoration	- Two reinforced-concrete baffled clearwells (≈31-ft depth; ~62 ft × 39 ft each). - Dual isolated inlets/outlets; clearwell bypass line. - Piping tie-ins to Reservoir 2 header. - E&IC upgrades. - Demo CT Basin and Res 1; site restoration. - New welded-steel GW tank on expansion parcel. - New 24-inch GW header connection and valving.
Land Use / Permitting	Minimal at existing tanks; new tank requires Forest Service parcel acquisition and rezoning to PF, with setbacks/height conformance.	Clearwells sited in existing footprint; no rezoning expected.	Clearwells sited in existing footprint; no rezoning expected.	Clearwells sited in existing footprint; no rezoning expected. New tank requires Forest Service parcel acquisition and rezoning to PF, with setbacks/height conformance.
Pros	- Uses existing tanks (Res 2 & 3) for parallel CT without building new clearwells. - Adds flexible system-wide storage on high-elevation parcel.	- Simpler hydraulics without level-control valve. - Dedicated CT basins with predictable baffled flow. - Leaves existing Reservoir 2/3 storage roles unchanged.	- CT independent of system WSE. - Smaller basins than Concept 2a for same CT. -Dedicated, high-confidence CT facility.	- Addresses system storage shortfall. - Maintains SW/GW operational split with dedicated CT. - Provides like-for-like comparison with Concept 1 (storage added).
Cons	-Continued reliance on aging tanks (Res 2/3) for critical treatment function. - Requires conversion work on Res 3 and new parcel development.	- Larger footprint requirements due to floating WSE constraint. - CT volume dependent on system water level. - Does not address system storage deficiency.	- Added control complexity and valve dependence. - Requires bypass pumping around the control valve. - Does not address storage deficiency unless combined with 2c.	- Larger clearwell footprint (floating WSE). - Requires new parcel and PF rezoning. - More infrastructure overall than 2a/2b.
Phasing / Transition	Decommission CT Basin early; keep Res 1 as temporary redundancy; complete Res 3 conversion and mixer installs; construct GW tank; retire Res 1 once parallel CT is proven.	Potential to build one clearwell first and rely on Res 2 for interim CT redundancy; commission second basin later, then decommission Res 1.	Same as Concept 2a.	Same as Concept 2a.

5.7 Preferred Concept

Based on the comparative evaluation summarized in Table 5-3 and input from the City, Concept 2B – Dedicated Level-Controlled Clearwells is identified as the preferred concept. Concept 2B provides the most practicable and operationally robust solution for meeting long-term contact time requirements while integrating effectively within the existing Outback Site footprint.

Concept 2B offers several advantages relative to the other concepts, including reliable contact time performance that is maintained regardless of system storage, smaller clearwell footprints compared to floating concept, and a clear separation of treatment and storage functions. The level-controlled clearwell configuration reduces reliance on aging reservoirs for critical treatment functions and provides predictable hydraulic conditions that simplify operations and regulatory compliance. While Concept 2B introduces additional control elements relative to Concepts 1 or 2A, the operational complexity is well understood and outweighed by the benefits of improved reliability, resiliency, and long-term maintainability.

Overall, the advantages of Concept 2B. including constructability, operational clarity, and treatment reliability, outweigh the limitations identified for the other concepts, making it the most balanced and practical option for implementation at the Outback Site. Further refinement of the preferred concept and confirmation of design assumptions will be undertaken during the next phase of design.

5.8 Preliminary Design Considerations and Next Steps

As the project transitions from siting evaluation toward future design phases, several items will require confirmation to validate assumptions, reduce uncertainty, and reevaluate that the recommended reservoir and clearwell improvements integrate effectively with existing facilities, site constraints, hydraulic requirements, and broader program needs. The items below identify where additional field verification, coordination, or analysis will be needed before advancing to detailed design.

State Regulatory Coordination and Approval: Advancement of the recommended reservoir and clearwell improvements will require coordination with Oregon Health Authority (OHA) Drinking Water Services during preliminary and final design. Key items for State review include confirmation of applicable treatment credits, CT configuration and operating conditions, monitoring locations, and compliance with disinfection and log removal requirements. Background information reviewed to date, including results documented in the City's filter pilot study, indicates that the City's membrane filtration units may be eligible for log removal credit for Giardia and Cryptosporidium. In addition, publicly available information from OHA lists certain membrane filtration units, including the Pall UNA 620A units installed at the WFF, as approved models for log removal of Giardia and Cryptosporidium. However, confirmation of applicable credits and acceptance of how those credits are applied within the overall treatment train, including proposed contact time configurations, must be obtained through the State's formal plan review and approval process. Early coordination with OHA is recommended to confirm regulatory expectations, document accepted credits, and avoid rework during later design phases.

Confirm Elevations at Tree Farm: The current siting evaluation assumes water service lateral elevations at Tree Farm. These elevations should be field verified, as they inform the minimum WSE set at Outback, protection of the City's transmission main, and adequate pressure for Tree Farm service pumps. Document findings and adjust assumptions as needed.

Storage Tank Material Selection and Life Cycle Cost Analysis: The planning-level scope and estimate assume welded steel for the new ~5 MG storage tank in alignment with Operations' preference. In subsequent

design development, the team will confirm this selection through a focused comparison of capital cost, coating/renewal needs, constructability, and service life. As part of that confirmation, side-by-side pricing for welded steel and prestressed concrete may be developed, and a streamlined life cycle cost check performed to confirm that the final selection reflects both near-term budget and long-term O&M considerations. While welded steel remains the planning basis, prestressed concrete can be competitive above ~3 MG, particularly when coating renewal cycles for steel are considered. The final material recommendation will be documented and confirmed with Operations before advancing to detailed design.

HPRW Line Considerations: The existing 30-inch HPRW line is planned for abandonment as part of the pretreatment program. Although reuse is outside the scope of this siting chapter, its proximity to the WFF and proposed reservoir/clearwell locations warrants noting. Depending on future assessments, the line may offer opportunities for supplemental conveyance, redundancy, or interconnection flexibility as facility layouts and sequencing are refined.

Instrumentation and Analyzer Locations: Analyzer and instrument locations will need to be reviewed and updated based on final reservoir siting, clearwell outlet routing, and operational configuration. Existing monitoring points were not evaluated in detail as part of this Outback Siting Study; some may require relocation or supplementation to maintain compliance and operational visibility under the selected concept.

Well Pump Capacity Assessment: A preliminary planning-level hydraulic screening was completed to evaluate the ability of the existing well pumps to serve a potential new groundwater storage tank (Concept 1 or Concept 2C, if selected). This screening analysis was used to confirm general feasibility, inform preliminary pipeline sizing, and evaluate conveyance performance under a representative high-demand scenario. Results indicate that conveyance to a new groundwater reservoir appears feasible with larger diameter piping (e.g., 30-inch), while smaller diameters exhibited elevated velocities under the evaluated conditions. These results are intended for feasibility screening only. Additional detailed hydraulic modeling, pump performance evaluation, and operating envelope confirmation will be required during preliminary design, including evaluation of alternative demand scenarios, final tank elevations, and coordination with future groundwater supply assumptions discussed in Chapter 6.

Reservoir 3 Piping Integration (Concept 1): If Reservoir 3 is converted to surface water service (Concept 1 and 2C), structural and piping connection points, including penetrations, roof and floor limitations, and construction access, will need verification to support installation of a new surface water inlet. Concept is connection of existing inlet to surface water.

Pipeline Routing and Utility Conflicts: Corridor space for new 24-inch pipelines (surface water inlet to Reservoir 3 under Concept 1, and groundwater header connection to a new groundwater tank under Concept 1 or Concept 2C) must be confirmed and potential conflicts with existing utilities or access routes identified.

Geotechnical and Site Constraints: Confirm geotechnical suitability, seismic criteria, grading limits, and applicable setback/height requirements for development on the expansion area, including assumptions related to Forest Service parcel acquisition and any future PF zone requirements for that parcel.

Construction Access and Sequencing: Identify access routes for large construction equipment, demolition sequencing for the CT Basin and Outback Reservoir 1, and approaches to maintain system operations during pipeline and facility reconfiguration.

PFAS Treatment and Future-Proofing Considerations: Although PFAS treatment is not currently required and may not be required in the future, potential PFAS regulatory developments and treatment strategies should be considered during final design of the reservoir and clearwell improvements. The selected reservoir concept should preserve flexibility to accommodate potential future treatment infrastructure, conveyance modifications, or operational changes, if needed. This may influence final tank placement, site layout, and structural allowances, as well as the provision of stub-outs, bypasses, or supplemental piping to facilitate future integration of PFAS treatment processes without significant reconstruction. Incorporating this level of foresight during final design can help minimize impacts to operations and capital reinvestment if regulatory requirements evolve.

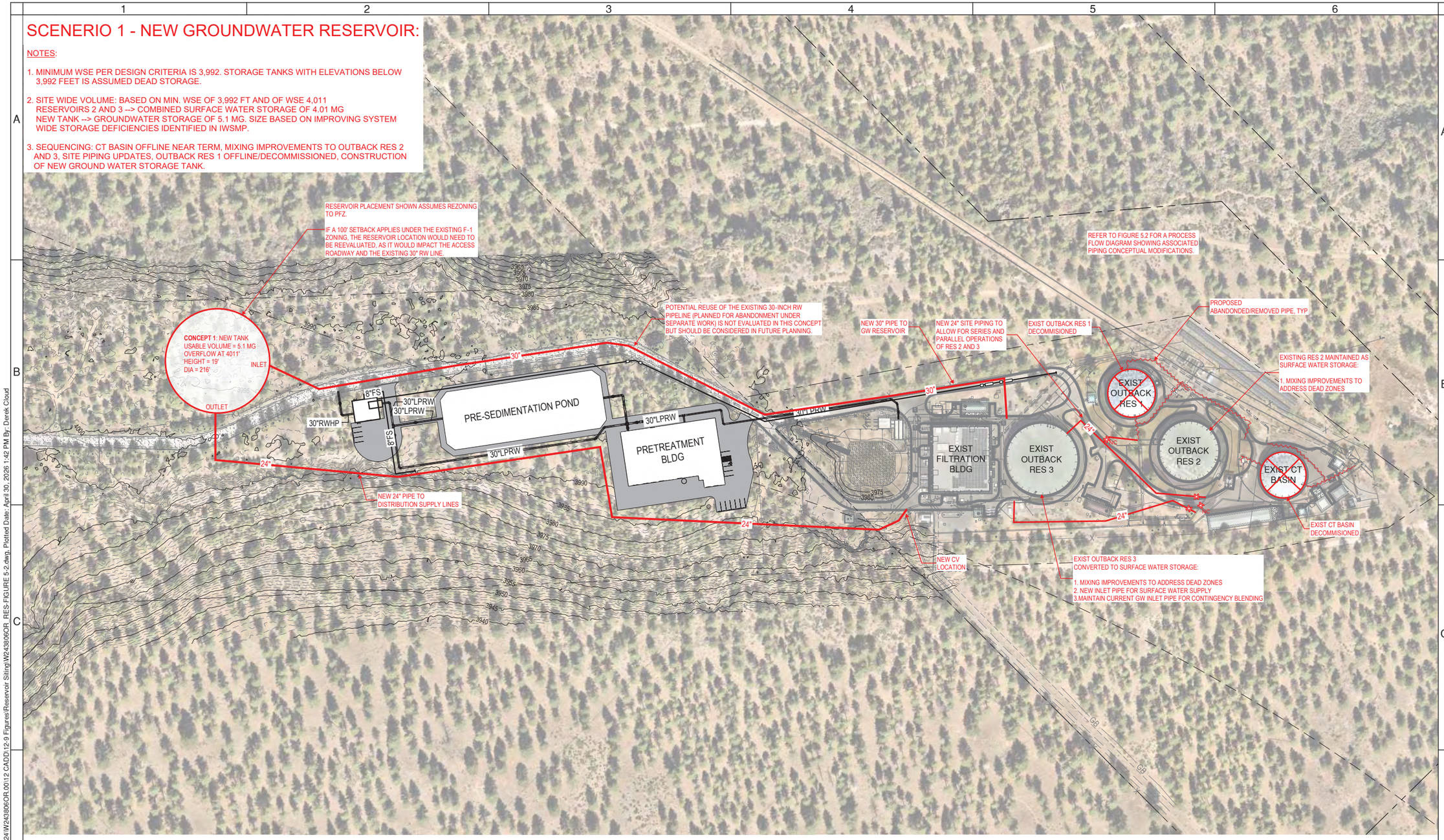
SCENERIO 1 - NEW GROUNDWATER RESERVOIR:

NOTES:

1. MINIMUM WSE PER DESIGN CRITERIA IS 3,992. STORAGE TANKS WITH ELEVATIONS BELOW 3,992 FEET IS ASSUMED DEAD STORAGE.

2. SITE WIDE VOLUME: BASED ON MIN. WSE OF 3,992 FT AND OF WSE 4,011
   RESERVOIRS 2 AND 3 --> COMBINED SURFACE WATER STORAGE OF 4.01 MG
   NEW TANK --> GROUNDWATER STORAGE OF 5.1 MG. SIZE BASED ON IMPROVING SYSTEM WIDE STORAGE DEFICIENCIES IDENTIFIED IN IWSMP.

3. SEQUENCING: CT BASIN OFFLINE NEAR TERM, MIXING IMPROVEMENTS TO OUTBACK RES 2 AND 3, SITE PIPING UPDATES, OUTBACK RES 1 OFFLINE/DECOMMISSIONED, CONSTRUCTION OF NEW GROUND WATER STORAGE TANK.



PLAN
SCALE: 1" = 100'

PRELIMINARY
NOT FOR CONSTRUCTION
FIGURE - CONCEPT ONLY

OUTBACK FACILITY PLAN
CITY PROJECT # 1WOFP
CONCEPT 1: NEW GW RESERVOIR
DESCHUTES COUNTY, OREGON

CITY OF BEND

REVISIONS:

consor
550 NW FRANKLIN AVENUE,
SUITE 428
BEND, OREGON 97703

DESIGNED BY: HKP
DRAWN BY: DKH
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

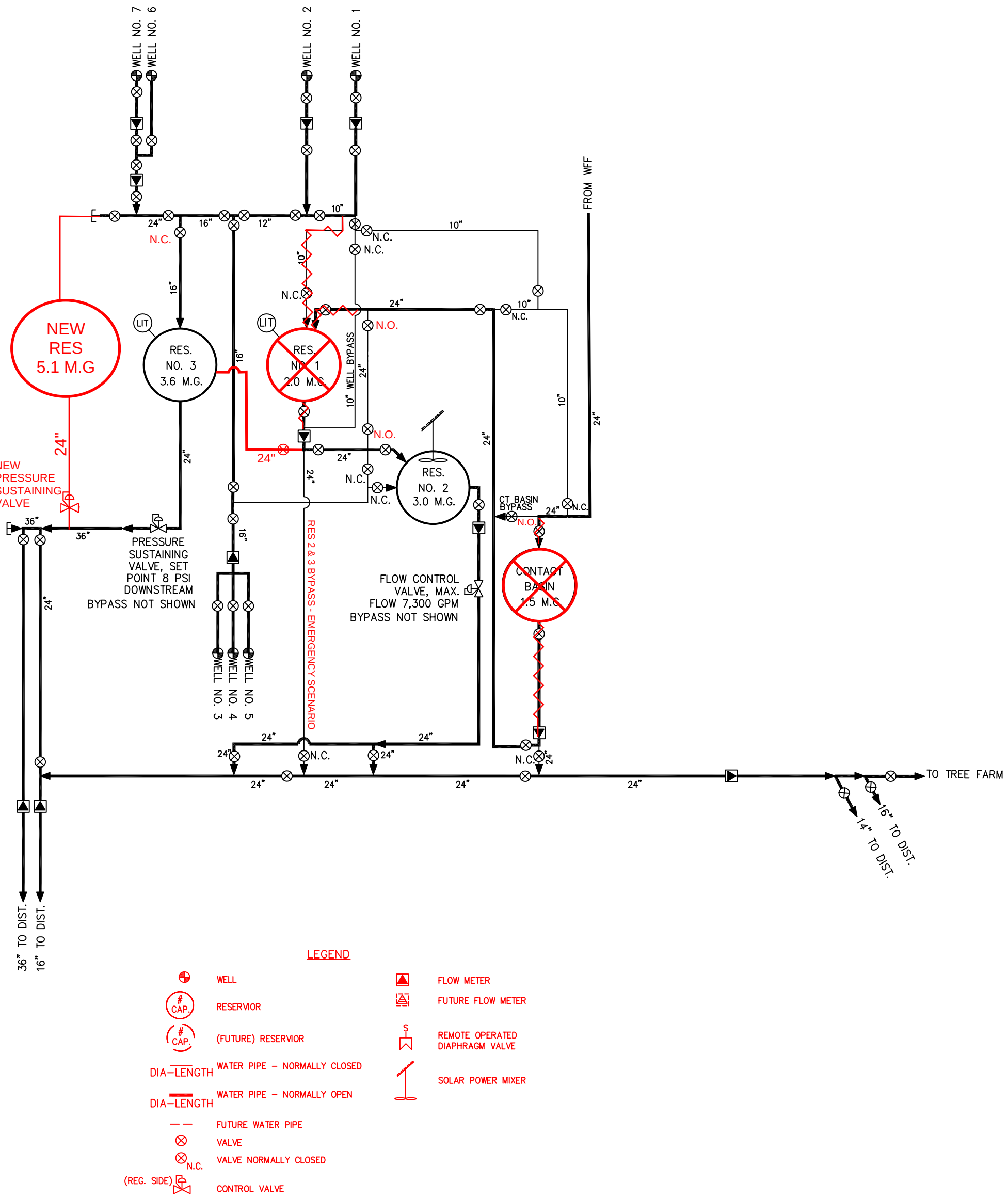
VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET:
FIG 5-2

COB # XXXX

Drawing Path and Name: A:_V-W\Projects\OR\Bend\2024\W243806OR.00\12 CADD\12-9 Figures\Reservoir Siting\W243806OR_RES-FIGURE 5-2.dwg, Plotted Date: April 30, 2026 1:42 PM By: Derek Cloud

FIG 5-3 RESERVOIR SITING TASK: CONCEPT 1 PROCESS FLOW DIAGRAM



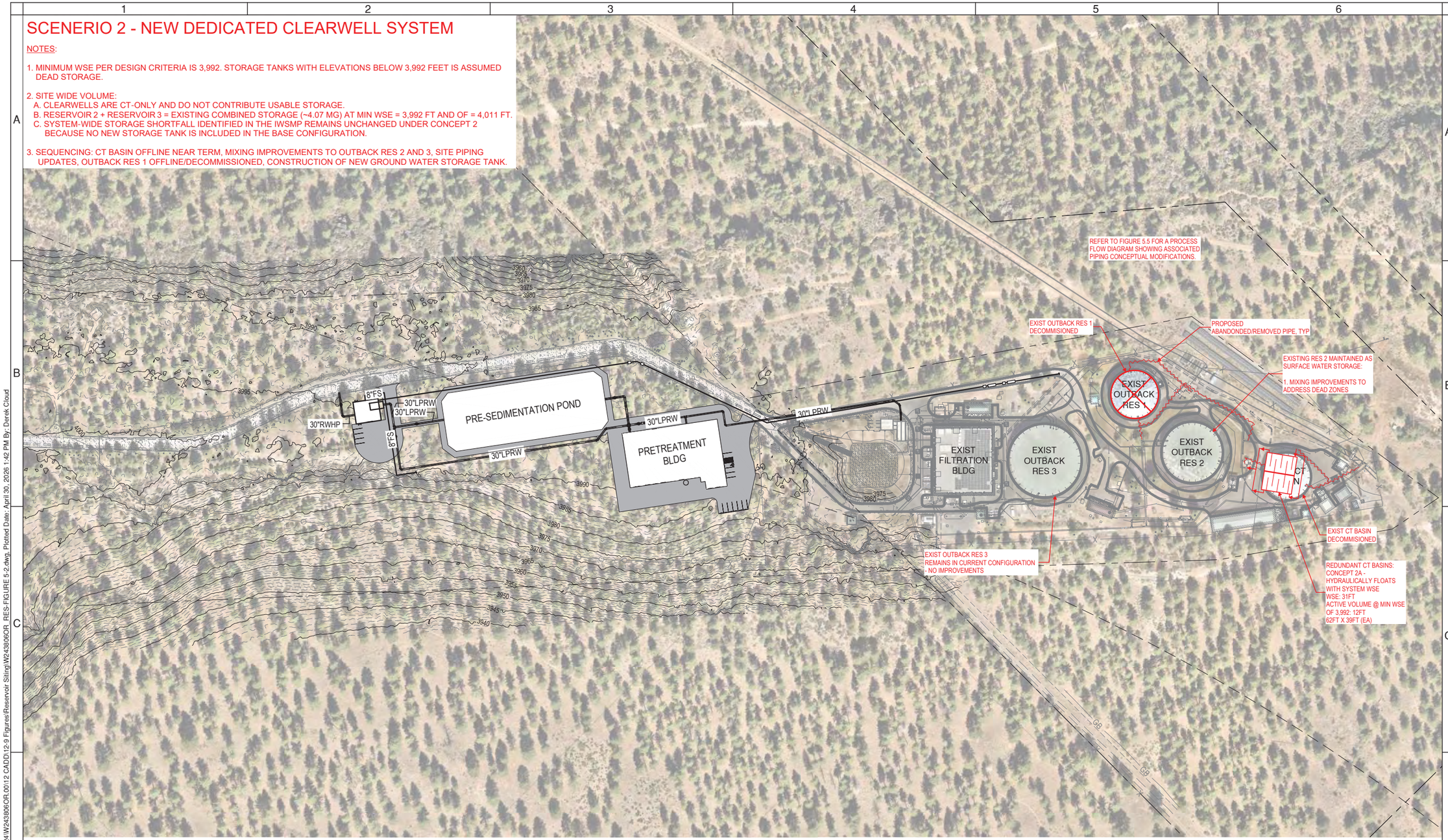
SCENERIO 2 - NEW DEDICATED CLEARWELL SYSTEM

NOTES:

1. MINIMUM WSE PER DESIGN CRITERIA IS 3,992. STORAGE TANKS WITH ELEVATIONS BELOW 3,992 FEET IS ASSUMED DEAD STORAGE.

2. SITE WIDE VOLUME:
   A. CLEARWELLS ARE CT-ONLY AND DO NOT CONTRIBUTE USABLE STORAGE.
   B. RESERVOIR 2 + RESERVOIR 3 = EXISTING COMBINED STORAGE (~4.07 MG) AT MIN WSE = 3,992 FT AND OF = 4,011 FT.
   C. SYSTEM-WIDE STORAGE SHORTFALL IDENTIFIED IN THE IWSMP REMAINS UNCHANGED UNDER CONCEPT 2 BECAUSE NO NEW STORAGE TANK IS INCLUDED IN THE BASE CONFIGURATION.

3. SEQUENCING: CT BASIN OFFLINE NEAR TERM, MIXING IMPROVEMENTS TO OUTBACK RES 2 AND 3, SITE PIPING UPDATES, OUTBACK RES 1 OFFLINE/DECOMMISSIONED, CONSTRUCTION OF NEW GROUND WATER STORAGE TANK.



PLAN
SCALE: 1" = 100'

PRELIMINARY
NOT FOR CONSTRUCTION
FIGURE - CONCEPT ONLY

OUTBACK FACILITY PLAN
CITY PROJECT # 1WOFP
CONCEPT 2A:NEW DEDICATED CLEARWELLS
CITY OF BEND
DESCHUTES COUNTY, OREGON

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

DESIGNED BY: HKP
DRAWN BY: DKH
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
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BAR EQUALS ONE INCH ON ORIGINAL DRAWING

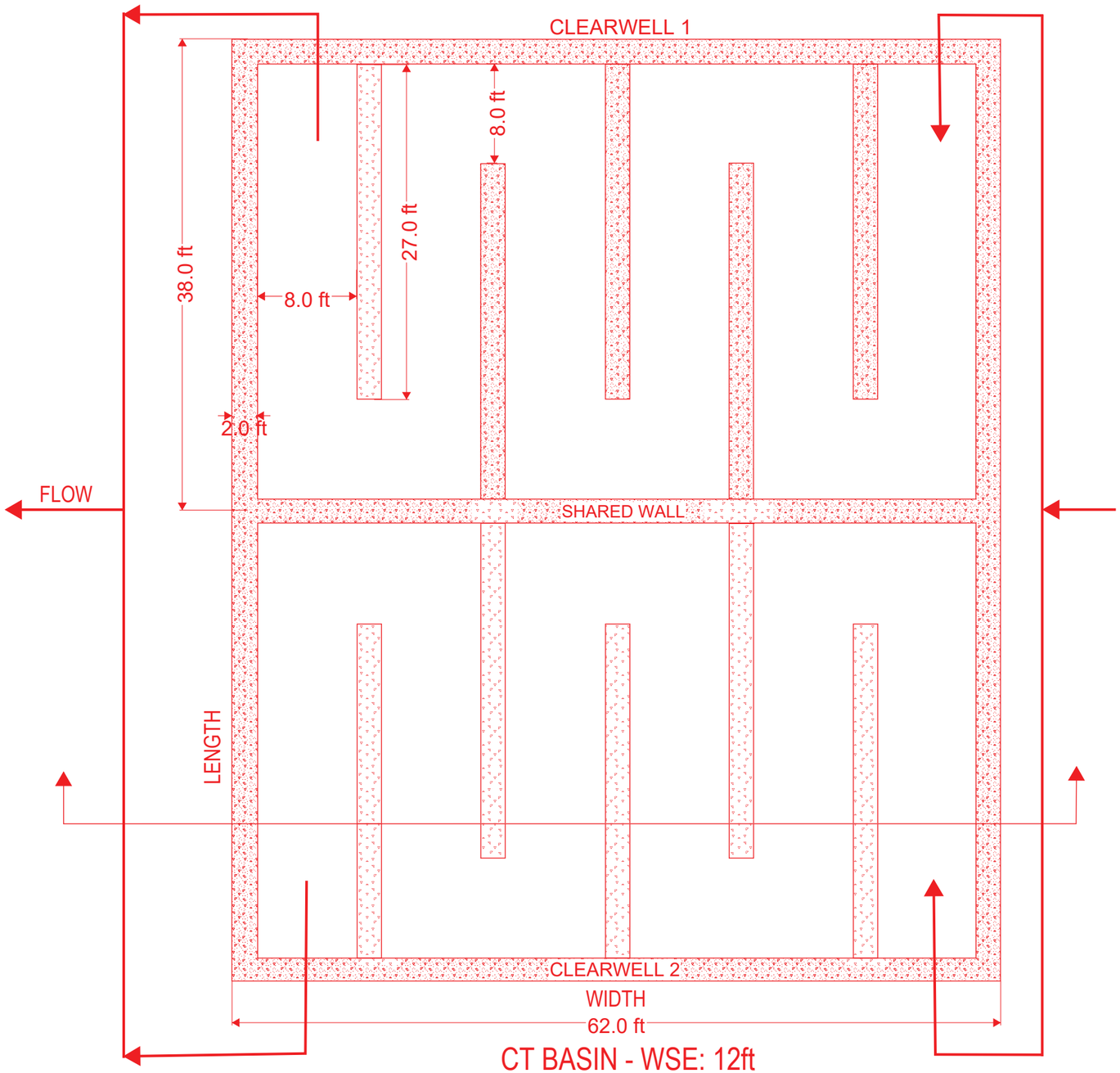
SHEET:
FIG 5-4

COB # XXXX

Drawing Path and Name: A:_V-W\Projects\OR\Bend\2024\W243806OR.0012 CADD\12-9 Figures\Reservoir Siting\W243806OR_RES-FIGURE 5-2.dwg, Plotted Date: April 30, 2026 1:42 PM By: Derek Cloud

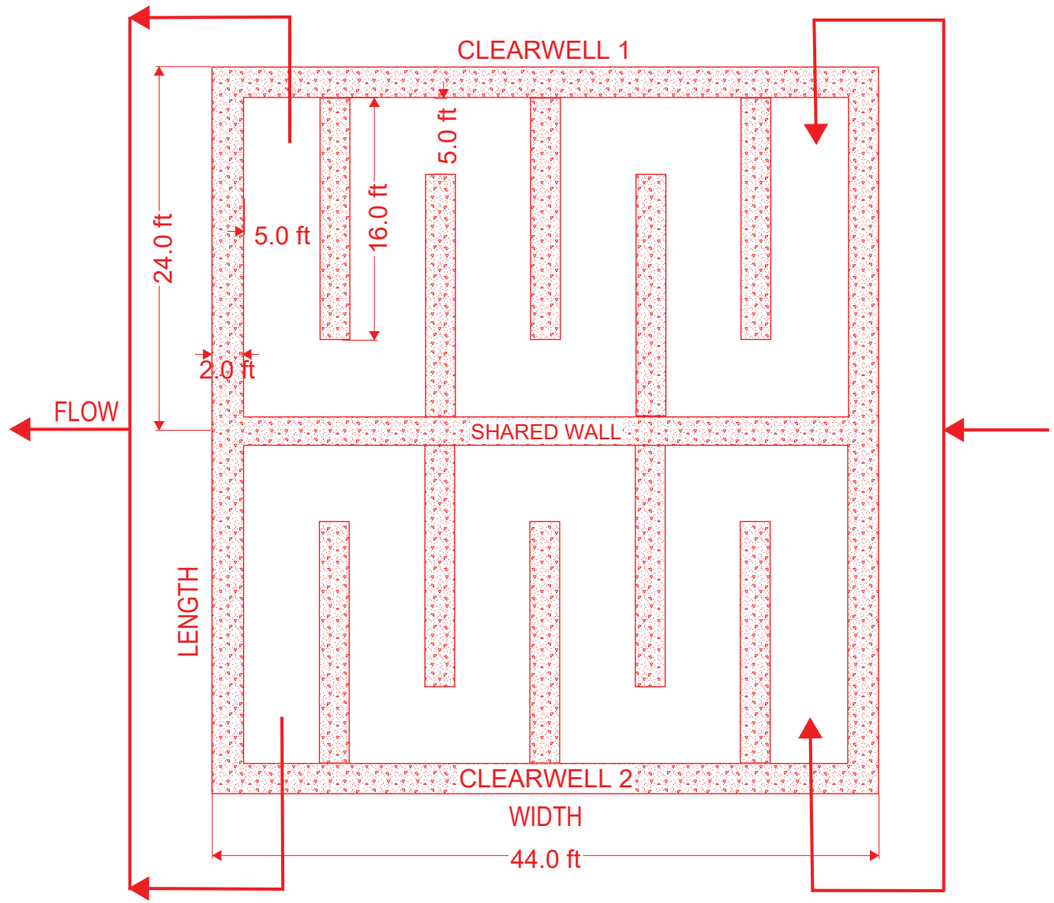
FIG 5-5 FOOTPRINTS OF CLEARWELLS

CONCEPT 2 ALTERNATIVE 2A: HYDRAULICALLY FLOATS WITH SYSTEM WSE



CT BASIN - WSE: 12ft

CONCEPT 2 ALTERNATIVE 2B: LEVEL-CONTROLLED CLEARWELLS

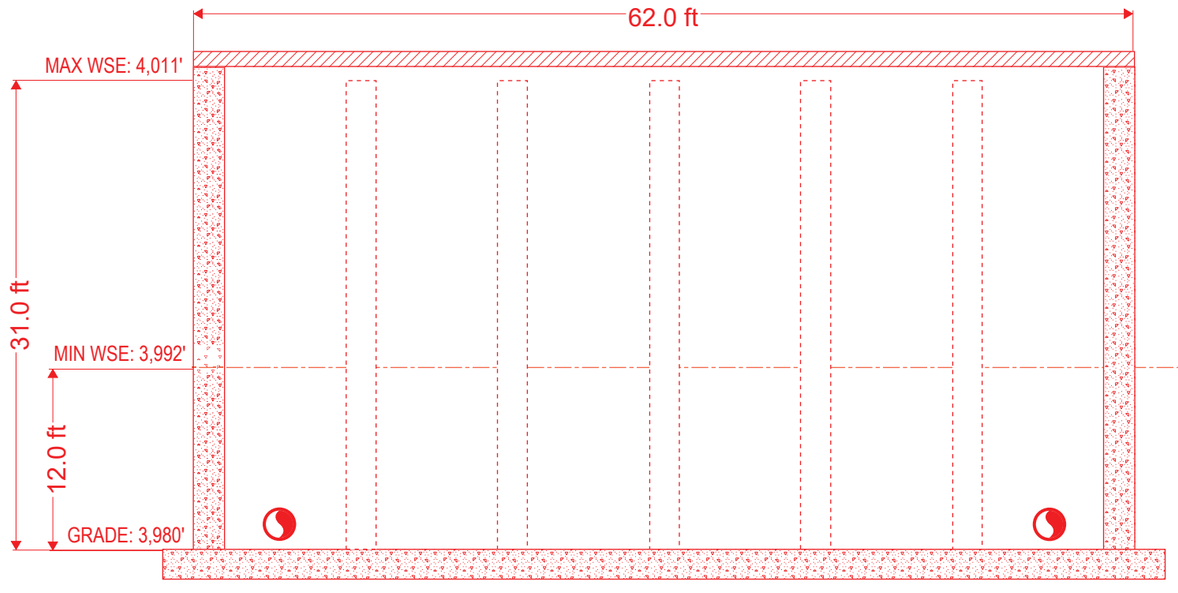


CT BASIN - WSE: 31ft

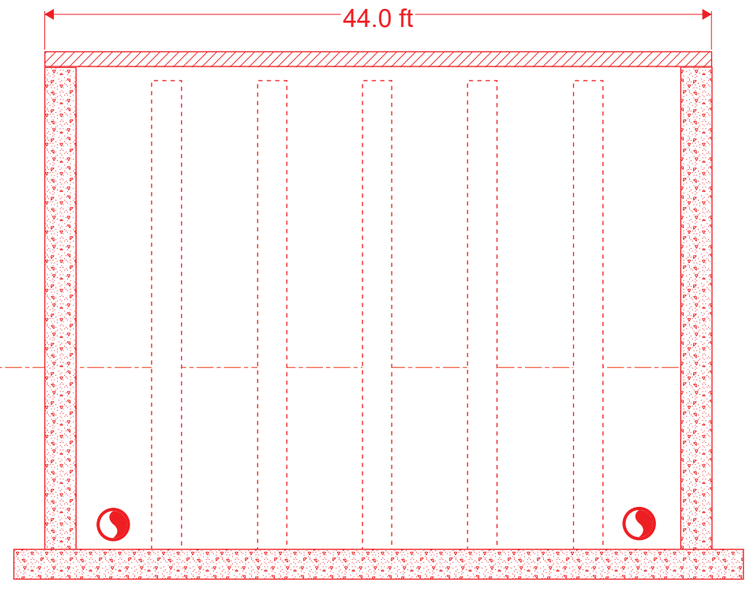
VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

FIG 5-6 ELEVATION VIEW OF CLEARWELLS

CONCEPT 2 ALTERNATIVE 2A:
HYDRAULICALLY FLOATS WITH SYSTEM WSE



CONCEPT 2 ALTERNATIVE 2B:
LEVEL-CONTROLLED CLEARWELLS



VERIFY SCALES
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CHAPTER 6

Integrated Facility Site Plan

6.1 Introduction

This chapter presents a single, integrated and comprehensive facility site plan for the Outback Site, consolidating all improvements identified in this Facility Plan into one location for a clear, site-wide overview. It focuses on how the components fit together physically and operationally across the site, linking pretreatment facilities (Chapter 3), in-conduit hydropower/energy dissipation facilities (Chapter 4), and the reservoir improvements (Chapter 5), together with miscellaneous sitewide elements such as PFAS treatment space allocation, new groundwater supply, a Forest Service water fill station, site access and security. Design details remain in the respective chapters and appendices and this chapter focuses on how the pieces fit on the site and how they operate together as a cohesive site.

This chapter is intended to serve as the City's coordinating reference during design and construction of facilities at the Outback site, ensuring that planned improvements remain integrated, consistent, and not overlooked as modifications are implemented across the site.

6.2 Sitewide Planning Framework

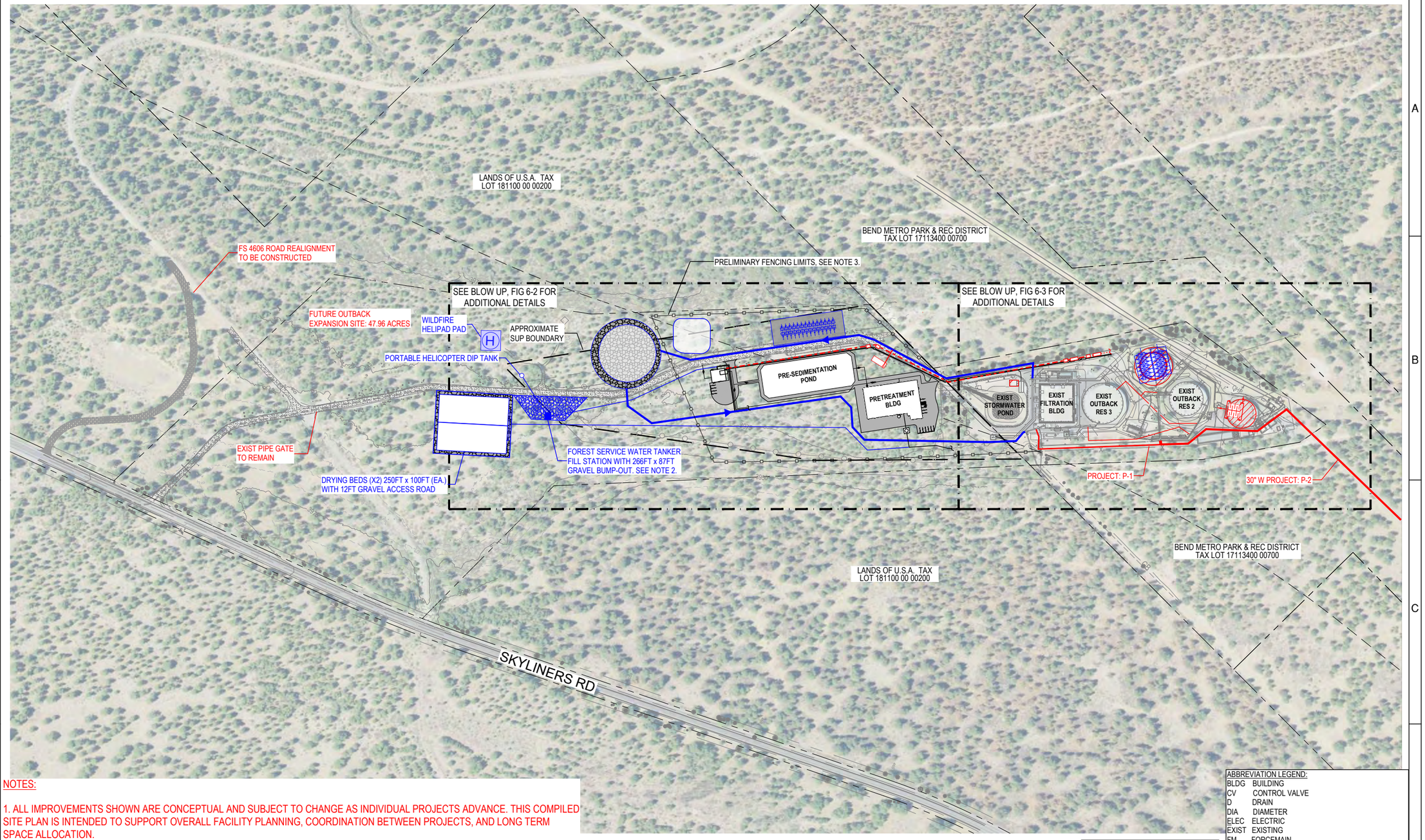
This section establishes the planning assumptions and sitewide context used to develop the integrated facility site plan. Detailed descriptions of existing site conditions, regulatory constraints, and permitting considerations are provided in Chapter 2 and Chapter 7 and are not repeated here.

For purposes of facility integration and layout, the Outback Site includes both the existing City-owned property and an adjacent expansion area. The existing City-owned site is located within Deschutes County (RR-10) and includes LM considerations near scenic roadways, as well as a wildlife corridor along the southern boundary that influences fence type, alignment, and access planning. Steeper slopes occur along portions of the northwestern and southwestern limits of the site, while much of the adjacent expansion area is relatively flat and suitable for new facilities, access roads, construction staging, and future expansion.

Planning for this Facility Plan assumes the City's acquisition of approximately 48 acres of adjacent Forest Service land under the Townsite Act. Improvements shown in this chapter are distributed across both the existing site and the assumed expansion area. The expansion area is integral for accommodating pretreatment facilities, solids handling, long-term storage, future groundwater supply improvements, and fire resilience features (e.g., fill stations), while also enabling improved operational separation between City water system infrastructure and public recreational traffic along Forest Service roadways.

6.3 Comprehensive Facility Improvements – Summary

This section provides a summary-level overview of all facility improvements integrated into the Outback Facility Site Plan and illustrated in Figure 6-1, Figure 6-2, and Figure 6-3. The purpose of this summary is to identify the full set of projects and site elements incorporated into the comprehensive layout, not to repeat detailed technical discussions.



PLAN
SCALE: 1"=175'

NOTES:

1. ALL IMPROVEMENTS SHOWN ARE CONCEPTUAL AND SUBJECT TO CHANGE AS INDIVIDUAL PROJECTS ADVANCE. THIS COMPILED SITE PLAN IS INTENDED TO SUPPORT OVERALL FACILITY PLANNING, COORDINATION BETWEEN PROJECTS, AND LONG TERM SPACE ALLOCATION.

2. FOREST SERVICE WATER TANKER FILL STATION IS ASSUMED TO TIE INTO THE NEW FIRE SERVICE LINE THAT WILL BE INSTALLED AS PART OF THE IN-CONDUIT HYDROPOWER AND PRETREATMENT DESIGNS. ANOTHER ALTERNATIVE IS TYING INTO THE NEW GROUNDWATER STORAGE RESERVOIR IF BUILT.

3. PRELIMINARY FENCING LIMITS ARE CONCEPTUAL AND SHOWN FOR REFERENCE ONLY. FINAL FENCING EXTENT, ALIGNMENT, AND TYPE WILL BE REFINED THROUGH CONFIRMATION OF EXISTING FENCING, CITY SECURITY REQUIREMENTS, AND REGULATORY COORDINATION, INCLUDING WILDLIFE AREA COMBINING ZONE AND ODFW REVIEW. LAYOUT ONLY SHOWS ENCLOSING INFRASTRUCTURE PLANNED FOR THE NEAR TERM (IN-CONDUIT HYDROPOWER AND PRETREATMENT). FUTURE FENCE EXPANSIONS WILL BE NEEDED TO ACCOMODATE INFRASTRUCTURE AS THEY ARE BUILT.

PROJECT TIMELINE LEGEND:
- SHORT-TERM
- MEDIUM-TERM
- LONG-TERM

*REFERENCE CHAPTER 9 OF THE OUTBACK FACILITY PLAN

ABBREVIATION LEGEND:

BLDG	BUILDING
CV	CONTROL VALVE
D	DRAIN
DIA	DIAMETER
ELEC	ELECTRIC
EXIST	EXISTING
FM	FORCEMAIN
FS	FIRE SERVICE
FT	FOOT
LV	LOW VOLTAGE
MV	MEDIUM VOLTAGE
NC	NORMAL CLOSED
ODFW	OREGON DEPARTMENT OF FISH & WILDLIFE
OSHG	ON-SITE HYPOCHLORITE GENERATION
PFAS	POLYFLUOROALKYL SUBSTANCES
SS	SANATARY SEWER
W	WATER
W/	WITH
WSE	WATER SURFACE ELEVATION
V	VOLTAGE

PRELIMINARY
NOT FOR
CONSTRUCTION

OUTBACK COMPREHENSIVE FACILITY SITE PLAN
OVERVIEW
CITY OF BEND
DESCHUTES COUNTY, OREGON

REVISIONS:

consor
550 NW FRANKLIN AVENUE,
SUITE 428
BEND, OREGON 97703

DESIGNED BY: HKP
DRAWN BY: CAD
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
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BAR EQUALS ONE INCH
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FIG 6-1

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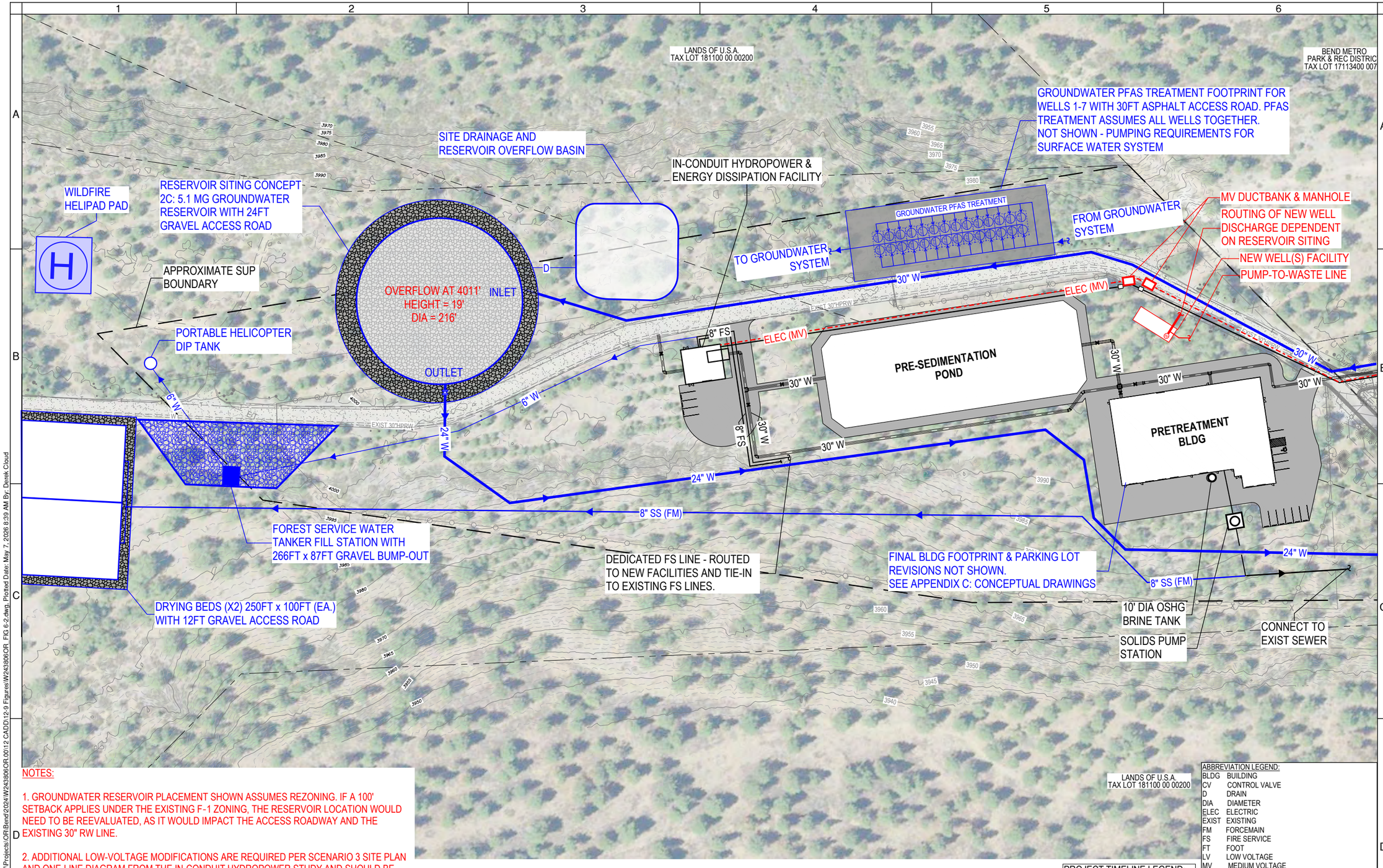
Drawing Path and Name: A:\..V-W\Projects\OR\Bend\2024\W243806OR.00\12 CADD\12-9 Figures\W243806OR_FIG 6-1.dwg, Plotted Date: May 7, 2026 8:38 AM By: Derek Cloud



NOTES:

1. GROUNDWATER RESERVOIR PLACEMENT SHOWN ASSUMES REZONING. IF A 100' SETBACK APPLIES UNDER THE EXISTING F-1 ZONING, THE RESERVOIR LOCATION WOULD NEED TO BE REEVALUATED, AS IT WOULD IMPACT THE ACCESS ROADWAY AND THE EXISTING 30" RW LINE.

2. ADDITIONAL LOW-VOLTAGE MODIFICATIONS ARE REQUIRED PER SCENARIO 3 SITE PLAN AND ONE-LINE DIAGRAM FROM THE IN-CONDUIT HYDROPOWER STUDY AND SHOULD BE DEFINED DURING FINAL DESIGN IF THE CITY DECIDES TO PROCEED WITH THIS SCENARIO.

3. ALL IMPROVEMENTS SHOWN ARE CONCEPTUAL AND SUBJECT TO CHANGE AS INDIVIDUAL PROJECTS ADVANCE. THIS COMPILED SITE PLAN IS INTENDED TO SUPPORT OVERALL FACILITY PLANNING, COORDINATION BETWEEN PROJECTS, AND LONG TERM SPACE ALLOCATION.

PLAN
SCALE: 1" = 60'

LANDS OF U.S.A.
TAX LOT 181100 00 00200

PROJECT TIMELINE LEGEND:
- SHORT-TERM
- MEDIUM-TERM
- LONG-TERM

*REFERENCE CHAPTER 9 OF THE OUTBACK FACILITY PLAN

ABBREVIATION LEGEND:

BLDG	BUILDING
CV	CONTROL VALVE
D	DRAIN
DIA	DIAMETER
ELEC	ELECTRIC
EXIST	EXISTING
FM	FORCEMAIN
FS	FIRE SERVICE
FT	FOOT
LV	LOW VOLTAGE
MV	MEDIUM VOLTAGE
NC	NORMAL CLOSED
ODFW	OREGON DEPARTMENT OF FISH & WILDLIFE
OSHG	ON-SITE HYPOCHLORITE GENERATION
PFAS	POLYFLUOROALKYL SUBSTANCES
SS	SANATARY SEWER
W	WATER
W/	WITH
WSE	WATER SURFACE ELEVATION
V	VOLTAGE

PRELIMINARY
NOT FOR
CONSTRUCTION

OUTBACK COMPREHENSIVE FACILITY SITE PLAN
AREA A
DESCHUTES COUNTY, OREGON

CITY OF BEND

REVISIONS:

consor
550 NW FRANKLIN AVENUE,
SUITE 428
BEND, OREGON 97703

DESIGNED BY: HKP
DRAWN BY: CAD
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
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BAR EQUALS ONE INCH
ON ORIGINAL DRAWING

SHEET:
FIG 6-2

COB # XXXX

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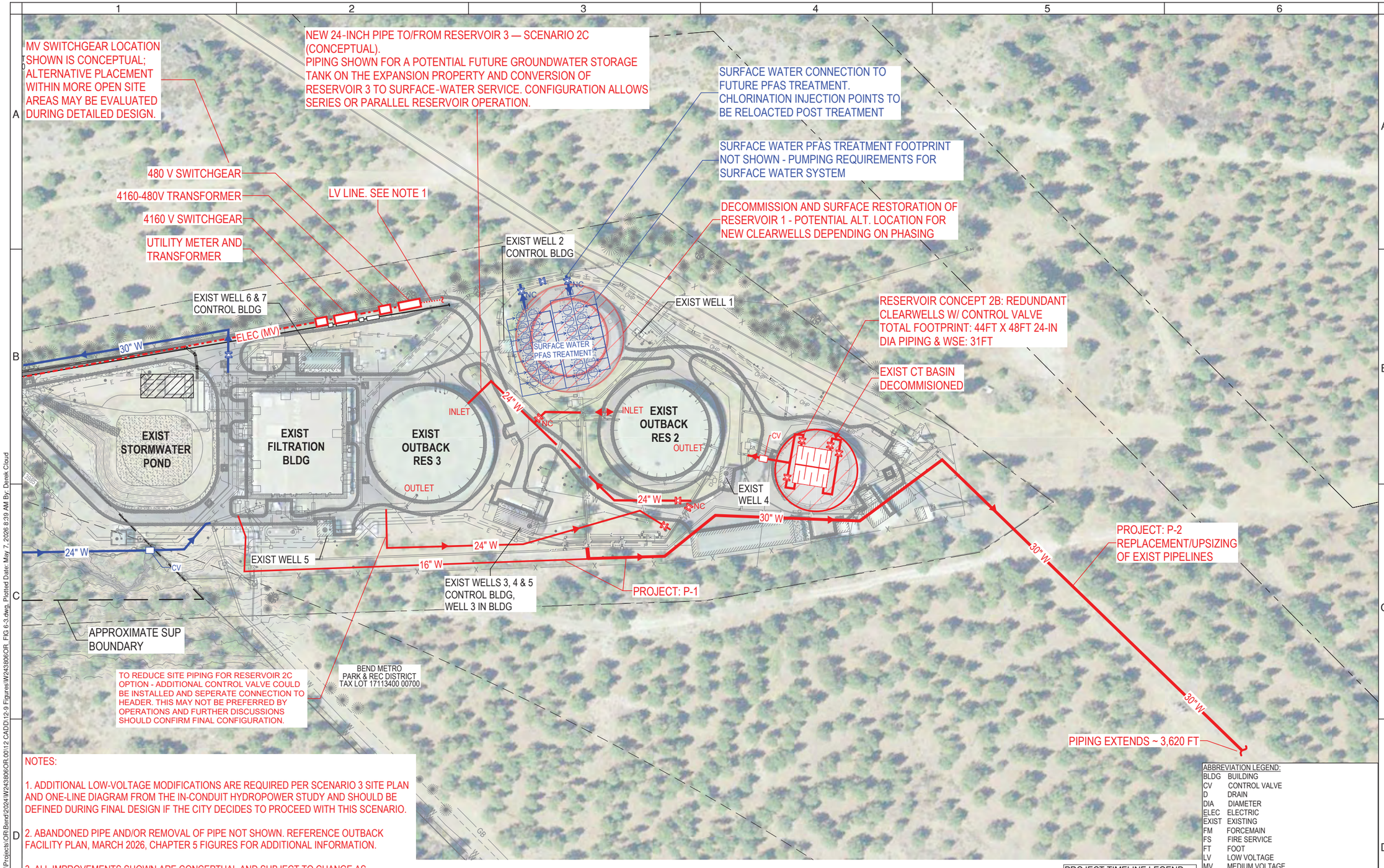

NOTES:

1. ADDITIONAL LOW-VOLTAGE MODIFICATIONS ARE REQUIRED PER SCENARIO 3 SITE PLAN AND ONE-LINE DIAGRAM FROM THE IN-CONDUIT HYDROPOWER STUDY AND SHOULD BE DEFINED DURING FINAL DESIGN IF THE CITY DECIDES TO PROCEED WITH THIS SCENARIO.

2. ABANDONED PIPE AND/OR REMOVAL OF PIPE NOT SHOWN. REFERENCE OUTBACK FACILITY PLAN, MARCH 2026, CHAPTER 5 FIGURES FOR ADDITIONAL INFORMATION.

3. ALL IMPROVEMENTS SHOWN ARE CONCEPTUAL AND SUBJECT TO CHANGE AS INDIVIDUAL PROJECTS ADVANCE. THIS COMPILED SITE PLAN IS INTENDED TO SUPPORT OVERALL FACILITY PLANNING, COORDINATION BETWEEN PROJECTS, AND LONG TERM SPACE ALLOCATION.

4. A PUMP STATION WILL LIKELY BE REQUIRED TO MAINTAIN RESERVOIR LEVELS. THIS WAS NOT EVALUATED AT DURING THIS STAGE OF PLANNING DEVELOPMENT.

PLAN
SCALE: 1" = 60'

PROJECT TIMELINE LEGEND:
- SHORT-TERM
- MEDIUM-TERM
- LONG-TERM

*REFERENCE CHAPTER 9 OF THE OUTBACK FACILITY PLAN

ABBREVIATION LEGEND:

BLDG	BUILDING
CV	CONTROL VALVE
D	DRAIN
DIA	DIAMETER
ELEC	ELECTRIC
EXIST	EXISTING
FM	FORCEMAIN
FS	FIRE SERVICE
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LV	LOW VOLTAGE
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ODFW	OREGON DEPARTMENT OF FISH & WILDLIFE
OSHG	ON-SITE HYPOCHLORITE GENERATION
PFAS	POLYFLUOROALKYL SUBSTANCES
SS	SANATARY SEWER
W	WATER
W/	WITH
WSE	WATER SURFACE ELEVATION
V	VOLTAGE

PRELIMINARY
NOT FOR CONSTRUCTION

OUTBACK COMPREHENSIVE FACILITY SITE PLAN
AREA B
CITY OF BEND
DESCHUTES COUNTY, OREGON

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

DESIGNED BY: HKP
DRAWN BY: CAD
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
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BAR EQUALS ONE INCH ON ORIGINAL DRAWING

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FIG 6-3

COB # XXXX

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Several of the facilities listed below have been fully developed and documented in earlier chapters of this Facility Plan. For those elements, this chapter focuses only on-site layout, spatial relationships, and integration, with brief narrative summaries that reference the respective chapters where detailed planning, design criteria, and evaluations are provided.

Other elements identified below represent future or supporting projects that have not been fully developed elsewhere in this report. These items are discussed later in this chapter at a planning or siting level, sufficient to preserve footprint, access, and utility coordination, but they are not advanced to the same level of design detail as the primary pretreatment, in-conduit hydropower, and reservoir projects.

6.3.1 Integrated Outback Site Facility Elements

The comprehensive site plan includes the following facilities and improvements.

- In-Conduit Hydropower and Energy Dissipation Facilities: discussed in Chapter 4, located within the expansion area southwest of the existing Outback facilities.
- Pretreatment Facilities: discussed in Chapter 3, located northeast of the in-conduit hydropower facilities within the expansion area and southwest of the existing WFF. Major components include the pre-sedimentation pond, pretreatment building (including the OSHG system) drying beds, and associated site piping to support gravity conveyance, bypassing, and integration with the WFF.
- Reservoir Improvements: discussed in Chapter 5, located primarily within the existing basin footprints. A new storage reservoir is also shown southwest of the proposed in-conduit hydropower and pretreatment facilities within the expansion area to allocate space for potential storage improvements related to increasing system-wide storage.
- Water Supply – Groundwater Expansion and Well Optimization: sited within the expansion area at a planning level to preserve access, constructability, and proximity to existing electrical and pipeline infrastructure while allowing flexibility for future well development.
- Outback Site Transmission Main Improvements: identified in the iWSMP (Projects P-1 and P-2), incorporated into the site plan to preserve corridor alignments and avoid conflicts with planned facilities, though construction is anticipated beyond the near-term planning horizon.
- Site Access and Security Improvements: including a dedicated Skyliners Road entrance, planned changes to Forest Service Road 4606, and planning-level accommodation for expanded physical and operational security measures, are incorporated to support secure, reliable operations while managing high public use in the surrounding area.
- PFAS Treatment Sizing and Space Allocation: Planning-level areas are identified to preserve space for potential future PFAS treatment with minimized tie-in distances to surface water and groundwater systems. Siting is intended to maintain regulatory and operational flexibility without committing to a specific treatment technology or final system configuration.
- Forest Service Firefighting Water Supply Coordination: Planning-level accommodation for potential wildfire-response water supply infrastructure (e.g., water fill station, dip pond access) in coordination with the Forest Service. Elements are shown to preserve siting, access, and integration flexibility.

6.4 Pretreatment, In-Conduit Hydropower, and Reservoir Integration

To avoid repeating technical details from Chapter 3, Chapter 4, and Chapter 5, this section summarizes only the key spatial relationships, hydraulic interfaces, and site integration drivers among the pretreatment facilities, in-conduit hydropower/energy dissipation facilities, and reservoir improvements. Detailed process descriptions, design criteria, and condition assessments are provided in their respective chapters.

6.4.1 In-Conduit Hydropower/Energy Dissipation: Chapter 4 – Integration Summary

- The in-conduit hydropower and energy dissipation facility is located generally southwest of the pretreatment facilities, along the existing raw water transmission pipeline corridor, to capture available hydraulic head while minimizing disturbance and new conveyance length.
- The required turbine centerline elevation establishes controlling site grades and directly influences the vertical and horizontal positioning of adjacent pretreatment and conveyance infrastructure, as reflected on the comprehensive site plan and the conceptual drawings.
- All raw water flow will be routed through the in-conduit hydropower and energy dissipation facility, which will serve as the site's primary head control point. Flow is conveyed through the turbine when operating or through parallel sleeve valve dissipation when the turbine is offline, prior to routing toward pretreatment or pretreatment bypass as applicable.
- The comprehensive site plan accommodates medium voltage electrical infrastructure to support hydropower integration and sitewide power distribution; equipment locations shown are conceptual, and alternative placement areas within the site may be evaluated during detailed design.
- A new 8-inch fire service connection is provided at the in-conduit hydropower facility to maintain code-compliant fire protection coverage for nearby buildings and infrastructure.

6.4.2 Pretreatment Facilities: Chapter 3 — Integration Summary

- The pretreatment facilities are located southeast of the in-conduit hydropower and energy dissipation facility, consistent with the direction of raw water flow shown on the comprehensive site plan, to maintain gravity conveyance to the WFF.
- Facility placement preserves a direct and compact hydraulic connection between the energy dissipation facilities and the existing MF feed wet well at the Outback Site and eliminates the need for additional pumping.
- The pretreatment building footprint and adjacent access roads are coordinated with the hydropower facility layout and solids-handling features to support shared circulation, utility corridors, and maintenance access.
- The pretreatment building is configured to accommodate future OSHG, with supporting structural, electrical, and utility infrastructure incorporated within the building. An exterior brine storage tank is sited adjacent to the building, with access coordinated to use the same truck approach and turning geometry as pretreatment chemical deliveries, providing direct pull-up access, safe hose

routing, and short, protected connections between the brine tank, generation equipment, and chemical injection points.

- Drying beds are located adjacent to the pretreatment area at a planning-level siting location to minimize grading, preserve operational access from the pretreatment facilities, and maintain flexibility for future refinement during design.

6.4.3 Reservoirs & CT Improvements: Chapter 5 — Integration Summary

- The comprehensive site plan reflects the preferred reservoir siting concept (Concept 2B) identified in Chapter 5, along with the proposed future groundwater storage reservoir shown as Concept 2C within the expansion area.

- Reservoir footprints, access roads, and grading are coordinated with pretreatment and hydropower layouts to preserve constructability and provide clear separation between treatment, storage, and operations areas.

- Corridors are preserved for finished water inlet and outlet piping, analyzer locations, and operational bypasses, including additional site piping shown for reference associated with a potential future groundwater storage scenario (Option 2C) and series or parallel reservoir operation. The extent of piping illustrated exceeds that required for the preferred Option 2B and is shown to identify long-term corridor needs and preserve constructability if additional storage is implemented in the future.

- Condition-based maintenance items and rehabilitation work identified in Chapter 5 are not repeated here or shown on the comprehensive site plan.

6.5 Water Supply – Groundwater Expansion and Well Optimization

6.5.1 Background and Planning Context

As part of the broader Outback Facility planning effort, a parallel technical evaluation was completed to assess the feasibility and system performance of expanding groundwater supply at the Outback Water Treatment Facility. This work is documented in the Outback Groundwater Supply Expansion Technical Memorandum prepared by Consor in September 2025.

The memorandum evaluated multiple high-demand operational scenarios using the City's Extended Period Simulation (EPS) hydraulic model, including conditions such as the loss of Copperstone Well, the loss of Pilot Butte Well 4, and the complete loss of surface water supply. The analysis incorporated potential additions to groundwater production at the Outback Site to assess system resilience, reservoir performance, and transmission constraints under stress conditions.

The results of this evaluation inform long-term planning at the Outback Site and provide context for the siting and integration considerations reflected in this Facility Plan.

6.5.2 Summary of Groundwater Supply Findings and Assumptions

Key findings from the groundwater expansion evaluation demonstrated that incremental increases in groundwater supply at the Outback Site can significantly improve system resilience, although transmission

limitations and reservoir operating strategies continue to govern system performance under extreme scenarios.

Based on recent coordination with City staff, the following planning assumptions are reflected in this Facility Plan:

- Existing Wells 1 and 2 are anticipated to be phased out or become operationally obsolete and are not relied upon in future supply planning scenarios.
- Existing Wells 3 through 7 are assumed to remain in service and are currently undergoing separate optimization efforts that may increase individual well capacities by approximately 300 to 500 gpm per well, subject to ongoing evaluation.
- For long-term planning purposes, the City has directed the Facility Plan to assume one new groundwater well at the Outback Site, herein referred to as Well 8, with a nominal capacity of approximately 1,000 gpm, to provide flexibility for future supply expansion and operational redundancy.

These assumptions are consistent with recent City direction to adopt a conservative but feasible planning basis that accounts for potential capacity increases at existing wells while avoiding under sizing of shared infrastructure.

6.5.3 Future Well Siting Approach and Planning-Level Rationale

The comprehensive site plan identifies a planning-level location for a future groundwater well facility within the expanded Outback Site. While a single well location is depicted graphically, the site layout intentionally preserves sufficient space, access, and utility corridors to accommodate one future well, consistent with the iWSMP.

The site plan does not represent a final well layout or well count. Rather, it illustrates a feasible siting concept intended to:

- Minimize conflicts with pretreatment, hydropower, reservoir, and site access features.
- Preserve logical routing opportunities for future well piping, electrical, and controls infrastructure.
- Allow incremental expansion of groundwater supply without requiring relocation or reconfiguration of other planned facilities.

The selected siting approach balances constructability, operational efficiency, and long-term flexibility. The location is adjacent to existing and planned water infrastructure, which minimizes the length of new piping, electrical, and instrumentation runs and simplifies hydraulic integration with the treatment and distribution systems. The site also benefits from existing access roads constructed as part of pretreatment and pre-sedimentation improvements, reducing site disturbance while providing adequate geometry for drilling operations, crane access, maintenance, and emergency response.

In addition, the proximity of the future well site to pretreatment and operations facilities supports efficient day-to-day monitoring, maintenance, and integration into sitewide control systems. The exact number, capacity, and configuration of future wells will be confirmed during subsequent phases of design and operational planning.

6.5.4 Planning-Level Considerations and Summary

The location identified for future groundwater well development is suitable from a planning standpoint; however, several items will require confirmation and refinement during subsequent phases of well design and construction. These include verification of final access and staging requirements for drilling rigs and pump maintenance activities; confirmation of setbacks and protection measures for adjacent structures, utilities, and pond embankments; determination of hydraulic tie-in locations, valving configurations, and isolation capabilities; and coordination with any future groundwater storage facilities that may influence optimal well placement, pumping head, and operational efficiency. Utility clearances, geotechnical conditions, and wellhead protection criteria will also need to be confirmed prior to construction.

Overall, the comprehensive site plan preserves a flexible and efficient location for future groundwater well development at the Outback Facility. Consistent with City direction to allow for additional groundwater wells, the layout remains intentionally conservative and adaptable, allowing final well count, capacity, and configuration to be determined as groundwater optimization efforts, hydraulic evaluations, and future capital planning are completed. This approach ensures that groundwater supply expansion can be implemented incrementally without requiring reconfiguration of other planned site facilities.

6.6 Outback Site Transmission Main Projects

The Outback Site transmission main projects include two improvements that were identified in the iWSMP (P-1 and P-2) that strengthen hydraulic performance, provide additional transmission capacity, and support future groundwater and surface water operations at the Outback Site. Both projects are identified as Beyond-2040 needs, as they are not required until system maximum day demand approaches the 45.2 MGD threshold. Although these improvements are not needed in the near term, their alignments are incorporated into the comprehensive site plan to preserve space, maintain constructability, and avoid conflicts with planned pretreatment, in-conduit hydropower, reservoir, and site-wide infrastructure upgrades.

The P-1 project provides a future hydraulic connection between the North and South Outback Transmission Mains through approximately 530 feet of 16-inch pipe and 540 feet of 30-inch pipe (shown as the purple/white and brown/white dashed alignments). These improvements will enhance system hydraulic performance and provide additional operational flexibility at the Outback Site.

The P-2 project replaces the aging 14-inch and 16-inch parallel transmission mains with approximately 4,320 liner feet of new 30-inch pipe to restore capacity and improve hydraulic performance along the Outback North Transmission corridor. This segment of the system is in deteriorating condition and represents a long-term capacity constraint. A portion of the pipeline will be installed by the developer, assumed at 1,000 liner feet.

6.7 Site Access and Security Improvements

6.7.1 Dedicated Access and FS Road 4606 Realignment

The comprehensive site plan reflects the City's previously planned realignment of Forest Service Road 4606, based on CAD information provided by the City. This realignment is a City-led project and is shown on the Facility Site Plan for coordination and context only. Realignment of Forest Service Road 4606 is also a requirement of the Townsite Act land acquisition associated with expansion of the Outback Site onto adjacent Forest Service property.

The design and construction of the Forest Service Road 4606 realignment are being advanced as part of the pretreatment project and are included in the associated OPCC and is summarized here to provide site-wide context and coordination rather than as a standalone improvement.

The realignment preserves a dedicated access connection to Skyliners Road, separating City operations and critical water infrastructure access from public use of Forest Service Road 4606. With extensive trail systems surrounding the Outback Site, public use and activity in the area are high, and Forest Service Road 4606 currently experiences public access, parking, and seasonal closures related to wildlife management. The planned access configuration reduces conflicts with recreational traffic, improves reliability of year-round access, and supports the intent of the AWIA to limit public interaction with critical water infrastructure while maintaining safe access for operations, maintenance, and emergency response.

6.7.2 Planning-Level Site Security Framework

The Outback Site includes some level of existing security infrastructure associated with the current facility footprint; however, the extent, configuration, and performance of these measures were not evaluated in detail as part of this Facility Plan and are not documented herein. As the Outback Site expands to include additional treatment processes, reservoirs, energy dissipation and in-conduit hydropower facilities, future groundwater wells, and supporting operations, security needs will need to be reassessed and expanded to remain appropriate for the larger operational footprint and evolving risk profile.

Beyond access control provided through roadway configuration, the expanded Outback Site will require enhanced physical and operational security measures consistent with its role as a critical water treatment and supply facility. While detailed security requirements have not yet been finalized for the Outback Site, the City is developing standardized physical security criteria intended to be applied consistently across its water infrastructure facilities.

Planning for site security at Outback is informed by:

- Planned security upgrades at other City facilities
- Draft City physical security standards currently under development
- The scale and complexity of the proposed Outback facility expansion, including pretreatment, hydropower, reservoirs, groundwater wells, and support facilities

Security elements anticipated to be evaluated and implemented in future phases may include, but are not limited to:

- Perimeter security, such as fencing, controlled vehicular and pedestrian gates, and wildlife-compatible fence transitions where required
- Access control measures, including secure door hardware and Knox Boxes for emergency responder access.
- Surveillance infrastructure, such as security cameras with associated mounting and local power provisions; requirements for network connectivity, data storage, and system integration will be evaluated separately through coordination with City IT and Operations.
- Signage and site delineation to clearly communicate restricted access areas

Security planning will require coordination with City Operations, IT/Network Services, emergency responders, and regulatory stakeholders to ensure consistency with City-wide standards while accounting for site-specific constraints such as public interface areas, wildlife corridors, existing operational access routes, and parking and circulation needs for employees, visitors, and fleet vehicles. Security planning will also need to account for wildlife corridor fencing requirements that influence fence height, type, and alignment, as discussed in Section 6.7.3.

6.7.3 Wildlife Corridor Fencing Requirements and Security Implications

The entire Outback Site and the planned expansion property, are located within a Wildlife Area (WA) Combining Zone. The existing Outback Site is located within deer winter range; the expansion area is located within both deer winter range and elk habitat. The County has adopted fencing requirements for development in the WA Zone (See Deschutes County Code 18.88.070), which are intended to maintain wildlife movement and connectivity. These requirements generally limit fence height to approximately 48 inches, require a minimum clearance beneath the fence, and favor smooth wire or wooden fencing over woven wire. Alternative fence designs may be considered following consultation with the Oregon Department of Fish and Wildlife (ODFW).

While these standards serve an important environmental function, wildlife-compatible fencing provides limited physical security and does not, by itself, deter unauthorized access to critical water supply infrastructure. As a result, planning for site security at the Outback Facility must balance wildlife corridor objectives with the need to protect essential treatment, storage, conveyance, and supply facilities.

The fencing provisions also include exemptions for fences encompassing less than 10,000 square feet where such fencing surrounds or abuts structures. However, given the scale, layout, and operational interdependence of facilities at the Outback Site, individual facilities generally exceed this threshold or are not readily segregated into small, independently fenced areas. As a result, reliance on these exemptions as a primary security strategy is limited, and site security planning must instead consider alternative approaches that balance wildlife corridor requirements with the need to protect critical infrastructure, informed by coordination with regulatory agencies. The ODFW has approved alternative fence designs for the Outback site in the past (See County File Nos. CU-04-23, SP-04-13, LM-04-66).

The Outback Facility is subject to the AWIA, which places increased emphasis on protecting drinking water infrastructure and limiting exposure to security vulnerabilities. As site development advances, the City anticipates that AWIA considerations will inform coordination with ODFW and other regulatory stakeholders to evaluate alternative fencing strategies, selective wildlife passages, or variance approaches that preserve wildlife movement while meeting security objectives appropriate for a critical water supply facility.

Final determinations regarding fence alignment, height, materials, exemption applicability, and any allowable variances will be made during subsequent design and permitting phases as site details are refined and regulatory coordination progresses.

6.8 PFAS Treatment Sizing and Space Allocation

6.8.1 Planning Context and Intent

At the time of preparation of this Facility Plan, PFAS have not been detected at either the City's surface water supply or the Outback groundwater sources. However, given the rapidly evolving regulatory environment, including the EPA's 2024 National Primary Drinking Water Regulation for PFAS, and the long-

term planning horizon of this Facility Plan, the City has directed that planning-level accommodation for potential future PFAS treatment be incorporated into the Outback Facility Site Plan.

The intent of this section is to identify conceptual treatment footprints, access requirements, and piping corridors that would allow PFAS treatment to be implemented in the future for surface water, groundwater, or both, if required. No PFAS treatment technology is selected in this chapter, and no commitment is made to construct PFAS facilities at this time. Rather, this effort's intent is that space and infrastructure are preserved so future PFAS treatment can be implemented without significant reconfiguration of adjacent facilities.

Planning-level PFAS assumptions for the Outback Facility are informed by the City's prior evaluation of PFAS treatment alternatives at the Copperstone Well, which evaluated pressure vessel PFAS treatment technologies, footprint requirements, and operational considerations. While that work focused on a single groundwater source, the conclusions regarding vessel scale, access needs, and site integration provide a reasonable basis for planning-level accommodation at the Outback Facility.

6.8.2 PFAS Treatment Planning Approach

The Outback Facility supplies the City's water system using a combination of surface water and groundwater. Future PFAS treatment requirements could apply to either source independently or to both sources concurrently, depending on monitoring results, regulatory interpretation, and City operational policy. To account for this uncertainty, PFAS treatment planning includes treatment space for both surface water and groundwater treatment configurations that can be implemented independently. Should the City desire to combine groundwater and surface water flows to use the same treatment vessels, considerations should be made about how to achieve appropriate chlorination of the combined water sources downstream of the vessels (including contact time for surface water).

Groundwater PFAS treatment assumptions vary by planning scenario. In Groundwater Scenario A, groundwater PFAS treatment is assumed to occur within a cluster of wells (Wells 6 and 7), providing operational flexibility and a basis for defining minimum treatment footprints. In Groundwater Scenario B, the most conservative planning case, all existing Outback wells are assumed to be treated concurrently, representing a worst case condition that maximizes footprint and infrastructure needs. This footprint is shown on **Figure 6-1** and **Figure 6-2**.

Should PFAS be detected in the City's surface water source, treatment is assumed to require the full 11.8 MGD (18.2 cfs) of treatment capacity regardless of needs. But while PFAS has been detected in groundwater sources in the Pacific Northwest and Oregon, it is less commonly found in watershed surface water sources. Construction of PFAS treatment for 11.8 MGD (18.2 cfs) of flow is also significantly expensive, as shown in **Chapter 8**. The surface water scenario assumes 11.8 MGD (18.2 cfs) of treatment is required to consider maximum required treatment footprints which is depicted on **Figure 6-1** and **Figure 6-3**.

While actual operating strategies, well capacities, surface water treatment needs, and wellfield configurations may change over time, the scenarios presented are intended to bracket potential future PFAS treatment needs rather than predict a specific operating condition.

6.8.3 PFAS Treatment Planning Scenarios

Two groundwater and one surface water planning-level PFAS treatment scenarios were developed to define relative footprint sizes, access requirements, and piping configurations. These scenarios are not intended to represent final designs or preferred implementation strategies.

- Groundwater Scenario A – Limited Capacity Groundwater PFAS Treatment: Scenario A represents the minimum PFAS treatment condition and assumes that future PFAS treatment is required only for groundwater, with treatment provided for Outback Wells 6 and 7. This scenario establishes a minimum planning footprint while preserving flexibility to address groundwater-only PFAS needs. Under this scenario, PFAS treatment capacity is sized for two wells (3.74 MGD or 5.79 cfs) which would include eight 12-foot diameter pressure vessels.

- Groundwater Scenario B – Full Groundwater PFAS Treatment: Groundwater Scenario B represents the most conservative planning case related to groundwater supply and assumes PFAS treatment of all existing Outback wells, Wells 1 through 7 (11.8 MGD or 18.2 cfs). This scenario reflects a worst case planning condition for groundwater supply intended to preserve maximum flexibility rather than an anticipated near-term implementation strategy. Under this scenario, groundwater treatment includes 26 pressure vessels, each 12-foot diameter, reflecting concurrent treatment of all wells.

- Surface Water Scenario – Full Surface Water PFAS Treatment: The Surface Water Scenario assumes PFAS treatment of the full surface water flow (11.8 MGD or 18.2 cfs). Under this scenario, surface water treatment includes 26 pressure vessels, each 12-foot diameter.

6.8.4 PFAS Site Plan Representation and Planning-Level Assumptions

The PFAS treatment concepts shown on the Facility Site Plan illustrate relative footprint sizes, access needs, and piping corridors associated with the three PFAS planning scenarios. Specific PFAS treatment areas have not been permanently sited, and the layouts shown are intended for comparison and planning purposes only. Across all scenarios, PFAS treatment is assumed to be provided using pressure vessel systems consistent with technologies previously evaluated by the City, with no permanent backwash infrastructure shown at the planning level. A minimum of 30-foot drivable surfacing is provided around the treatment areas to support truck access for media handling, delivery, and removal.

While groundwater treatment assumptions reference Wells 1 through 7, it is recognized that well capacities, operating strategies, and future well development may change over time, which could affect future PFAS treatment requirements. Accordingly, the scenarios presented are intentionally conservative and adaptable and are intended to bracket potential future conditions rather than predict a specific operating configuration.

By incorporating PFAS treatment planning scenarios into the Facility Site Plan, the City preserves adequate space and utility corridors to accommodate future PFAS treatment while avoiding conflicts with other planned Outback facilities. The planning-level layouts support future cost estimating and regulatory response planning and maintain flexibility to implement PFAS treatment in phases or targeted configurations as requirements evolve. The concepts shown are intended to inform long-term site integration and do not represent final design decisions; final selection of PFAS treatment technologies, vessel configuration, system sizing, and operational approach will be completed in future planning or design phases, informed by updated regulations, monitoring data, and City policy decisions.

6.9 Forest Service Wildland Fire Fighting Infrastructure

The City is evaluating incorporation of wildfire fighting infrastructure at the Outback Site due to its proximity to high wildfire risk forest lands. Locating response infrastructure at this site would reduce response times, improve operational efficiency, and help protect adjacent lands, City assets, and critical water supply systems.

The City is acquiring a large parcel adjacent to the Outback Site, providing sufficient space to accommodate wildfire fighting facilities while maintaining flexibility to integrate with existing and planned water supply infrastructure. This effort supports proactive planning as part of the broader Outback Facility Plan.

This section provides a high-level planning assessment of potential Forest Service wildfire fighting infrastructure at the Outback Site, intended to inform site layout and long-range infrastructure planning during ongoing facility upgrades.

Specifically, this section considers planning requirements and constraints for the following components:

- Truck accessible water fill station to support fire engines and water tenders, connected to existing or planned City water infrastructure at the Outback Site.
- Helicopter dip station using the new pre-sedimentation pond or stand-alone tank.
- Helipad to support helicopter landing, staging, and ground-to-air coordination, improving aviation response efficiency and operational safety during wildfire events.

The objective is to identify minimum clearance, access, and operational area requirements for vehicles, helicopter buckets, staging areas, and helicopter approach and departure paths. This information will support land reservation and coordination with other planned infrastructure improvements. Final design and operational details, including agency coordination, would be addressed in subsequent project phases. Figure 6-1 and Figure 6-2 provides the proposed siting of the wildfire-fighting facilities.

6.9.1 Truck Accessible Water Fill Station

Based on preliminary coordination with the Forest Service, the truck accessible water fill station is assumed to utilize a standard Forest Service standpipe configuration capable of overhead filling for Type 1 and Type 2 water tenders, with layout, clearances, and operational configuration governed by the Forest Service Water Tanker Fill Station Standard Drawings (Appendix F).

For planning purposes, access and circulation considerations are based on accommodation of a Forest Service Type 2 Water Tender (Model 22), as identified by the Forest Service for planning-level site access assumptions. Detailed vehicle turning analyses and final access geometry have not been evaluated at this stage and would be completed during subsequent design.

6.9.1.1 Existing Site Constraints and Considerations

6.9.1.1.1 Site Access & Security

The Outback Site is accessed from Skyliners Road via approximately 3,100 linear feet of a 24-foot wide gravel access road that is currently intersected by multiple Forest Service gravel roads and trails. As part of the Outback Facility upgrades, the Forest Service 4606 access road is planned to be relocated, restricting access to the existing access road to the Outback Site and ultimately improving site security. Two access

gates are located approximately 1,850 feet and 1,050 feet from the Outback Site WFF, with fencing along both sides of the roadway. These features influence feasible truck access and fill station siting; however, planned improvements include reconfiguration of fencing and access points.

The existing access road to the Outback Site has relatively level shoulders; however, steep slopes occur approximately 70 to 200 feet beyond the road edge (up to 36 percent northwest and 16 percent southeast). These conditions favor siting that remains close to the access roadway prism to minimize grading and disturbance.

6.9.1.1.2 Source Water and Fill Station Pressure Considerations

Source water for the fill station is anticipated to be raw surface water from the Bridge Creek Intake Facility. During large wildfire events, surface water availability and quality may be impacted by elevated sediment loads or debris. While firefighting operations routinely use non-potable surface water, overall source reliability during extreme wildfire conditions should be considered during future design. The Outback Site also includes groundwater infrastructure, which is not currently planned to be interconnected but could be evaluated in future phases to improve operational resilience.

Adequate pressure at the water fill station is a key operational consideration. For planning purposes, the fill station is anticipated to connect to the existing hydrant and fire service infrastructure serving the Outback Site, rather than the potable distribution system downstream of the WFF. As part of the proposed in-conduit hydropower and pretreatment projects, the fire service line and/or connection point is planned to be realigned, and the fill station would be connected to this improved fire service infrastructure.

Fire service systems are designed to provide sufficient pressure and flow for firefighting operations, and no pressure limitations are anticipated at the planning level. While detailed hydraulic analysis has not been performed under this effort, the proposed connection to the realigned fire service system, including approximately 700 feet of 6-inch supply piping, is not expected to result in pressure losses that would limit fill station functionality. Final confirmation of available pressure, flow capacity, and any required pressure control or regulating components would be completed during subsequent design in accordance with City fire service standards.

6.9.1.2 Forest Service Standard Fill Station Configuration

The Forest Service standard includes two compliant fill station configurations: a pressure fill station and an air gap fill station, both capable of overhead filling for Type 1 and Type 2 water tenders (Appendix F). In either configuration, water use would be metered.

For planning and cost estimating purposes, this Facility Plan assumes use of the pressure configuration, which includes a double check valve assembly (DCVA) and represents a conservative assumption with respect to footprint and infrastructure complexity. The air gap fill station is shown for reference only and is not assumed for layout or cost development but should be evaluated as part of future planning.

The Forest Service pressure fill station includes aboveground piping elements that require additional consideration given the freezing temperatures likely to occur at the Outback Site. Freeze protection strategies could include providing power for heat tracing or enclosure, relocating vulnerable piping below grade, or configuring the system to allow full isolation and drainage when not in use. Final freeze protection approach and configuration should be determined during design in coordination with the Forest Service and the City to meet the most restrictive applicable requirements.

Figure 6-4 | Forest Service Standard Pressure-Type Fill Station – Steel Tower with DCVA (USFS Standard Drawings)

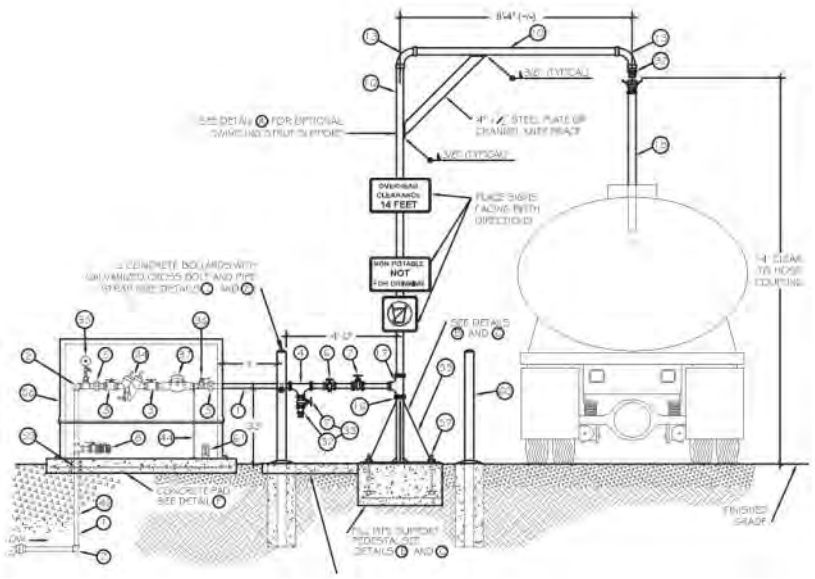
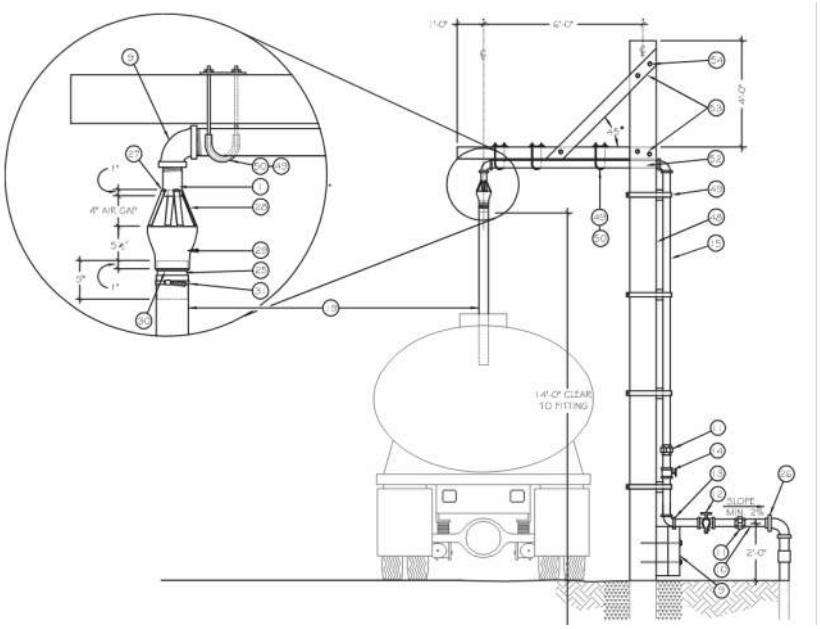


Figure 6-5 | Forest Service Standard Air Gap-Type Fill Station – Wood Tower (USFS Standard Drawings)



6.9.1.3 Recommended Fill Station Location

The fill station is recommended to be located along the existing Outback Site access road near the proposed location of the drying beds, as depicted on **Figure 6-1** and **Figure 6-2**. This location minimizes new pipeline length, maintains safe access for firefighting apparatus, and integrates efficiently with planned site utilities.

The facility would utilize a graded roadway bump out within the existing fenced area, providing adequate width and sight distance for truck staging while minimizing off-road disturbance. The fill station would

connect to raw water transmission pipeline via a tap to the Outback Site fire service line that is being realigned as part of the in-conduit hydropower and pretreatment improvements. The connection would be near the proposed in-conduit hydropower facility. The following infrastructure elements are anticipated to support the recommended fill station location and have been included to inform planning-level cost development:

- Approximately 700 linear feet of 6-inch ductile iron pipe.
- A graded roadway bump.
- Forest Service standard pressure fill station, including standpipe, DCVA vault, foundation, and associated appurtenances.
- Minor site restoration, striping, and signage as required.

6.9.2 Helicopter Dip Tank

A helicopter dip tank is proposed at the Outback Site to support aerial wildfire suppression in the absence of nearby natural lakes or reservoirs. The dip tank would provide a dedicated, non-potable water source for wildfire helicopters operating in the surrounding forested areas.

6.9.2.1 Site Constraints & Planning Assumptions

The Outback Facility is located on a graded high point, with steep terrain descending from the northwest side of the site and more moderate slopes to the southeast. Existing and planned above-grade infrastructure constrain available siting areas, and minimum clearance requirements for helicopter dipping operations must be maintained. Adequate horizontal and vertical separation from structures, fencing, and other obstructions is required to support safe approach, dipping, and departure maneuvers.

The Forest Service and the National Wildfire Coordinating Group provide guidance for the design, implementation, and operation of helicopter dip tanks. While final design and operational approval would be required during later phases, the following planning-level assumptions are used to inform siting and footprint needs:

- Minimum tank depth: 10 feet
- Tank diameter: 16 feet
- Helicopter filling clearance: 110-foot diameter clear area (safety circle) is the clearance the helicopter needs when hovering to fill the bucket.
- Water quality: Potable or non-potable
- Tank surface: Smooth concrete, vinyl, or steel surface free of sharp edges and obstructions.

Ultimately, each dip tank must be designed and approved on a case-by-case basis in coordination with local fire departments. The below alternatives are based on national Forest Service standards for dip tanks, but coordination with Bend Fire & Rescue and Deschutes Rural Fire Protection District is recommended to confirm tank design specifications and operation requirements.

6.9.2.2 Dip Tank Options & Key Considerations

Several dip tank configurations were reviewed at a planning level based on Forest Service standards, site constraints, and operational considerations. For this evaluation, options are limited to use of the proposed pre-sedimentation basin and standalone dip tank facilities (temporary or permanent).

A key differentiating factor among these options is interaction with pretreatment facilities during wildfire conditions. Two surface water-based approaches are considered: use of the pre-sedimentation basin and construction of a dedicated dip tank supplied from the surface water system.

During wildfire events, the pre-sedimentation basin may be operating at or near full capacity to manage elevated sediment loads. Under these conditions, it may be difficult to reliably assume adequate water depth would be available for helicopter dipping, and use of the basin as a dip tank could interfere with its primary function of settling solids and reducing turbidity when pretreatment performance is most critical.

In contrast, a dedicated standalone dip tank supplied from the surface water system ahead of the pre-sedimentation basin could be designed to support helicopter dipping operations without affecting pretreatment performance. This approach would allow water depth to be maintained independently and provide operational separation between wildfire response activities and treatment infrastructure.

Existing and proposed stormwater ponds at the Outback Site are not assumed to be feasible dip tank options due to high infiltration rates known to occur at the site, which would limit the ability of these facilities to reliably retain water at depths required for helicopter dipping operations.

An additional consideration is the potential to supply a standalone dip tank from the existing groundwater system. Groundwater could be routed from existing wells to a permanent dip tank via additional piping and control infrastructure. This approach would avoid wildfire-related sediment concerns and pretreatment conflicts; however, it would require additional conveyance infrastructure and coordination with water supply operations. Groundwater supply is noted as a feasible planning-level option but is not assumed under the selected configuration.

Another planning-level consideration is the volume and rate of water withdrawal required to support aerial firefighting operations. While use of surface water for wildfire response is anticipated, allowable diversion rates and volumes are subject to City operational constraints and applicable water rights or regulatory requirements. The extent to which helicopter dipping operations could withdraw substantial quantities of water during wildfire events would require further evaluation and coordination with City water supply operations during subsequent design and agency coordination phases.

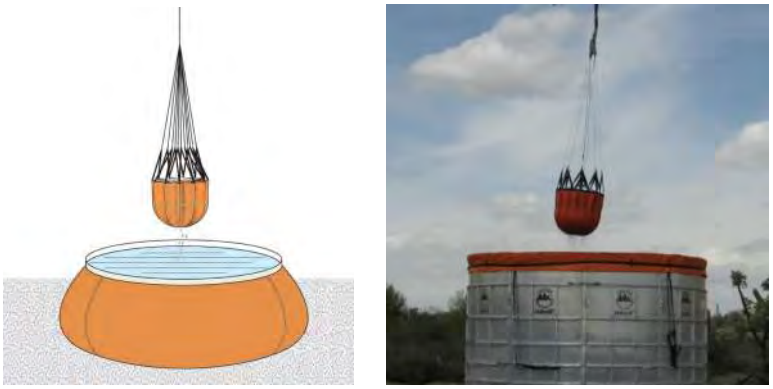
6.9.2.3 Dip Tank Alternatives Considered

Alternative 1 – Standalone Dip Tank: Install a prefabricated, standalone dip tank supplied by a new water connection and sited to meet required helicopter clearance criteria. Portable dip tanks may consist of frameless, self-supporting synthetic tanks or rigid, metal-framed tanks (see **Figure 6-6**). The dip tank fill would require an approved air gap or DCVA to protect the water supply from contamination, even when supplied with raw surface water that ultimately enters the treatment system. This alternative functions as a single-purpose facility independent of existing treatment or storage infrastructure. For future planning reference, SEI Industries is a vendor for the framed design, also called a heliwell, and they noted that the tank could be assembled in less than 2 hours with three people. It would consist of 8 to 10 aluminum panels

that fit a pickup track and can be constructed and deconstructed and stored when not in use. The frameless design is meant to be stored away when note in use, FOL-DA-TANK is a sample vendor.

- Pros: Flexible sizing and configuration; rapid deployment; predictable costs; avoids interference with pretreatment facilities.
- Cons: Shorter service life than basin alternatives; requires dedicated supply piping, pad preparation, and anchoring; may require seasonal installation or removal.

Figure 6-6 | Portable Dip Tank Designs: Frameless dip tank (left) and metal-framed dip tank (right)



Alternative 2 – Utilize the proposed pre-sedimentation basin: Utilize the proposed pre-sedimentation basin as a dual-use facility by allowing helicopter dipping during wildfire events. This alternative assumes the basin design can accommodate helicopter operations without adversely affecting pretreatment performance.

- Pros: No new dip tank construction required; basin footprint accommodates helicopter clearance needs; preliminary design indicates adequate depth under normal operating conditions.
- Cons: Potential conflicts with pretreatment operations during wildfires; basin is in preliminary design and may require modification; reliability of available depth during wildfire conditions is uncertain; increased operational complexity.

6.9.2.4 Selected Dip Tank Configuration (Planning Assumption)

For planning and cost estimating purposes, this memo assumes use of a standalone, temporary helicopter dip tank as the selected configuration.

The standalone dip tank represents the most conservative and implementable option based on current site conditions, project schedule, and operational uncertainty. This approach avoids reliance on pretreatment facilities, minimizes the risk of delaying other water supply projects, and can be deployed independently to support wildfire response.

The following infrastructure elements are anticipated to support the selected standalone dip tank and have been included for planning-level footprint and cost development:

- Prefabricated temporary dip tank (approximately 16 feet in diameter and 10–12 feet in height), metal framed option.
- Prepared foundation or pad, including grading, compaction, and surface stabilization

- Dedicated raw water supply connection with approved backflow protection (DCVA or air gap)
- Clear area approximately 110 feet in diameter, free of vertical obstructions

Final tank type, duration of use, operational protocols, and agency approvals would be addressed during subsequent design and coordination phases.

6.9.3 Helipad

A helipad is proposed at the Outback Site to support helicopter landing, staging, maintenance, and emergency operations associated with wildfire response. The helipad is intended to complement the helicopter dip tank by reducing turnaround time and supporting coordinated ground-to-air operations.

6.9.3.1 Planning-Level Criteria and Assumptions

Helipad planning is based on accommodating the largest anticipated wildfire helicopter (Type 1; overall length approximately 88 feet) to conservatively define space and clearance requirements. Planning-level assumptions are informed by Federal Aviation Administration heliport guidance and National Wildlife Coordinating Group wildland fire aviation practices. The dimensional relationships used for planning and siting are illustrated in **Figure 6-7**.

For planning purposes, the following clearance envelope is assumed (see **Figure 6-7**):

- Final Approach and Takeoff Area (FATO): approximately 132 feet wide
- Safety area: extending approximately 25 feet beyond the FATO on all sides
- Overall clear area: approximately 182 feet by 182 feet, free of vertical obstructions
- Approach/departure surfaces: clear of vertical obstructions for approximately 400 feet along the helicopter flight path from the FATO

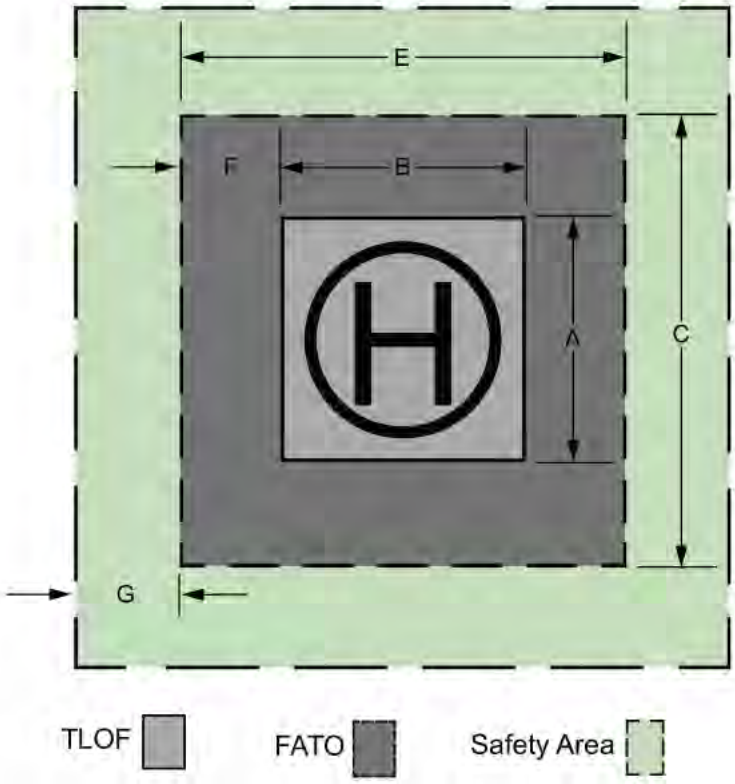
Approach and departure surfaces are assumed to remain free of obstructions consistent with Federal Aviation Administration visual flight rules, with the approach/departure surface rising at a 1:8 slope from the helipad. For planning purposes, a conservative clearance has been assumed, which may require selective vegetation removal along the flight path out to approximately 400 feet from the helipad.

Local topography includes relatively steep drop offs along portions of the approach and departure paths. This terrain provides a natural advantage by reducing the effective amount of vegetation clearing required and was a key factor in selection of the proposed helipad location (see **Figure 6-1** and **Figure 6-2**).

These dimensions exceed typical minimum wildland helicopter landing zone recommendations and are intended to provide a conservative envelope for preliminary siting and planning only. Detailed aviation design, helicopter performance evaluation, and obstruction clearance analyses have not been performed at this stage and would be completed during final design.

Figure 6-7 | Helipad Planning Dimensions and Clearance Areas

Dim	Item	GA
A	TLOF Width	0.83 D
B	TLOF Length	0.83 D
C	FATO Length [2]	1.50 D
E	FATO Width	1.50 D
F	Separation between TLOF and FATO perimeters [3]	0.34 D



6.9.3.2 General Construction Approach

At a planning level, the helipad is assumed to consist of a reinforced concrete pad constructed on leveled and compacted subgrade, with grading configured so the pad occupies a relative high point and surrounding surfaces slope away to facilitate drainage and maintain visibility. Pavement thickness and structural design are assumed for planning-level footprint and cost development and would be finalized during detailed design.

Vegetation clearing and obstruction removal would be required within the assumed clear area and along approach and departure paths to maintain required operational clearances.

The following infrastructure elements are anticipated for planning-level footprint and cost development.

- Subgrade preparation, grading, and compaction for helipad
- Concrete helipad pad construction assumed 6 inches thick
- Clearing and grading of a 400-foot by 400-foot area
- Minor drainage and erosion control improvements
- Site restoration, striping, and signage as required

No lighting or nighttime operational features are assumed, as helipad use is anticipated to be limited to daylight wildfire response operations. Final orientation, pad geometry, markings, and construction details would be refined during subsequent design and agency coordination.

CHAPTER 7

Permitting Summary

7.1 Introduction

This document is intended to provide the City with a summary of the permits and other authorizations needed for planned expansions of the potable water infrastructure at the Outback Site to accommodate future needs and provide resiliency for the City's water supply system, herein referred to as the Project area.

The City of Bend Outback Site Conveyance Environmental Assessment (EA) (DNF 2026) conducted in support of the Forest Service's proposal to convey land to the City under the Townsite Act was issued in February of 2026. The Forest Service also released a draft decision and Finding of No Significant Impact for the project. The EA (DNF 2026) studied the project's effects on the quality of the built and natural environment and provides a summary of the determination of any potential effects on the affected environment. No regulatory permits are required as part of the Forest Service's decision to convey this parcel of land to the City.

7.2 Permits Required

The following describes permits and authorizations that may be required for future activities on the conveyed land or at the existing Outback Site, or explains why certain commonly required permits may not be needed. Table 7-1 summarizes required permits and authorizations, associated timeframes, and other relevant information.

Table 7-1 | Summary of Potential Environmental and Land Use Permit and Authorization Requirements

Permitting Agency	Permit/ Approval	Nexus/ Authority	Permit Trigger	Needed for Project?	Permit Duration	Time to Prepare Permit Application	Approval Timeframe	Notes
United States Forest Service	Special Use Permit	National Forest Management Act	Road work on National Forest land	Possible	5-30 years	2 months	Typically 3 months, National Environmental Policy Act (NEPA) compliance is already underway	The EA prepared for the conveyance of property fully considered the effects of the road realignment, so additional NEPA analysis will not be required.
US Fish and Wildlife Service (USFWS)	Incidental Take Permits are generally not issued for construction projects, compliance is generally through impact avoidance	Migratory Bird Treaty Act	Impacts to migratory birds	Compliance likely achieved through impact avoidance	Not applicable	Not applicable	Typically 2 months for initial coordination	If the clearing of trees and shrubs (i.e., nesting habitat) would occur at the site, it should take place outside the typical nesting period (generally April-July). If this is not possible, then nest surveys may be required to avoid take (harm) of nesting migratory birds.
USFWS	Incidental Take Permit	Bald and Golden Eagle Protection Act	Impacts to Bald and Golden Eagles	Possible	5 years for construction permits	2 months	6-12 months	A survey can be conducted to ensure no bald eagle nests are present at the project site. If none are present, a permit would not be needed.
Federal Energy Regulatory Commission	Federal Energy Regulatory Commission (FERC) Conduit Hydropower Authorization	Federal Power Act Hydropower Regulatory Efficiency Ac	Hydroelectric Generating Facility	Yes	Authorization is perpetual	2 months	2 months	If a party files comments or motions to intervene contesting whether the facility meets the qualifying criteria, it can add time beyond the baseline approval timeframe. The project will typically need to be constructed within 2 years of FERC's authorization. FERC can grant extensions.
Oregon Water Resources Department	Certificate to use water for hydroelectric purposes within artificial delivery system	Oregon Revised Statutes 543.765	Hydroelectric Generating Facility	Yes	Authorization is perpetual	2 months	3-6 months	This assumes only a certificate is needed. The certificate is typically invalidated if the project is not developed within 5 years
Oregon Health Authority Oregon Drinking Water Services	Oregon Drinking Water Services Plan Review	Oregon Revised Statutes Chapter 448 and Oregon Administrative Rules Chapter 333, Division 61	Construction or modification of drinking water pretreatment facility	Yes	Set by the conditions of the authorization and associated compliance schedule	Approximately 2 months; varies (depending on the complexity of the project and the required engineering analysis)	2-4 months	For new water source system or complex projects, the review can take up to 4 months
Deschutes County	Land Use and Development Review	Deschutes County Code	Development review required for zoning change, map and text amendments (if Public Facility Zone approach chosen), conditional use permit, site plan review, design review	Yes	Authorization is perpetual unless otherwise indicated in the conditions of approval; required to initiate use within 2 years of approval unless extended (see DCC 22.36)	Approximately 2 months (depending on the extent of technical analysis required and the complexity of the project)	4 months, possibly longer if appealed. State law (ORS 215.427) requires final decision within 150 days for land use permits including conditional use permits and site plan review.	A pre-application meeting is typically held to confirm applicable zoning and development criteria, and information/studies (e.g., Geotechnical review) needed to demonstrate compliance. Following this, land use applications must be prepared, including compliance narrative and a plan for any mitigation needed.
Deschutes County Road Department	Road Access and Road Realignment Approval	Deschutes County Code Title 17.48 & Oregon Standard Specifications for Construction	Realignment of the connection between Forest Service Road 4606 and Skyliners Road	Yes		1-2 months; varies (depending on the complexity of the project)	2 months	Times can vary based on application completeness and project complexity
Oregon Department of Forestry	Permit or notification	Oregon Revised Statutes 477.515–477.545	Using fire in any form or power-driven machinery within one-eighth of one mile of a forest protection district	Yes	Valid for a specific activity period and fire season conditions.	Days to a week	2-3 weeks	

7.2.1 Wetlands and Aquatic Habitats

The Project area lies within well-drained soils within relatively arid forest habitat, and does not contain or lie near any wetlands, floodplains, waterways or designated wild and scenic rivers. No aquatic species of any kind are present in the Project area, and no riparian areas will be affected. There is no habitat for Forest Service sensitive aquatic species within or near the Project area. Tumalo Creek is the nearest water body, located more than 0.5-mile away from the Project area, which indicates that typical erosion and sediment control measures implemented during construction will be sufficient to protect the water resources that lie well outside the Project area. As result, no permits related to wetlands or aquatic habitats will be needed from the Army Corps of Engineers, Oregon Department State Lands, or other regulatory agencies.

7.2.2 Threatened, Endangered, Proposed, or Sensitive Species

The EA determined that the Proposed Action would not result in adverse impacts to Threatened, Endangered, Proposed, or Forest Service Sensitive species within the analysis area. The EA concludes a No Effect determination for ESA-listed species, including the Oregon spotted frog, northern spotted owl, gray wolf, and wolverine. Therefore, no consultation under the Endangered Species Act is likely to be required. For Forest Service Sensitive species, the EA analysis indicates the action would not result in a trend toward federal listing or loss of viability; accordingly, no additional permitting or consultation will be required.

7.2.3 US Forest Service Special Use Permit

Implementation of the Forest Service Road 4606 realignment would require appropriate authorization from the Forest Service for work on National Forest System lands. The specific authorization (e.g., special use permit, easement, or other instrument) would be determined by the Forest Service prior to construction.

7.2.4 U.S. Fish and Wildlife Service Permits

7.2.4.1 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) makes it unlawful to pursue, hunt, take, capture, kill, or possess any protected migratory birds, their parts, nests, or eggs. While the application of the MBTA to "incidental take" (unintentional killing of birds during otherwise lawful activities, such as infrastructure projects or tree trimming) has been a subject of legal debate and varying court interpretations, the law generally requires all entities, including government agencies at all levels, to comply. Cities must take measures to avoid actions that would result in the prohibited take of migratory birds, especially during nesting seasons. If tree removal is required, we recommend the project follow the DNF guidance from the EA in order to remain in compliance with the MBTA:

- Remove trees outside the primary nesting season for the area, which occurs in the area between April 15 and July 15.

If this seasonal restriction is not possible, the following are recommended between April 15 and July 15.

- One week or less prior to ground clearing and vegetation removal activities, engage a qualified biologist to review project work areas to determine the presence or absence of active nesting (nests containing eggs and/or young) of any birds covered under the provisions of the MBTA. This should be accomplished by walking the entire area in the early morning when birds are most active, listening, and scanning vegetation with binoculars.

- If identified, all active nests (or suspected nesting behavior in dense vegetation or trees to be removed) would need to be avoided during initial construction and ground clearing activities.

- If nest locations cannot be avoided, or cannot be detected with reasonable certainty, request further assistance from the USFWS Migratory Bird Permit Office or from the Animal and Plant Health Inspection Service, which can issue "take" permits that allow for removal of active nests in some situations.

7.2.4.2 Bald and Golden Eagle Protection Act

Bald eagles are protected under the Bald and Golden Eagle Protection Act. Although the project area is within the range of bald eagles, the Wildlife Effects Analysis for the EA (DNF 2025) indicates bald eagles are not known or suspected to be present in the project area and they do not have suitable habitat near or in the project area. Prior to any construction, a biologist should confirm whether active nests occur within the buffers described below by scanning the tree line.

If eagles are found in the Project vicinity, the following measures should be considered. To avoid disturbing nesting bald eagles, USFWS recommends maintaining natural forested or established vegetative buffers around nest trees and avoiding certain activities during the nesting season. The following buffer areas serve to minimize visual and auditory impacts associated with human activities near nest sites. To avoid the non-purposeful take of bald eagles or their young, USFWS recommends the following:

For construction activities within line-of-sight of the nest:

- Reduce disturbance by maintaining a 660-foot buffer between the activity and any active nest if no landscape buffer exists

For construction activities with a visual landscape buffer:

- If there is a visual landscape buffer (e.g., tree screen), a minimum 330-foot buffer may suffice.

- Restrict all clearing, external construction and landscaping activities within 660 feet of the nest to outside of the nesting season.

7.2.5 Permits for in-Conduit Hydropower

7.2.5.1 Notice of Intent to Construct a Qualifying Conduit Hydropower Facility

The City evaluated in-conduit hydropower opportunities across its distribution system in the In-Conduit Hydropower Feasibility Study (City of Bend 2025). At the WFF expansion site, an in-conduit facility would generate electricity to power the Outback Facility using existing pipelines that convey water to the WFF, with no additional surface water diversion. Such systems typically have minimal environmental effects because they recover energy from flows already subject to dissipation or operational control. The WFF raw water transmission pipeline was identified as a strong candidate due to the high pressure dissipated at the existing energy dissipation infrastructure before water enters the WFF. No environmental impacts from construction or operation are anticipated (Deschutes National Forest 2026).

Under the Hydropower Regulatory Efficiency Act of 2013, as amended by AWIA, the FERC is required to determine whether a project meets the criteria to be considered "qualifying conduit hydropower facilities." Qualifying conduit hydropower facilities are not required to be licensed or exempted by the FERC. However, any person, State, or municipality proposing to construct a facility that meets the criteria must file a Notice

of Intent to Construct a Qualifying Conduit Hydropower Facility with the FERC. Within 15 days of receiving a Notice of Intent, FERC staff must make an initial determination on whether the project meets the "qualifying conduit" criteria. If the project qualifies, the FERC issues a public notice. Stakeholders then have 30 days to contest the determination. If no one contests the project within that 30-day window, the facility is deemed "qualified" and is authorized for construction (16 U.S.C. § 823a).

Preparation of the notification would follow the implementing regulations for section 30(a) of the Federal Power Act are at 18 CFR § 4.400-401.

Any facility must meet the following provisions:

1. A conduit is any tunnel, canal, pipeline, aqueduct, flume, ditch, or similar manmade water conveyance that is operated for the distribution of water for agricultural, municipal, or industrial consumption, and is not primarily for the generation of electricity.

2. The facility generates electric power using only the hydroelectric potential of a non-federally owned conduit.

3. The facility has an installed capacity that does not exceed 40 megawatts (MW).

4. The facility was not licensed or exempted from the licensing requirements of Part I of the FPA on or before August 9, 2013.

The FERC provides guidance on the material to submit with required notice. Once prepared, the notification would be filed electronically at FERC Online.

7.2.5.2 Oregon Water Resources Department Certificate to Use Water for Hydroelectric Purposes within its Municipal Water Distribution Line

To install a hydroelectric project in or on a conduit delivery system, the City would need to apply to the Oregon Water Resources Department under Oregon Revised Statutes (ORS) 543.765 for a certificate to use water for hydroelectric purposes within its municipal water distribution line. A hydropower generation right can be added to existing water rights for in-conduit hydropower through a defined process managed by the Oregon Water Resources Department. ORS 543.765 provides an expedited process for obtaining a certificate to use water for hydroelectric purposes within an artificial water delivery system, such as a pipeline or canal. Under ORS 543.765(5), a certificate issued under this section must be analyzed by ODFW to determine if fish passage measures are required, or if a payment in lieu of fish passage is necessary depending on the specific project and its potential impact on fish populations. No impacts to fish are anticipated for this project. The use of water is limited to the quantity of water diverted to satisfy the authorized specific use under the existing water right. Under City Code and its Forest Service Special Use Permit, “The instantaneous rate allowed from the Bridge Creek point of diversion shall be limited to the demand for municipal use, up to a maximum of 18.2 cubic feet per second (cfs).” (see Bend Code Section 14.10.090; Special Use Permit BEN1158) (Deschutes National Forest 2026).

7.2.6 Oregon Health Authority Drinking Water Services

The OHA Drinking Water Services program regulates public water systems under ORS Chapter 448 and Oregon Administrative Rule (OAR) Chapter 333, Division 61, consistent with the federal Safe Drinking Water Act. The City would be required to obtain OHA approval of engineering plans and specifications prior to construction of the Outback Facility and receive authorization prior to operation. The facility would also be

subject to ongoing monitoring, reporting, and operational requirements to ensure compliance with applicable drinking water standards and protection of public health.

Specifically:

- Under OAR 333-061, public water systems must submit engineering plans and specifications for new or modified facilities, in addition to a Land Use Compatibility Statement, as a Plan Review. If water storage is constructed, a geotechnical report will be required.
- The OHA must review and approve these plans to ensure compliance with design and treatment standards.
- Construction of drinking water system components cannot proceed until OHA issues a letter of conditional approval.
- Following construction, the system must demonstrate that facilities were built according to approved plans.
- The OHA then provides approval through a Project Final Approval Request Form to place the facility into operation, sometimes contingent on startup testing and performance verification.
- A conditional use permit would be required from the county for every new facility or phase since the planned infrastructure projects may be allowed as conditional uses in the Forest Use 1 (F1) zone. The County will also require site plan review and LM review under the County Zoning Ordinance (See Deschutes County Code (DCC) 18.124 and 18.84). The LM review would be required because views from Skyliners Road are protected as a scenic resource (See LM Zone under DC 18.84). A decision for a conditional use permit with related land use reviews is final unless it is appealed. Project sequencing should account for potential delays associated with appeals. If a potential Public Facility Zone were approved, proposed uses would go through site plan review and LM review because they would be allowed as uses permitted outright in the Public Facility Zone.

7.2.7 Oregon Department of Forestry Permit or Notification

After the land for the WFF is conveyed to the City, it will be considered private land for the purposes of the Oregon Forest Practices Act. Under ORS 477.625, a permit is required when using fire in any form or power-driven machinery within one-eighth of one mile of a forest protection district.

7.2.8 Permit Sequencing

When considering how permitting might affect project sequencing, the City should consider the following:

- A special use permit will likely be needed before realignment of Forest Service Road 4606.
- The need for permits related to wildlife impacts should be evaluated on a case-by-case basis. Although any construction activity at the Outback site (conveyed land or existing WFF) could trigger the need for these permits, impacts to migratory birds can likely be avoided and permits would only be required if eagles occupy the project site.
- Authorizations for in-conduit hydropower should be in place prior to construction of infrastructure needed for this purpose.

- For OHA approvals, construction of drinking water system components cannot proceed until OHA issues a letter of conditional approval.

- A conditional use permit would be required from the county for every new facility or phase since the planned infrastructure projects may be allowed as conditional uses in the Forest use 1 (F1) zone. The County will also require site plan review and Landscape Management review under the County Zoning Ordinance (see DCC 18.124 and 18.84). The Landscape Management review would be required because views from Skyliners Road are protected as a scenic resource (see Landscape Management Zone under DC 18.84). A decision for a conditional use permit with related land use reviews is final unless it is appealed. Project sequencing should account for potential delays associated with appeals. If a potential Public Facility Zone (PFZ) were approved, proposed uses would go through site plan review and Landscape Management review because they would be allowed as uses permitted outright in the PFZ.

- Permits (e.g., building permit) generally follow approval of a conditional use permit. Issuance of the permits are typically contingent upon final approval of a conditional use permit. Early planning should prioritize a conditional use permit approval.

- To avoid delays, a pre-application meeting with the County Community Development planner is recommended as they can confirm applicable approval criteria and other important information for permit approval.

7.3 Potential Constraints from the Outback Environmental Assessment

The City of Bend Outback Site Conveyance EA (DNF 2026) identifies certain measures and constraints that will need to be implemented for project activities only on Forest Service lands. The EA is not expected to impose constraints on activities on lands conveyed to the City.

7.3.1 Realignment of Forest Service Road 4606

To minimize potential resource impacts from the road realignment, project design criteria (PDC) have been incorporated into this action. No PDC are assigned to the Proposed Expansion Area because that land would be transferred to City ownership and would instead be subject to applicable state, local, and federal laws rather than Forest Service-specific requirements. The road-realignment PDC are intended to reduce environmental effects and ensure compliance with applicable laws and regulations and include best management practices and Forest Plan standards and guidelines.

A PDC workshop was held with Anderson Perry, Forest Service resource specialists, and the City to confirm that the PDC for the road realignment are feasible and implementable.

The PDC apply only to the proposed Forest Service Road 4606 Realignment Area, as identified in the EA, which would remain National Forest System land managed by the Deschutes National Forest. As such, all applicable Forest requirements would continue to apply. Forest Service permits would be obtained as needed for any work on National Forest System lands.

The PDC for road realignment are identified in the EA. The PDC address: (1) Wildlife; (2) botany and invasive plants; (3) heritage; (4) soil; (5) transportation; (6) recreation, access; and public use; and (7) scenery.

7.3.2 Cultural Resources

The EA concluded that cultural resources are not known to occur in the land proposed for conveyance to the City. If unanticipated discoveries occur during road realignment on Forest Service lands, they would be addressed under an Inadvertent Discovery Plan in accordance with applicable federal requirements. For the City's reasonably foreseeable development within the conveyed area, any unexpected discoveries would be subject to ORS 358.905 to 358.961. Under these statutes, if an inadvertent discovery of cultural resources (excluding human remains) occurs, work in the immediate vicinity would cease and appropriate notifications would be made. In the event that human remains are discovered, all work must stop immediately, and law enforcement and the Oregon State Historic Preservation Office must be notified.

Under ORS 358.905–358.961, a permit is required to excavate, remove, or otherwise conduct subsurface sampling of archaeological resources on public lands. To reduce risk, the City should consider applying for this type of permit and preparing an Inadvertent Discovery Plan prior to construction at the Outback site. This can help minimize construction delays in the event of an inadvertent discovery by establishing approved procedures for the evaluation and treatment of cultural resources in advance.

The EA states that a total of five new archaeological sites and one isolate were recorded within the project's Area of Potential Effects[1] and five previously recorded sites were updated. Of the 11 identified cultural resources, 10 are ineligible for listing in the National Register of Historic Places. The remaining site (Forest Service Resource No. 0601010339) has not been formally evaluated but would not be affected, as it is located outside the area of disturbance for the Forest Service Road 4606 realignment and associated staging and would not be transferred out of federal ownership (i.e., it is not located on land that would be transferred to the City).

7.4 Land Use

The Outback Site is located within Deschutes County's jurisdiction and any expansion or improvements of the existing Outback Site are subject to the County's land use review process. The property proposed for conveyance to the City is zoned Forest Use 1 (F1) and owned by the US Forest Service. **Figure 7-1** depicts current Deschutes County Zoning in the Project area.

7.4.1 Current Base Zoning

The Project Area includes both an F1 zone and Rural Residential (RR-10) zone. The Project includes elements such as construction of water pretreatment facilities, additional reservoirs, wells, fencing, and related infrastructure, as well as the development of an in-conduit hydroelectric generation facilities that would use existing water already being diverted to the WFF. Project elements within the existing facility are located in the RR-10 zone, expansion area elements are included in the F1 zone. The following provides information for F1 zone and RR-10 zone including permitted outright and conditional uses, setback requirements, and applicable development standards.

[1] The geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking (36 CFR 800.16)

7.4.1.1 Forest Use 1

The following uses applicable to the projects proposed for this property are permitted outright in the F1 zone, subject to applicable siting criteria set forth in DCC 18.36 and any other applicable provisions of DCC Title 18 County Zoning (DCC 18.36.020):

- Local distribution lines and accessory equipment, or equipment that provides service hookups, including water service hookups (DCC 18.36.020(F)).

The following applicable uses and their accessory uses may be allowed in the Forest Use Zone as conditional uses:

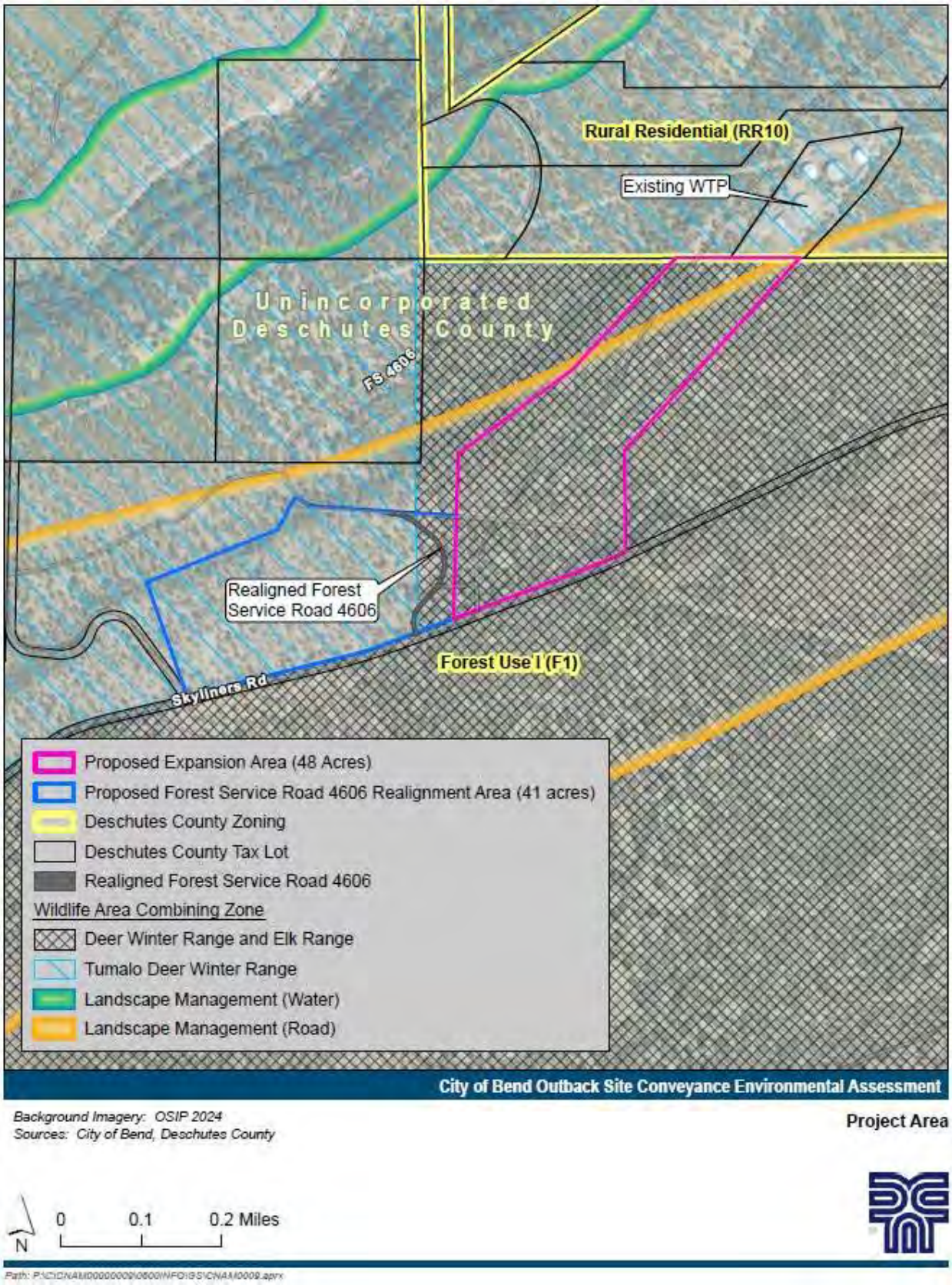
- Commercial utility facilities for the purpose of generating power. A power generation facility shall not preclude more than 10 acres from use as a commercial forest operation unless an exception is taken pursuant to OAR 660, Division 4 [DCC 18.36.030(K)].
- Water intake facilities, related treatment facilities, pumping stations and distribution lines [DCC 18.36.030(M)].
- Reservoirs and water impoundments [DCC 18.36.030(N)].
- Transportation improvements on rural lands allowed by and subject to the requirements of OAR 660-012-0065 [DCC 18.36.030 (AE)].

The conditional use permit process may be reviewed administratively by the planning staff or referred to the Hearings Body for a public hearing. The conditional use permit involves obtaining a land use approval that meets specific criteria related to site suitability, transportation access, and compatibility with surrounding land uses and natural environment.

The Project involves elements that correspond to several uses identified as conditional uses in DCC Chapter 18.36, including those listed above. There are limitations on conditional uses and the limitations are designed to make the use compatible with forest operations and agriculture and to conserve values found on forest lands:

- The proposed use will not force a significant change in, or significantly increase the cost of, accepted farming or forest practices on agricultural or forest lands.
- The proposed use will not significantly increase fire hazard or significantly increase fire suppression costs or significantly increase risks to fire suppression personnel.
- Prior to final approval of the uses listed in DCC 18.36.030(K), (M), (N), and (AE) the landowner shall sign and record in the County Clerk's office a written statement of consent for the proposed land use change.
- Recognizing the rights of adjacent and nearby landowners to conduct forest operations consistent with the Forest Practices Act and Rules.

Figure 7-1 | Deschutes County Zoning in the Project Area



The DCC 18.36.040 identifies several limitations on conditional uses with the purpose of making the use compatible with forest operations and conserving values found on forest lands. If the Project involves the construction of reservoir(s), the applicant shall obtain and record in the County Clerk's office a written statement with landowner's signature recognizing the rights of adjacent and nearby landowners to conduct forest operations consistent with the Forest Practices Act and Rules [DCC 18.36.040(C)].

In an F-1 zone, dimensional standards include:

- The minimum lot area is 80 acres; or
- Land divisions creating lots or parcels with a lot area of less than 80 acres may only be approved for uses listed in DCC 18.36.030(D) through (O), provided that those uses have been approved pursuant to DCC 18.36.040. Such division shall create a lot or parcel that is the minimum lot area necessary for the use.
- No structure shall be erected or enlarged to exceed 30 feet in height, except as approved under DCC 18.120.040[2].

Applicant shall adhere to the County's setback standards for an F-1 zone:

- The front setback shall be 40 feet from a lot line with street frontage on a local street right of way, 60 feet from a lot line with street frontage on a collector right of way, and 100 feet from a lot line with street frontage on an arterial right of way. Oregon's Transportation Map[2] showing functional classification of roads in the City identifies Skyliners Road as a major collector. Therefore, the front setback is 60 feet.
- Each side setback shall be a minimum of 25 feet, except a parcel or lot with a side lot line abutting land zoned forest use shall have a minimum side setback of 100 feet.
- Rear setbacks shall be a minimum of 25 feet, except parcels or lots with rear lot lines abutting land zoned forest use shall have a minimum rear setback of 100 feet.
- The setback from any north lot line shall meet the solar setback requirements in DCC 18.116.180.
- In addition to the setbacks, any greater setbacks required by applicable building or structural codes adopted by the State of Oregon and/or the County under DCC 15.04 shall be met.

7.4.1.2 Rural Residential Zone; RR-10

The DCC 18.60.020 lists uses permitted outright in the RR-10 zone; of those uses, only "utility facilities necessary to serve the area including energy facilities, water supply and treatment and sewage disposal and treatment" is the only use applicable to this project [DCC 18.60.020(B)].

Similarly, DCC 18.60.030 lists uses which may be permitted conditionally in the RR-10 zone and the hydroelectric facility is the only conditional use in the RR-10 zone that applies to this project [DCC 18.60.030(I)]. There are limitations on conditional uses set by DCC 18.60.070. The County may require establishment and maintenance of fire breaks, the use of fire resistance materials in construction and landscaping, or similar conditions or limitations to reduce fire hazards or prevent the spread of fire to

[2] See also the height limitation of the Landscape Management Zone under either DCC 18.84.080(E) or 18.84.081(E).
[3] Oregon Transportation Map, Showing Functional Classification of Roads City of Bend Deschutes County 2023 edition, https://www.oregon.gov/odot/Data/Documents/City_Bend.pdf

surrounding areas. Also, the County may limit changes in the existing and natural grade of land, or the alteration, removal, or destruction of natural vegetation to prevent or minimize erosion or pollution [DCC 18.60.070(A)&(B)].

The DCC 18.60.040 addresses various setback requirements.

- Front setback requirements [DCC 18.60.040(A)]:
  - Minimum 20 feet from a lot line with street frontage on a local street right of way
  - 30 feet from a lot line with street frontage on a collector right of way
  - 50 feet from a lot line with street frontage on an arterial right of way
  - If a lot or parcel contains multiple front lot lines and has street frontage along at least one collector or arterial right of way, front setbacks may be reduced to 20 feet with written authorization from the relevant road authority (discretionary alternative).
- Side setback: Minimum of 10 feet [DCC 18.60.040(B)].
- Rear setback: Minimum of 20 feet [DCC 18.60.040(C)].

All structures must meet any greater setbacks required under applicable state or County structural codes.

The DCC 18.60.060 establishes dimensional standards in the RR-10 zone. Lot coverage may not exceed 30 percent of the lot area and no structure may exceed 30 feet in height unless an exception applies under DCC 18.120 040. The minimum lot area in the RR-10 zone is 10 acres and for lots separated by new arterial rights of way, an exemption may be granted per County's nonconforming lot areas rules in DCC 18.120.020.

7.4.2 Additional Zoning

The project area contains the following additional zoning designations: WA Combining Zone and LM Combining Zone. The additional zoning overlays do not replace the underlying zoning regulations. The regulations of the overlays apply in addition to those of the base zone. If there is a conflict between the base zone regulations and the additional overlay zone regulations, the stricter regulations apply (See DCC 18.144.010).

7.4.2.1 Wildlife Area Combining Zone

The WA Zone is intended to preserve key wildlife habitats in the County, safeguard an important environmental, social, and economic resource, and allow only those types of development that are compatible with protecting wildlife. In any zone combined with the WA Zone, the uses allowed outright are those already permitted outright in the underlying zone. The conditional uses in a zone combined with the WA Zone are the same conditional uses allowed in the underlying zone, and they must follow the Comprehensive Plan, DCC 18.128 Conditional Use, and any other relevant regulations. To reduce impacts on wildlife habitat, the County may place conditions on approvals that restrict the timing, frequency, season, and total number of outdoor events in the WA Zone, regardless of whether those events are public or private, or secular or religious.

In the project area, there are two WAs: elk range, and Tumalo deer winter range. In the Tumalo deer winter range the minimum lot size for new lots or parcels shall be 40 acres. In areas designated as elk range, the

minimum lot size for new lots or parcels shall be 160 acres. The required setbacks are the same as those established for the underlying zone that the WA Zone.

Also, there are fencing requirements that must be met for any new fence built as part of a property's development under a conditional use permit and/or site plan review. All new fences within the WA Zone must be constructed to allow wildlife to move through them. The following standards apply unless the County, after consulting the ODFW, approves an alternative design that provides equivalent wildlife access.

- The bottom wire or board must be at least 15 inches above the ground.
- The fence may not be taller than 48 inches.
- Smooth-wire or wooden fences that facilitate wildlife movement are preferred, while woven-wire fencing is discouraged[4].

7.4.2.2 Landscape Management Combining Zone (LM Zone)

The LM Zone is intended to protect scenic and natural resources in designated areas and to preserve and improve views of natural landscapes as seen from specified roads, rivers, and streams. The requirements of DCC 18.84 apply to all land within one-quarter mile of roads identified as landscape management corridors in the Comprehensive Plan and County Zoning Map, as well as to all areas specifically designated as landscape management corridors in those documents. This distance is measured horizontally from the centerline of identified roads or from the closest ordinary high-water mark of designated rivers or streams. Any conditional use allowed in the underlying zone remains a conditional use when combined with an LM Zone. In a LM Zone, the minimum lot area shall be as established in the underlying zone with which the LM Zone is combined.

Any new structure, or any significant exterior modification requiring a building permit, must receive site plan approval under DCC 18.84 before construction. A "substantial exterior alteration" is defined as one that increases the floor area or assessed value of the structure by more than 25 percent. Structures or parcels that cannot be seen from the designated roadway, river, or stream- and are guaranteed to remain screened by vegetation, terrain, or existing development- are exempt from DCC 18.84.080 (Design Review Standards) and DCC 18.84.090 (Setbacks). Applicants may either comply with DCC 18.84 or provide evidence that the proposed development will not be visible from the designated viewpoint[5].

Structures that are not visible must follow the setback rules of the underlying zone. All structures within a LM Zone must meet the requirements of DCC 18.84.080 and DCC 18.84.090 regarding design review and setbacks.

The proposed site plan will be evaluated using the following general/discretionary design review standards. Conditions may be imposed with the land use decision to ensure these standards are met.

- Existing trees and shrubs that screen the development from a designated road, river, or stream must be preserved, except where removal is necessary for access roads, building pads, septic systems, utility easements, parking, and similar needs. This does not prohibit lawn maintenance, removal of dead or hazardous vegetation, lawful commercial forest harvest under the Oregon Forest Practices Act, or agricultural use.
- New buildings and additions should ideally be finished in subdued earth-tone colors that blend with nearby vegetation and the natural landscape.

- Large surfaces, including roofs, may not use white, bright, or reflective materials. Roofing, including metal, must be non-reflective and colored to blend with the surroundings. This rule does not apply to attached additions to buildings that were legally existing on April 8, 1992, unless major roof improvements are made.

- Unless rimrock setback standards or exceptions in DCC 18.84.090(E) apply, structures must be placed to make use of existing vegetation, trees, and landforms to reduce visual impacts from designated roads, rivers, or streams. If multiple non-agricultural structures are proposed and no natural features exist to screen them, they must be clustered to lessen their visual impact.

- Building height may not exceed 30 feet, measured from average natural grade—the average ground elevation before development along the wall closest to the designated viewpoint. For structures along a state scenic waterway or federal wild and scenic river, height includes chimneys, antennas, flagpoles, and similar roof projections.

- Where feasible, new commercial driveway access points to designated landscape management roads must be consolidated.

- All new exterior lighting, including security lighting, must be directed downward and shielded so it cannot be seen directly from a designated road, river, or stream.

- The Planning Director or Hearings Body may require introduced landscaping to screen new structures or major exterior changes, ensure compatibility with existing vegetation, limit glare, manage circulation, or improve the development's appearance, provided it does not block traffic visibility or scenic views. Native plants are encouraged.

- Signs or outdoor advertising visible from designated roads, rivers, or streams are prohibited. Property protection signs such as "No Trespassing" or "No Hunting" are permitted.

- A conservation easement, as defined in DCC 18.04.030 and required under DCC 18.116.220, must be established for all landscape management site plans involving properties adjacent to the Deschutes River, Crooked River, Fall River, Little Deschutes River, Spring River, Whychus Creek, or Tumalo Creek. These easements do not require public access.

In the LM Zone, the required minimum setbacks are the same as the setbacks in the underlying zoning that the LM Zone is added onto. The LM Zone uses the setback rules that already apply in the F1 Zone. All new structures or additions to existing structures on lots or parcels with street frontage on a designated landscape management road shall have a minimum setback of 100 feet from the edge of the designated road right of way unless the Planning Director or Hearings Body finds that [DCC 18.84.090(B)]:

1. A location closer to a designated road would more effectively screen the structure from the road; or protect a distant vista.

2. The lot dimensions make a 100-foot setback not feasible.

3. Buildings on both lots or parcels abutting the subject lot or parcel have front setbacks of less than 100 feet and the abutting buildings are within 100 feet of the lot lines of the subject property, and the depth of the front setback area is not less than the average depth of the front setback areas of the abutting lots or parcels.

4. If the above findings are made, the Planning Director or Hearings Body may approve a less restrictive front setback which will be appropriate to carry out the purpose of the zone.

All new structures or additions to existing structures must be setback at least 100 feet from the ordinary high water line of designated streams and rivers or obtain a setback exception in accordance with DCC 18.120.030. For the purpose of DCC 18.84.090(C), decks are considered part of a structure and must conform with the setback requirement. New structures (including decks or additions to existing structures) shall have a minimum setback of 50 feet from the rimrock in a LM Zone. An exception to this setback may be granted pursuant to the provisions of DCC 18.84.090(E) below if at least one of the following is met.

- A lesser setback will make the structure less visible or completely screened from the river or stream.
- The subject lot or parcel was a lot of record prior to the adoption of the DCC.
- Adherence to the 50-foot setback would prevent the structure from being sited on the lot or parcel.

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Table 7-2 | Zoning Requirements

Zoning Type	Uses Permitted Outright	Conditional Uses	Dimensional Standards	Setback Standards	Other Requirements or Standards
Forest Use 1 (F1)	Local distribution lines and accessory equipment, or equipment that provides service hookups, including water service hookups.	Commercial utility facilities for the purpose of generating power. A power generation facility shall not preclude more than 10 acres from use as a commercial forest operation unless an exception is taken pursuant to Oregon Administrative Rules 660, Division 4 [DCC 18.36.030(K)] Water intake facilities, related treatment facilities, pumping stations and distribution lines [DCC 18.36.030(M)] Reservoirs and water impoundments [DCC 18.36.030(N)]	The minimum lot area is 80 acres; or Land divisions creating lots or parcels with a lot area of less than 80 acres may only be approved for uses listed in DCC 18.36.030(D) through (O), provided that those uses have been approved pursuant to DCC 18.36.040. Such division shall create a lot or parcel that is the minimum lot area necessary for the use. No structure shall be erected or enlarged to exceed 30 feet in height, except as approved under DCC 18.120.040.	The front setback shall be 40 feet from a lot line with street frontage on a local street right of way, 60 feet from a lot line with street frontage on a collector right of way, and 100 feet from a lot line with street frontage on an arterial right of way. Each side setback shall be a minimum of 25 feet, except a parcel or lot with a side lot line abutting land zoned forest use shall have a minimum side setback of 100 feet. Rear setbacks shall be a minimum of 25 feet, except parcels or lots with rear lot lines abutting land zoned forest use shall have a minimum rear setback of 100 feet. The setback from any north lot line shall meet the solar setback requirements in DCC 18.116.180. In addition to the setbacks, any greater setbacks required by applicable building or structural codes adopted by the State of Oregon and/or the County under DCC 15.04 shall be met.	If the Project involves the construction of reservoir(s), Applicant shall obtain and record in the County Clerk's office a written statement with land owner's sign recognizing the rights of adjacent and nearby landowners to conduct forest operations consistent with the Forest Practices Act and Rules. **Limitations on Conditional uses in F1 zone:** The proposed use will not force a significant change in, or significantly increase the cost of, accepted farming or forest practices on agricultural or forest lands The proposed use will not significantly increase fire hazard or significantly increase fire suppression costs or significantly increase risks to fire suppression personnel Prior to final approval of the uses listed in DCC 18.36.030(G), (N), (R), (U), (X), and (Y) the land owner shall sign and record in the County Clerk's office a written statement recognizing the rights of adjacent and nearby land owners to conduct forest operations consistent with the Forest Practices Act and Rules.
Rural Residential Zone (RR-10)	Utility facilities necessary to serve the area including energy facilities, water supply and treatment and sewage disposal and treatment	Hydroelectric facility [DCC 18.60.030(I)]	Lot Coverage: Not to exceed 30% of the lot area Height: May not exceed 30 feet unless exception applies under DCC 18.120.040 Minimum lot size: 10 acres For lots separated by new arterial rights of way, an exemption may be granted per County's nonconforming lot areas rules in DCC 18.120.020	**Front setback requirements [DCC 18.60.040(A)]:** Minimum 20 feet from a lot line with street frontage on a local street right of way 30 feet from a lot line with street frontage on a collector right of way 50 feet from a lot line with street frontage on an arterial right of way If a lot or parcel contains multiple front lot lines and has street frontage along at least one collector or arterial right of way, front setbacks may be reduced to 20 feet with written authorization from the relevant road authority **Side setback: Minimum of 10 feet [DCC 18.60.040(B)]** **Rear setback: Minimum of 20 feet [DCC 18.60.040(C)]**	All structures must meet any greater setbacks required under applicable state or County structural codes. **Limitations on Conditional Uses:** County may require establishment and maintenance of fire breaks, the use of fire resistance materials in construction and landscaping, or similar conditions or limitations to reduce fire hazards or prevent the spread of fire to surrounding areas; County may limit changes in the existing and natural grade of land, or the alteration, removal, or destruction of natural vegetation to prevent or minimize erosion or pollution [DCC 18.60.070(A)&(B)].
Wildlife Area Combining Zone (WA Zone)	Uses permitted outright in the underlying zone	The conditional uses in a zone combined with the WA Zone are the same conditional uses allowed in the underlying zone, and they must follow the Comprehensive Plan, DCC 18.128 Conditional Use, and any other relevant regulations.	In the Project Area, there are three wildlife areas: elk range, deer winter range, and Tumalo deer winter range. In the Tumalo deer winter range, the minimum lot size for new lots or parcels shall be 40 acres. In areas designated as significant elk habitat, the minimum lot size for new lots or parcels shall be 160 acres.	The required setbacks are the same as those established for the underlying zone	The following standards apply unless the County- after consulting the Oregon Department of Fish and Wildlife- approves an alternative design that provides equivalent wildlife access: The bottom wire or board must be at least 15 inches above the ground The fence may not be taller than 48 inches Smooth-wire or wooden fences that facilitate wildlife movement are preferred, while woven-wire fencing is discouraged.

Zoning Type	Uses Permitted Outright	Conditional Uses	Dimensional Standards	Setback Standards	Other Requirements or Standards
LM Combining Zone (LM Zone)	Uses permitted in the underlying zone with which an LM Zone is combined shall be permitted in a LM Zone	Any conditional use allowed in the underlying zone	The minimum lot area shall be as established in the underlying zone (See dimensional standards for F1 zone above)	In the LM Zone, the required minimum setbacks are the same as the setbacks in the underlying zoning that the LM Zone is added onto. All new structures or additions to existing structures on lots or parcels with street frontage on a designated landscape management road shall have a minimum setback of 100 feet from the edge of the designated road right-of-way unless the Planning Director or Hearings Body finds that [DCC 18.84.090(B)]: A location closer to a designated road would more effectively screen the structure from the road; or protect a distant vista; or The lot dimensions make a 100-foot setback not feasible; or Buildings on both lots or parcels abutting the subject lot or parcel have front setbacks of less than 100 feet and the abutting buildings are within 100 feet of the lot lines of the subject property, and the depth of the front setback area is not less than the average depth of the front setback areas of the abutting lots or parcels If the above findings are made, the Planning Director or Hearings Body may approve a less restrictive front setback which will be appropriate to carry out the purpose of the zone	Design Review Standards: All existing trees and shrubs located between the development site and the designated road, river, or stream must be preserved. All roofing, including metal roofs, must be non-reflective and have a light reflectance value (LRV) of 40 or lower Subject to rimrock setback rules or exceptions under DCC 18.84.090(E), if natural topographic features such as outcrops, knolls, hills, or ridges exist that can screen any portion of a proposed structure from a designated viewpoint, the structure must be placed so that those features lie between it and the designated road, river, or stream Structures may not exceed 30 feet in height, measured from the lowest adjacent natural grade All new exterior lighting, including security lighting, must be shielded and directed downward Signs or outdoor advertising visible from the designated road, river, or stream are prohibited, except for property protection signs such as “No Trespassing” or “No Hunting.” A conservation easement must be established as a condition of approval for all landscape management site plans on properties bordering the Deschutes River, Crooked River, Fall River, Little Deschutes River, Spring River, Whychus Creek, or Tumalo Creek.

CHAPTER 8

Opinions of Probable Construction Cost

8.1 Introduction

This chapter presents the planning-level OPCCs for the major improvements identified in this Facility Plan, including pretreatment, in-conduit hydropower, reservoir storage, groundwater expansion, PFAS accommodation, site-wide utilities, and supporting infrastructure upgrades. While Chapter 3 through Chapter 6 focus on technical concepts, siting, and planning-level alternatives, cost information in those chapters is limited to high-level context where applicable and does not represent a complete or consolidated estimate. Chapter 8 serves as the primary location for compiled OPCCs, providing the City with a single, coordinated source to support planning, budgeting, and future capital improvement program sequencing. Detailed cost breakdowns and supporting spreadsheets are included in Appendix G and referenced throughout this chapter.

The cost estimates in this chapter are planning level and reflect the current level of planning and conceptual design and are intended to support long-range capital planning, grant strategy development, and implementation phasing.

8.2 Basis of Cost Estimate and Key Assumptions

8.2.1 Estimate Classification

All OPCCs presented in this chapter were developed in accordance with AACE International Class 5 estimating guidelines, which apply to early-stage, conceptual planning efforts. Class 5 estimates typically correspond to 0-2% design completion and are used for feasibility evaluations, alternatives screening, and order-of-magnitude budgeting. Accuracy expectations for this estimate class generally range from -50 to +100 percent, recognizing the limited definition available at this stage.

Consistent with AACE Class 5 methodology, cost development relies heavily on stochastic and parametric techniques, including cost-per-unit factors, capacity-based scaling, and historical benchmarks, where detailed design information is not yet available. Where conceptual drawings or defined system elements exist, the estimate incorporates more detailed bottom-up quantities using labor, material, equipment, and subcontract pricing.

Because Class 5 estimates are intended for project planning, not for final budgeting or procurement, results should be interpreted as concept-level approximations subject to refinement as design advances and more detailed information becomes available.

8.2.2 Basis of Cost Estimate - Documents and Data Sources

Costs in this chapter were developed using a combination of planning-level design information, industry cost data, vendor quotations, and City-specific historical experience. Data sources and inputs include:

- Conceptual drawings and scope narratives.
- Engineering cost references such as RSMeans Heavy Construction Cost Data (2026), including national labor and material baseline pricing.
- Vendor budgetary pricing for major mechanical and electrical systems, including turbine generator equipment, control systems, freight, and startup/commissioning allowances.
- Recent bid tabs and construction cost information from comparable Pacific Northwest water and site civil projects.
- The City provided unit costs and historical project data, consistent with methodologies used in previous OPCC efforts for well rehabilitation and treatment improvements.
- Engineering News-Record (ENR) Construction Cost Index escalated to March 2026, consistent with the ENR 20-City Index escalation.
- Local labor and material adjustments, reflecting Central Oregon construction market conditions.
- Professional engineering judgment informed by planning-level design maturity, siting concepts, and feasibility-level assumptions.

8.2.3 General Assumptions

- Costs are presented in March 2026 dollars, using ENR-based escalation from previous-year values where applicable.
- Property acquisition costs for the Forest Service parcel are excluded (City-led process).
- Environmental permitting, NEPA compliance, cultural resource review, and mitigation are not included unless noted elsewhere.
- Construction assumes typical Central Oregon seasons, with limited winter work and no extraordinary productivity penalties.
- Quantities for pretreatment and in-conduit hydropower elements are based on conceptual layouts appropriate for AACE Class 5 design maturity.
- Reservoir and contact time concepts rely on planning-level geometry and unit cost factors consistent with other Outback Facility Plan elements.
- No escalation beyond 2026 is included; later project phases will apply financial modeling-level escalation separately.
- No market adjustment premium is applied.

8.3 Cost Components and Markups

The markup categories identified in **Table 8-1** are consistent with the City's previous planning documents and AACE Class 4 and 5 expectations.

Table 8-1 | Cost Components and Markups

Cost Element	Description
Construction Cost	Direct labor, materials, equipment, subcontractors, and contractor overhead & profit.
Mobilization/ Demobilization	10% of construction cost. Mobilization markup covers the contractor's administrative and direct expenses to mobilize equipment, materials, and labor to the worksite.
Construction Contingency	30%
Engineering, Legal, and Administrative	Planning-level allowance of 25% of construction cost. Includes design costs associated with the recommendation as well as construction management which is associated with managing the construction phase of the project. Increase for administration and legal costs associated with the City's financial and legal oversight of the contract.
Owner's Contingency	30% for planning uncertainties, permitting risk, and evolving project definition.

8.4 Summary of Improvements and OPCC by Project Element

An OPCC has been developed for each project element described in detail in **Chapter 3** through **Chapter 6**. Due to differences in the level of project development, varying uncertainty ranges have been applied. OPCCs for the pretreatment facilities and in-conduit hydropower components are based on more advanced planning and definition and therefore carry an estimated accuracy range of -30 to +40 percent. OPCCs for all other project improvements are based on less progressed information and higher conceptual uncertainty and, accordingly, are assigned a broader accuracy range of -50 to +100 percent.

The OPCCs include the same major cost categories: construction, mobilization, contingency, engineering/ administrative allowances, and owner's contingency. The following sections summarize the OPCCs, full cost breakouts with additional notes on what is included in each item can be found in **Appendix G**.

8.4.1 Pre-treatment Facilities (Chapter 3) and Miscellaneous Site Improvements (Chapter 6)

The pretreatment facilities OPCC is summarized in two parts to distinguish the primary cost drivers:

- Site Civil Improvements: including the pre-sedimentation pond, earthwork, FS Road 46060 realignment, access roads, yard piping, and associated site features (including site security improvements), see **Table 8-2**, and
- The Pretreatment Building and Process Systems: covering rapid mix, flocculation, plate settlers, chemical systems, HVAC, electrical, and architectural elements, see **Table 8-3**.

Presenting the costs separately provides clearer visibility into the major components of the pretreatment scope while recognizing that site development, access, and security improvements are integral to implementation of the pretreatment facilities.

Table 8-2 | Pretreatment Facilities: Site Civil Improvements

Item No.	Item	Cost
1	Mobilization & Demobilization	$844,000
2	Temporary Erosion & Sediment Control Measures (TESC)	$380,000
3	Demolition & Surface Restoration	$140,000
4	Sitework, Earthwork, & Site Utilities	$1,740,000
5	Pre-Sedimentation Pond	$3,050,000
6	Large Diameter Site Piping, Valves & Fittings	$1,780,000
7	Solids Pump Station & Forcemain to Existing Sewer	$380,000
8	Landscaping – Planning Allowance	$150,000
9	FS Road 4606 Realignment	$170,000
10	Site Security	$650,000
	Construction Subtotal	**$9,284,000**
	Engineering, Legal, and Admin (25%)	$2,321,000
	Construction Contingency (30%)	$2,785,200
	PROJECT SUBTOTAL (Rounded)	**$14,391,000**
	AACE Class 5 Low Estimate Range (-30%):	*$10,073,700*
	AACE Class 5 High Estimate Range (+40%):	*$20,147,400*

Table 8-3 | Pretreatment Facilities: Pretreatment Building

Item No.	Item	Cost
1	Mobilization & Demobilization	$1,977,000
2	Sitework & Earthwork	$820,000
3	Structural Concrete (Basins, Slabs, Channels & Clean-In-Place Walls)	$4,700,000
4	Building Architectural & Structural Framing	$7,810,000
5	Building HVAC, Plumbing & Electrical	$1,440,000
6	Rapid Mixing System	$500,000
7	Flocculation System & Plate Settler System	$4,000,000
8	Chemical Systems and Storage	$500,000
	Construction Subtotal	**$21,747,000**
	Engineering, Legal, and Admin (25%)	$ 5,436,750
	Construction Contingency (30%)	$ 6,524,100
	PROJECT SUBTOTAL (Rounded)	**$ 33,708,000**
	AACE Class 5 Low Estimate Range (-30%):	*$ 23,595,600*
	AACE Class 5 High Estimate Range (+50%):	*$ 47,191,200*

8.4.1.1 Additional Additives

Several optional improvements were evaluated that may be added to the costs. These additive options are presented separately from base OPCCs as they are not required.

Additive options include:

- Solids Drying Beds: An additive cost item is included for construction of two concrete lined solids drying beds to support long-term pretreatment residuals handling. The work includes formation of the bed basins through excavation and embankment, installation of a gravel base and concrete liner, perimeter curbs, and a gravel access road around the beds. Piping from the solids process pump station is included, while the pump station itself is accounted for separately. The costs before additives is $1.06M, this cost is provided in the Pretreatment Site Civil cost breakout. Total project subtotal would be $1.64 M.

- OSHG System: Provide and install a complete OSHG system, including generation skid(s), brine tank, metering pumps, electrical connections, ventilation provisions, secondary containment, and SCADA integration. Includes concrete pad, piping tie-ins, and startup/commissioning support. Assumption is that system will be located inside new pretreatment building so cost does not include building cost. The costs before additives is $1.0 M, this cost is provided in the Pretreatment Building Breakout. Total project subtotal would be $1.55 M.

8.4.1.2 Narrative on Cost Estimate Differences from Original Siting Study – Pretreatment Components

The current project cost estimate is significantly higher than the values presented in the original Siting Study. Increases to the project costs were expected and largely attributable to additional scope and inflation. The Siting Study cost estimates were developed in 2020. The cost of construction has increased considerably since then. The scope of improvements in the Facility Plan has also evolved to include more refined designs, additional treatment process and other facility improvements.

The Siting Study assumed two plate settler channels for pre-treatment. The current design includes three plate settler channels to support a 2+1 operational configuration to improve reliability, redundancy, and overall plant performance. Adding an entire process channel introduces additional process, structural, mechanical, and electrical costs that were not included in the original concept.

The pretreatment building is now being developed as a fully functional operations facility rather than a simple process structure. Architectural features, building systems, HVAC, electrical distribution, lighting, and operational support spaces were not fully considered in the original planning-level cost estimate and contribute to the increase in projected cost.

The current design also reflects an expansion and refinement of site civil scope relative to the assumptions used in the Siting Study. More fully defined grading, access roads, and parking areas are now included around the hydro facility and pretreatment building, along with expanded site civil work around the pre-sedimentation pond. In addition, the pretreatment basins are planned to be constructed at or near ground level to improve hydraulics and allow for gravity flow through the pre-treatment facility, requiring the structures to be buried approximately 17 feet below grade. This design approach increases excavation, shoring, and backfill requirements and results in additional earthwork costs that were not fully identified or quantified in the Siting Study.

The design further incorporates increased site piping, valving, and appurtenances to support operational flexibility, including the ability to bypass individual pretreatment components. These enhancements materially increase both mechanical installation and associated civil costs compared to the high-level assumptions used in the Siting Study.

The project also includes a required solids pump station to convey flows to an existing sewer connection. The need for this pump station and off-site conveyance approach was not fully identified in the Siting Study and represent additional scope and cost now captured in the pretreatment OPCC. In contrast, drying beds associated with solids handling remain optional and are carried as a separate bid item, independent of the required pump station.

Separately, there are systems reflected in the current project that were not fully identified in the Siting Study and are now more clearly defined. An OSGH system has been included in the project but was not part of the Siting Study's chemical feed assumptions and represents a significant capital cost due to the specialized equipment, building space, electrical infrastructure, and supporting systems required. This system is optional and is therefore carried as a separate bid item.

Taken together, these scope clarifications, civil and earthwork expansions, system enhancements, and the transition from a planning-level estimate to a more detailed cost estimate fully explain the differences between the Siting Study estimate and the current projected cost for the Outback Pretreatment Facility.

8.4.2 In-Conduit Hydropower and Energy Dissipation Facility

The in-conduit hydropower and dissipation facility was discussed in **Chapter 4**, and the major components of this project element are summarized in **Table 8-4**. The table presents the baseline OPCC for Scenario 1, with adjustments for Scenarios 2 and 3 described later in this section. For clarity, the cost allocation assumes that the in-conduit hydropower and dissipation facility includes raw water transmission pipeline installation from the tie-in at the existing HPRW transmission line to the new in-conduit hydropower building. All site piping downstream of the in-conduit hydropower facility, including conveyance through pretreatment processes, is captured under the pretreatment facilities project element.

Table 8-4 | In-Conduit Hydropower and Energy Dissipation Facility

Item No.	Item	Cost
1	In-Conduit Hydropower & Energy Dissipation Facility	$ 1,800,000
2	Turbine-Generator Equipment Package	$2,470,000
3	Electrical & Controls System	$50,000
4	Bridge Crane	$120,000
5	Process Piping & Valves	$1,300,000
6	Yard Piping & Site Utilities	$200,000
7	Sitework & Earthwork	$110,000
	Construction Subtotal	**$6,050,000**
	Engineering, Legal, and Admin (25%)	$1,512,500
	Construction Contingency (30%) – included in project costs	-
	PROJECT SUBTOTAL (Rounded)	**$ 7,563,000**
	AACE Class 5 Low Estimate Range (-30%):	*$ 5,294,100*
	AACE Class 5 High Estimate Range (+40%):	*$ 10,588,200*

Note:

Costs for the in-conduit hydropower facility were developed independently by a subconsultant and do not follow the OPCC line item structure used elsewhere in this chapter. Contingency and mobilization/demobilization are included within the total estimated cost and are not shown separately.

8.4.2.1 Electrical Scenario Considerations

Three electrical interconnection scenarios were evaluated in the feasibility phase, each with different cost implications based on the transformer configuration, metering approach, and the degree of electrical infrastructure modification required.

- Scenario 1 - Base Case: 4.16 kV to 12.47 kV step-up transformer and metering options (1A/1B). This scenario requires the fewest changes to existing WFF electrical systems. Scenario 1 is used as the baseline OPCC in Table 8-4.

- Scenario 2 - Step-Down Interconnection: WFF Demand-Only: 4.16 kV to 480 V step-down transformer feeding the WFF switchboard. Adds work at the WFF switchboard (powerpack integration, automatic transfer switch reprogramming, 2000A feed connections). Reduces high-voltage equipment but increases low-voltage distribution scope. The OPCC includes the incremental cost difference relative to Scenario 1. Construction subtotal increases by $165,000 under this scenario. Total project subtotal would be $260 K.

- Scenario 3 – Full Meter Consolidation and Sitewide Reconfiguration: Physically consolidates all meters and reconfigures the electrical service. Adds substantial new switchgear, feeders, manholes/vaults, multi-building LV distribution, and utility meter enclosure work. Represents the highest-cost option due to sitewide electrical modifications. The OPCC includes the incremental cost difference relative to Scenario 1. Construction subtotal increases to $5.28M under this scenario.

8.4.2.2 Narrative on Cost Estimate Differences from In-Conduit Hydropower Feasibility Study

The current project cost estimate differs from the values presented in the In-Conduit Hydropower Feasibility Study primarily due to differences in scope definition and cost allocation between studies. The feasibility study estimate was developed in 2024 and included conceptual allowances for installation of the full pipeline segment associated with the in-conduit hydropower system. In the current Facility Plan, pipeline costs are not included within the in-conduit hydropower project estimate, as construction of the applicable pipeline segments is fully captured under the pretreatment facilities scope.

By assigning pipeline costs to the pretreatment project, where the pipeline is functionally required regardless of hydropower implementation, the hydropower project estimate reflects only hydropower-specific infrastructure, including generation equipment, appurtenances, and facility integration improvements. This approach avoids double counting of shared infrastructure and results in a clearer delineation of costs by functional project component.

8.4.3 Reservoir Siting

This section presents the planning-level OPCC for the reservoir siting and contact time improvement concepts described in Chapter 5. The reservoir concepts address aging infrastructure, regulatory contact time requirements, long-term storage needs, and integration with other major Outback Site improvements. The OPCCs reflect conceptual-level designs consistent with AACE Class 5 estimating standards and are intended to support comparative evaluation, selection of a preferred concept, and future capital planning.

Three reservoir concepts were evaluated:

- Concept 1 – Convert Outback Reservoir 3 to Surface Water + Construct New Groundwater Storage: This concept repurposes existing Reservoirs 2 and 3 as surface water reservoirs and includes piping and valving allowances to support either parallel or series operation, depending on the final operating configuration selected during design. A new ~5 MG groundwater tank is constructed in the expansion area. Contact time is achieved within existing reservoirs, with the CT Basin and Reservoir 1 ultimately decommissioned. See **Table 8-5**.

- Concept 2A – Dedicated Clearwells (Floating WSE Configuration): This concept introduces two new baffled reinforced concrete clearwells that float hydraulically with the system. Each clearwell is sized to independently provide contact time (≈150,000 gallons effective volume). Reservoirs 2 and 3 remain in their current surface water and groundwater roles. See **Table 8-6**.

- Concept 2B – Dedicated Clearwells (Level-Controlled Configuration): Similar to Concept 2A, but incorporates an outlet control valve to maintain a near constant clearwell operating level. This reduces clearwell footprint while maintaining required contact timeT. See **Table 8-7**.

Table 8-5 | Reservoir Concepts: Concept 1

Item No.	Item	Cost
1	Mobilization & Demobilization	$1,186,000
2	Modified Mixing System at Outback Reservoir 2	$ 60,000
3	New Groundwater Reservoir	$7,100,000
4	Groundwater System Piping (for new tank)	$3,100,000
5	Outback Reservoir 3 Conversion to Surface Water	$850,000
6	Decommissioning CT Basin and	$250,000
7	Decommissioning Outback Reservoir 1	$300,000
8	Appurtenances & Sitework	$200,000
	Construction Subtotal	**$ 13,046 ,000**
	Engineering, Legal, and Admin (25%)	$ 3,261,500
	Construction Contingency (30%)	$ 3,913,800
	PROJECT SUBTOTAL (Rounded)	**$ 20,222,000**
	AACE Class 5 Low Estimate Range (-50%):	*$ 10,111,000*
	AACE Class 5 High Estimate Range (+100%):	*$ 40,444,000*

Table 8-6 | Reservoir Concepts: Concept 2A (Clearwell – Floating WSE)

Item No.	Item	Cost
1	Mobilization & Demobilization	$420,000
2	Decommissioning CT Basin	$ 250,000
3	New Reinforced Concrete CT Clearwell Basins	$2,300,000
4	Clearwell Site Piping and Fittings	$1,250,000
5	Decommissioning Reservoir 1	$300,000
6	Appurtenances & Sitework	$100,000
	Construction Subtotal	**$4,620,000**
	Engineering, Legal, and Admin (25%)	$ 1,115,000
	Construction Contingency (30%)	$ 1,386,000
	PROJECT SUBTOTAL (Rounded)	**$ 7,161,000**
	AACE Class 5 Low Estimate Range (-50%):	*$ 3,580,500*
	AACE Class 5 High Estimate Range (+100%):	*$ 14,322,000*

Table 8-7 | Reservoir Concepts: Concept 2B (Clearwell – Level-Controlled) - Preferred Concept

Item No.	Item	Cost
1	Mobilization & Demobilization	$360,000
2	Decommissioning CT Basin	$ 250,000
3	New Reinforced Concrete CT Clearwell Basins	$1,600,000
4	Clearwell Site Piping and Fittings	$1,350,000
5	Decommissioning Reservoir 1	$300,000
6	Appurtenances & Sitework	$100,000
	Construction Subtotal	**$3,960,000**
	Engineering, Legal, and Admin (25%)	$ 990,000
	Construction Contingency (30%)	$ 1,188,000
	PROJECT SUBTOTAL (Rounded)	**$ 6,138,000**
	AACE Class 5 Low Estimate Range (-50%):	*$ 3,069,000*
	AACE Class 5 High Estimate Range (+100%):	*$ 12,276,000*

8.4.3.1 Additional Additives

Several optional improvements were evaluated that may be added to one or more of the primary concepts. These additive options are presented separately from base concept costs so the City may combine the base concepts with desired enhancements.

Additive options include:

- Enhanced Mixing Upgrades (Existing Reservoirs): Enhanced mixing may be added to Concept 1, Concept 2A, or Concept 2B. The City may elect individual or combined mixing upgrades depending on the selected concept.
  - Alternative Mixing Upgrade – Reservoir 2 (Submersible Mixer Replacement): Replacement of existing floating mixer with a new electric submersible circulation mixer (e.g., GridBee GS-12),

including electrical feed, SCADA integration, and removal of existing equipment. Construction subtotal increases to $60,000 under this additive.

- Hydrodynamic Mixing System – Reservoir 2: Draining, installation of mixing pipe, anchors, duckbill valves, filling, chlorination, and commissioning. Construction subtotal increases to $250,000 under this additive.
- Hydrodynamic Mixing System – Reservoir 3: Same scope as Reservoir 2. Construction subtotal increases to $250,000 under this additive.

- Additional Groundwater Storage (Concept 2C): This option adds a new groundwater storage tank in the expansion area, including associated piping and the conversion of Reservoir 3 to surface water service, where applicable. This additive addresses systemwide storage needs identified in the iWSMP. Construction subtotal increases to $11 M under this additive.

8.4.4 Facility Site Plan Improvements (Chapter 6)

This section presents OPCCs for a set of facility-wide improvements identified in the Integrated Facility Site Plan (Chapter 6) that support long-term expansion, reliability, and operational integration at the Outback Site. These improvements are not part of the core pretreatment, hydropower, or reservoir concepts, but represent enabling infrastructure and supporting projects that would be implemented as the site expands and system needs evolve. The OPCCs provided herein consolidate planning-level costs for these site plan elements to support long-range capital planning, project sequencing, and comparative evaluation, with additional detail provided in the subsections that follow.

8.4.4.1 Water Supply – Groundwater Expansion and Well Optimization

For long-term planning purposes, and based on recent coordination with City staff, the Facility Plan assumes that Existing Wells 1 and 2 will be phased out or become operationally obsolete and are not relied upon in future supply planning scenarios. Existing Wells 3 through 7 are assumed to remain in service, with optimization efforts ongoing under separate City-led evaluations. In addition, the Facility Plan assumes one new groundwater well at the Outback Site (Well 8) with a nominal capacity of approximately 1,000 gpm to 2,000 gpm, to provide flexibility for future supply expansion and operational redundancy.

The new Well 8 facility project includes construction of a new production well, wellhouse building, pumping equipment, electrical and HVAC systems, and associated site piping and improvements to integrate the facility with existing system infrastructure.

Table 8-8 | New Well Facility (Well 8)

Item No.	Item	Cost
1	Mobilization & Demobilization	$255,000
2	Drill & Construct New Well	$1,000,000
3	Construct Wellhouse Building	$350,000
4	Building Mechanical (Wellhouse Pumping Equipment and Piping)	$550,000
5	Electrical & HVAC	$350,000
6	Site Piping and Site Improvements Allowance	$300,000
	Construction Subtotal	**$2,805,000**
	Engineering, Legal, and Admin (25%)	$701,250
	Construction Contingency (30%)	$ 841,500
	PROJECT SUBTOTAL (Rounded)	**$ 4,348,000**
	AACE Class 5 Low Estimate Range (-50%):	*$ 2,174,000*
	AACE Class 5 High Estimate Range (+100%):	*$ 8,696,000*

Groundwater well optimization costs are not included in the OPCC for the new Well 8 facility and are presented as a separate, planning-level placeholder item based on information provided by the City from independently completed or ongoing work efforts. The City-provided cost information reflects an example upgrade at Outback Well No. 7, consisting of upgrading to a 350-horsepower motor, replacing the existing pump, retaining the existing discharge column pipe, installing a new motor soft start, and completing associated minor electrical upgrades.

The estimated construction cost for this example optimization is approximately $490K per well, which includes public bidding and a 20 percent contingency. For planning purposes, this cost has been assumed to represent an order-of-magnitude, per-well estimate applicable to multiple existing wells (Wells 3 through 7), recognizing that actual costs will vary by well configuration, condition, and final selected upgrade approach.

This planning-level cost allowance is intended solely to represent potential investment for incremental production increases at existing wells. It does not include evaluation of site-specific well conditions, hydraulic impacts, or the need for upgrades to discharge headers, yard piping, transmission infrastructure, or downstream facilities, which would require further analysis during future project phases.

8.4.4.2 Outback Site Transmission Main Projects (P-1 & P-2)

The Outback Site Transmission Main Projects consist of two distinct improvements, identified as P-1 and P-2, each addressing specific hydraulic performance, system capacity, and infrastructural renewal needs at the Outback Site. Although these projects are identified as Beyond-2040 needs, incorporating their cost estimates in this Facility Plan supports comprehensive long-range budgeting and transmission system planning. For clarity and consistency with updated project phasing, P-1 and P-2 are evaluated and summarized as separate projects, with independent OPCCs developed for each at a Class 5 planning level. This approach provides improved transparency regarding the scope, scale, and relative cost of each transmission improvement while maintaining their role within the overall long-term transmission strategy for the Outback Site.

Table 8-9 | Outback Site Transmission Main Project P-1

Item No.	Item	Cost
1	Mobilization & Demobilization	$110,000
2	P-1 Outback Site Transmission Project	$1,100,000
	Construction Subtotal	**$1,210,000**
	Engineering, Legal, and Admin (25%)	$ 302,500
	Construction Contingency (30%)	$363,000
	PROJECT SUBTOTAL (Rounded)	**$1,876,000**
	AACE Class 5 Low Estimate Range (-50%):	*$938,000*
	AACE Class 5 High Estimate Range (+100%):	*$3,752,000*

Table 8-10 | Outback Site Transmission Main Project P-2

Item No.	Item	Cost
1	Mobilization & Demobilization	$350,000
3	P-2 Outback Site Transmission Project	$3,500,000
	Construction Subtotal	**$3,850,000**
	Engineering, Legal, and Admin (25%)	$962,500
	Construction Contingency (30%)	$1,155,000
	PROJECT SUBTOTAL (Rounded)	**$5,968,000**
	AACE Class 5 Low Estimate Range (-50%):	*$2,984,000*
	AACE Class 5 High Estimate Range (+100%):	*$11,936,000*

8.4.4.3 PFAS Treatment – OPCC

This section presents the OPCC for potential future PFAS treatment at the Outback Facility. Although PFAS treatment is not currently required based on available monitoring data, the City directed that cost estimates be developed to support long-range planning and evaluation of potential regulatory response needs. Three PFAS treatment scenarios were developed to bracket a range of possible future conditions, from limited groundwater-only treatment to full treatment of both surface water and groundwater sources. The scenarios are intended to provide comparative cost context rather than predict a specific implementation pathway and are summarized separately in the sections that follow.

Three PFAS treatment scenarios were evaluated:

- Groundwater Scenario A – Limited Groundwater PFAS Treatment: This scenario represents the minimum PFAS treatment condition and assumes PFAS treatment is required only for groundwater, with treatment provided for Outback Wells 6 and 7 using a pressure vessel-based system. Surface water PFAS treatment is not included. This scenario establishes a minimum planning-level footprint and cost baseline. See **Table 8-11**.
- Groundwater Scenario B – Full groundwater PFAS Treatment: This scenario assumes PFAS treatment is required for the full groundwater supply. See **Table 8-12**.
- Surface Water Scenario – Full Surface Water PFAS Treatment: This scenario represents the most conservative planning condition for surface water PFAS treatment and assumes PFAS treatment is required for the full surface water flow. See **Table 8-13**.

Table 8-11 | PFAS Groundwater Supply Scenario A

Item No.	Item	Cost
1	Mobilization & Demobilization	$489,000
2	PFAS Groundwater Scenario A	$4,888,000
	Construction Subtotal	**$5,377,000**
	Engineering, Legal, and Admin (25%)	$1,344,250
	Construction Contingency (30%)	$1,613,100
	PROJECT SUBTOTAL (Rounded)	**$8,335,000**
	AACE Class 5 Low Estimate Range (-50%):	*$4,167,500*
	AACE Class 5 High Estimate Range (+100%):	*$16,670,000*

Table 8-12 | PFAS Groundwater Scenario B

Item No.	Item	Cost
1	Mobilization & Demobilization	$1,560,000
2	PFAS Groundwater Scenario B	$15,600,000
	Construction Subtotal	**$17,160,000**
	Engineering, Legal, and Admin (25%)	$4,290,000
	Construction Contingency (30%)	$5,148,000
	PROJECT SUBTOTAL (Rounded)	**$26,598,000**
	AACE Class 5 Low Estimate Range (-50%):	*$13,299,000*
	AACE Class 5 High Estimate Range (+100%):	*$53,196,000*

Table 8-13 | Surface Water Supply PFAS Scenario

Item No.	Item	Cost
1	Mobilization & Demobilization	$1,560,000
2	PFAS Surface Water Scenario A	$15,600,000
	Construction Subtotal	**$17,160,000**
	Engineering, Legal, and Admin (25%)	$4,290,000
	Construction Contingency (30%)	$5,148,000
	PROJECT SUBTOTAL (Rounded)	**$26,598,000**
	AACE Class 5 Low Estimate Range (-50%):	*$13,299,000*
	AACE Class 5 High Estimate Range (+100%):	*$53,196,000*

8.4.4.4 Forest Service Wildland Fire Fighting Infrastructure

This section presents the OPCC for Forest Service-related improvements associated with the Outback Site. The scope includes construction of a truck-accessible Forest Service water fill station, a temporary helicopter dip tank, and a helipad, along with associated site preparation, piping connections, and restoration. These improvements are intended to support Forest Service firefighting operations and are presented at a planning level to reflect anticipated costs for future implementation. See **Table 8-14**.

Table 8-14 | Forest Service Wildland Fire Fighting Infrastructure

Item No.	Item	Cost
1	Mobilization & Demobilization	$70,000
2	Truck-Accessible Water Fill Station	$290,000
3	Helicopter Dip Tank	$170,000
4	Helipad	$240,000
	Construction Subtotal	**$770,000**
	Engineering, Legal, and Admin (25%)	$192,500
	Construction Contingency (30%)	$231,000
	PROJECT SUBTOTAL (Rounded)	**$1,194,000**
	AACE Class 5 Low Estimate Range (-50%):	*$597,000*
	AACE Class 5 High Estimate Range (+100%):	*$2,388,000*

8.5 Summary

The OPCCs presented in this chapter provide a planning-level cost framework to support the City's long-term capital strategy at the Outback Site. These estimates consolidate costs for major facility improvements, supporting infrastructure, and sitewide elements identified in this Facility Plan and form the basis for evaluating project sequencing, prioritization, and budgeting in Chapter 9.

Although the OPCCs are preliminary and will be refined as design advances, they allow the City to compare major alternatives, group projects for efficient phasing, assess near and long-term investment needs, and support funding strategy development. As site planning, permitting, and design progress, these cost opinions will be updated to reflect refined scope and conditions and should be viewed as a living planning tool that evolves alongside implementation.

CHAPTER 9

Implementation and Phasing Plan

9.1 Introduction

The purpose of this chapter is to present a planning-level implementation and phasing approach for the projects identified in this Facility Plan. The phasing framework is intended to guide the logical sequencing of projects based on system needs, project interdependencies, and anticipated future conditions.

The recommended improvements are not expected to be implemented all at once. Instead, projects will be phased over time to maintain operability, manage risk, align with funding availability, and respond to changing regulatory, operational, and demand-based drivers. In some cases, projects with longer-term objectives may be implemented earlier than their triggering conditions to support coordination with other improvements or to take advantage of bundling opportunities.

The implementation and phasing plan reflects the planning-level nature of this Facility Plan and is not intended to represent a fixed construction schedule. Actual project timing will be refined as projects advance through design, permitting, and funding. The phasing approach provides a flexible framework that can be updated as system conditions evolve and new information becomes available.

9.2 Prioritization Factors

The recommended improvements presented in this Facility Plan will be implemented over time rather than all at once so that projects can be completed in a coordinated and financially sustainable manner. A long-term implementation and phasing timeline is needed to guide when individual projects should be advanced for design and construction.

The implementation and phasing approach presented in this chapter reflects both technical evaluation and coordination workshops with City staff. These discussions considered system needs, operational priorities, infrastructure risks, project interdependence, funding considerations, and regulatory uncertainty. The plan recognizes that most improvements cannot be completed simultaneously and that, in some cases, projects with lower immediate urgency may be implemented earlier than required due to funding availability, coordination with other projects, or opportunities to bundle related improvements.

A variety of factors influence when projects can be implemented and how they should be phased. Some improvements are critical to maintaining system reliability and uninterrupted service, while others are driven by long-term resiliency goals, regulatory preparedness, or future triggers. The factors used to determine the phasing approach of this plan are summarized below.

9.2.1 Operability

Many of the improvements identified in this Facility Plan are intended to maintain and enhance the operability and resiliency of the City's water supply system. Operability, it this context, refers to the ability

of the system to reliably meet service needs during normal operations, maintenance activities, and abnormal or emergency conditions.

The City's water system improvements are not primarily driven by expansion of the service area or increasing demand. Instead, the recommended projects focus on improving operational flexibility, redundancy, and resiliency, particularly in response to infrastructure condition, environmental stressors, and system reliability considerations. Several improvements address known vulnerabilities in aging or condition-limited assets, while others are intended to reduce operational constraints and improve coordination among system components. Projects that directly support continued operability or reduce the consequence of infrastructure failure are generally prioritized earlier in the phasing plan than improvements that primarily enhance efficiency or operational convenience.

9.2.2 Dependencies and Triggers

Many of the improvements identified in this Facility Plan are interrelated, and dependencies between projects can influence the sequence and timing of implementation. In some cases, one project must be completed before another can proceed, while in other cases projects are triggered by future conditions such as system performance, changes in demand, or regulatory requirements.

Certain improvements depend on the construction or performance of other facilities before they can be implemented. In some cases, these dependencies introduce flexibility in how and when improvements are constructed. For example, solids drying beds are identified as a potential improvement to support residuals handling associated with the pretreatment facilities; however, final implementation timing may depend on available downstream sewer capacity and operational preferences. If existing sewer infrastructure is insufficient to accommodate pretreatment residuals, drying beds may be advanced concurrently with pretreatment facilities. If adequate sewer capacity is available, drying beds could be deferred or implemented as a follow-on improvement.

Similarly, some site-wide utilities and infrastructure improvements are most effectively constructed in coordination with major facility projects to avoid rework, temporary installations, or redundant construction efforts.

Other projects are intentionally identified as trigger-based improvements rather than scheduled at a fixed point in time. These projects are advanced only when specific conditions occur, such as increased system demand, deterioration of existing assets beyond acceptable thresholds, or adoption of new regulatory requirements. Examples include additional storage capacity, new groundwater supply infrastructure, transmission main expansions, and PFAS treatment facilities.

Dependencies and triggers were evaluated during the project phasing workshops with City staff to ensure that improvements are sequenced in a way that supports operability, minimizes disruption, and preserves flexibility to adjust future investments as system conditions evolve.

9.2.3 Risk

Certain improvements identified in this Facility Plan are prioritized to reduce the likelihood or consequence of adverse events that could affect system reliability, water quality, or public safety. In this plan, risk most often relates to the consequence of infrastructure failure, operational limitations under abnormal conditions, or reduced system resiliency during maintenance or emergency events. Examples include aging or condition-limited storage assets, limited treatment flexibility during high sediment or wildfire conditions, and infrastructure configurations that rely on single facilities to maintain required levels of service.

Improvements intended to reduce these risks are generally prioritized earlier in the phasing plan, even if they are not strictly required to meet current demand. This approach supports proactive asset management and enhances the City's ability to operate the system reliably under a range of conditions. Improvements that primarily address lower-consequence risks or provide incremental operational benefits are typically phased later or identified as trigger-based projects.

9.2.4 Regulatory Drivers

Regulatory requirements can influence both the timing and scope of system improvements. When new regulations are adopted, existing facilities and infrastructure may no longer meet required standards, necessitating upgrades, expansions, or operational modifications. Projects driven by regulatory compliance are often prioritized to meet mandatory timelines, maintain compliance, and avoid potential penalties or service disruptions.

A key regulatory consideration addressed in this Facility Plan is the potential future establishment of drinking water treatment standards for PFAS. Existing treatment facilities are typically not designed to accommodate the advanced treatment processes required for PFAS removal, and compliance may require new treatment infrastructure, modifications to existing facilities, or changes in system operations.

Although PFAS treatment requirements are not currently in effect for the WFF, the Facility Plan includes improvements intended to preserve flexibility and preparedness for potential future regulations. These planning-level improvements are structured to reduce implementation challenges and construction impacts if PFAS treatment is required in the future. Final implementation of PFAS treatment facilities is therefore identified as a trigger-based improvement that would be advanced only if monitoring results or regulatory action necessitate compliance.

9.2.5 Consideration for Bundling Opportunities

In some cases, it is efficient to implement multiple related improvements concurrently rather than as standalone projects. Bundling related projects can reduce overall costs, streamline design and construction efforts, and minimize operational disruption. This approach is particularly beneficial when projects are located in the same area, rely on shared infrastructure, or are part of the same treatment or conveyance process.

At the Outback Site, several improvements have been evaluated for potential bundling to maximize construction efficiency and coordination. The pretreatment facilities represent a major site-wide construction effort and provide opportunities to coordinate associated improvements such as site utilities, residuals handling infrastructure, and site security enhancements. While certain elements, such as solids drying beds or OSHG, are not required for initial operation of the pretreatment facilities, they may be advanced concurrently depending on operational preferences, downstream capacity constraints, or funding considerations.

Similarly, limited site piping and utility provisions intended to support potential future PFAS treatment may be constructed in coordination with pretreatment improvements to avoid redundant excavation and site disturbance. The implementation of PFAS treatment facilities themselves remains trigger-based and would be advanced only if required by future regulatory or monitoring outcomes.

Bundling opportunities were evaluated and discussed during phasing workshops with City staff and reflect a balance between construction efficiency, operational flexibility, and long-term planning considerations.

9.3 Implementation Summary

Table 9-1 located at the end of this chapter summarizes the recommended implementation and phasing of the projects identified in this Facility Plan. The table presents each major improvement alongside a brief description, planning-level cost information, anticipated implementation timeframe, and relevant notes regarding sequencing, dependencies, and triggers.

Projects are generally organized by near-term, long-term, and trigger-based implementation horizons, consistent with the prioritization factors described in Section 9.2. Near-term projects focus on maintaining operability, addressing known infrastructure risks, and advancing major facilities that enable future system improvements. Long-term and trigger-based projects are included to preserve flexibility and allow the City to respond to future changes in system condition, demand, regulatory requirements, or operational priorities.

The implementation timeframes shown in Table 9-1 reflect planning-level assumptions based on current information and coordination with City staff. These timeframes are not intended to represent fixed design or construction schedules. Actual implementation timing will be refined as projects advance through design, permitting, funding, and final decision-making processes.

Planning-level cost information is included to support long-range capital planning and comparison among projects. Cost values reflect the OPCC presented in Chapter 8 and are subject to refinement as project scope and design progress.

9.4 Project Phasing Summary

The projects identified in Table 9-1 are grouped into implementation phases based on operational priority, risk reduction, project dependencies, and trigger-based conditions. This section summarizes the anticipated sequencing of projects within near-term, long-term, and trigger-based implementation horizons. Phasing timeframes are provided at a planning level and will continue to be refined as projects advance.

9.4.1 Near-Term Improvements (Design and Early Implementation: 2026-2027)

Near-term improvements focus on maintaining operability, addressing known infrastructure risks, and advancing foundational facilities that enable future system improvements. These projects are generally those with the highest operational priority or those that provide opportunities for coordinated construction.

Pretreatment Facilities: The pretreatment facilities, including the pretreatment building, pre-sedimentation pond, and associated site civil improvements, design is planned to begin in 2027 and construction in 2028. The pretreatment facilities represent a major site-wide investment and serve as a foundational project for multiple other improvements. As part of the pretreatment project, related site infrastructure will be coordinated to support secure and controlled access to new facilities. This includes implementation of site security elements such as fencing, gates, and access controls around planned facilities, as well as coordination with the Forest Service Road 4606 access realignment to improve access management and site security. These elements are considered components of the overall pretreatment implementation rather than standalone projects and will be refined during pretreatment design.

In-Conduit Hydropower & Energy Dissipation Facility: The in-conduit hydropower and energy dissipation facility is also planned to be designed in 2027 and constructed in 2028 to align with pretreatment facility development. The energy dissipation component is required regardless of whether hydropower generation is ultimately installed. Coordinating this facility with pretreatment construction minimizes site disturbance and redundant work.

OSHG System: The OSHG system is anticipated to be designed with pretreatment, potentially in 2027, however, the implementation will be dependent upon available funds. While not required for initial pretreatment operation, the OSHG system improves operational resilience and reduces reliance on delivered chemicals. The system is assumed to be installed in space allocated in the pretreatment building.

Solids Drying Beds: Solids drying beds are identified as a potential early timeline improvement to support residuals management associated with pretreatment operations. Final implementation timing will depend on downstream sewer capacity, operational preferences, and funding considerations. Drying beds may be constructed concurrently with pretreatment facilities or deferred as a follow-on improvement if sewer capacity is adequate.

9.4.2 Risk-Based Mid-Term Improvements

Mid-term improvements are projects that address elevated operational or asset-condition risks but are not required for immediate system operability. These projects are prioritized based on the potential consequence of infrastructure failure or operational limitation rather than near-term capacity needs. Implementation timing may shift depending on asset performance, funding availability, or coordination with other projects.

Reservoir Siting Concept 2B (Preferred Concept): Reservoir Concept 2B, which includes construction of redundant level-controlled clearwell basins and decommissioning of the existing CT Basin and Outback Reservoir 1, is identified as a risk-based improvement. The existing CT Basin and Reservoir 1 are in poor condition with limited remaining service life, and replacement reduces the risk of service disruption and loss of treatment redundancy. Implementation timing will depend on the condition and performance of the existing contact time infrastructure. If deterioration accelerates or operational limitations increase, this project may be advanced. If existing facilities remain functional, implementation may be deferred to align with funding or other site improvements.

- Mixing Improvements (Additive): Additional mixing improvements for existing reservoirs are identified as additive enhancements that may be implemented in conjunction with reservoir siting improvements or phased separately based on operational needs. These improvements are not required to enable the preferred reservoir concept but may provide operational benefits depending on future system conditions.

Water Supply – Groundwater Expansion and Well Optimization: Improvements to increase capacity and reliability of existing Outback groundwater wells are anticipated within a mid-term planning horizon. These improvements are intended to enhance system resiliency and operational flexibility without the complexity of constructing a new well. Implementation timing will also depend on the continued performance of other groundwater sources within the City's system.

9.4.3 Long Term and Trigger-Based Improvements

Long-term and trigger-based improvements are not assigned fixed implementation dates. These projects are intended to provide planning-level guidance for responding to future system needs and will be advanced only when defined triggers related to demand, asset condition, or regulatory requirements occur.

Additional Groundwater Storage – Concept 2C: Concept 2C includes construction of an additional groundwater storage tank to address future system storage needs. This improvement is identified as a long-term project and is dependent on confirmation of future demand and storage requirements. Given stable service area boundaries and historical water use trends, implementation is intentionally deferred. A future master planning update is recommended prior to advancing this project to confirm required storage volumes and system configuration.

Water Supply – New Well: Development of a new groundwater supply well is identified as a long-term improvement beyond a 10-year planning horizon. This project is included to account for future system flexibility and long-range supply planning. Implementation of a new well will be informed by future system needs, performance of existing supply sources, and updated planning efforts. The timing and scope of this improvement will be refined through future evaluations as conditions warrant.

Outback Site Transmission Main Projects: The Outback Site transmission main projects are trigger-based improvements linked to future maximum day demand thresholds and development patterns. Both the scope and timing of these projects will be reevaluated prior to implementation to reflect updated demand projections, changes in site configuration, and coordination with private development that may affect the extent of City-constructed infrastructure.

PFAS Treatment: PFAS treatment facilities are fully trigger-based and would be implemented only if monitoring results or regulatory requirements necessitate treatment. Multiple PFAS treatment scenarios are included in this Facility Plan to support long-range planning and cost evaluation. No PFAS-specific treatment facilities are scheduled for near-term implementation.

Emergency Response Infrastructure: Emergency response infrastructure improvements at the Outback Site are intended to support wildfire suppression and coordinated emergency operations in the surrounding high-risk forested areas, as described in **Chapter 6**. These improvements include a truck-accessible water fill station for firefighting apparatus, a helicopter dip tank, and a helipad to support aerial operations. Together, these facilities would improve response times, operational efficiency, and coordination during wildfire events. Emergency response facilities are identified as planning-level improvements that support broader system resiliency objectives but are not required for routine water system operations. Implementation timing will depend on coordination with partner agencies, operational priorities, funding availability, and site development sequencing. The facilities may be implemented incrementally or as a combined project, depending on need and funding, and final siting, design, and operational requirements would be addressed during subsequent project phases.

9.5 Conclusion

This implementation and phasing plan provides a planning-level framework to guide the sequencing of improvements identified in this Facility Plan. Near-term projects focus on maintaining operability, addressing known infrastructure risks, and advancing foundational facilities that enable future system flexibility. Longer-term and trigger-based improvements allow the City to respond to future demand conditions, regulatory requirements, and evolving operational needs without committing to premature investments.

The recommended phasing approach was developed through technical evaluation and coordination with City staff and is intended to remain adaptable. As individual projects advance through design, permitting, funding, and construction, implementation, timing and scope should continue to be refined. This chapter is intended to support ongoing capital improvement planning and provide a clear framework for prioritizing future investments consistent with the long-term objectives of the Outback Facility Plan.

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Table 9-1 | Implementation and Phasing Plan

Facility/Project	Description	Facility Plan Ref.	Project Subtotal (Including Engineering/Admin/Legal:25% and Contingency: 30%)	Implementation	Notes (Construction Phasing, etc.)
Pretreatment Facilities	Adds treatment ahead of filtration to remove ash, sediment, and color during wildfire and storm events so the filtration plant can keep operating safely. Designed for 11.8 MGD (18.2 cfs). Includes pretreatment building, pre-sedimentation pond, and associated site civil including security improvements.	Ch. 3	**$48.10 M** Cost Range: -30% to +40% $33.7 M to $67.34 M	Design planned for 2027. Construction planned for 2028.	None.
In-Conduit Hydropower & Energy Dissipation Facility	Includes 1.3-MW in-conduit hydropower facility that incorporates new energy dissipation system to replace existing energy dissipation located near existing filtration building.	Ch. 4	-	Design planned for 2027. Construction planned for 2028.	Planned to be constructed in coordination with the pretreatment facilities to support shared site access and utilities. Energy dissipation infrastructure is required regardless of hydropower installation.
Scenario 1	Base Case: 4.16 kV to 12.47 kV step-up transformer and metering options (1A/1B). This scenario requires the fewest changes to existing WFF electrical systems.		**$7.56 M** Cost Range: -30% to +40% $5.21 M to $10.59 M	-	None.
Scenario 2	Step-down interconnection WFF Demand-Only: 4.16 kV to 480 V step-down transformer feeding the WFF switchboard. Adds work at the WFF switchboard (powerpack integration, automatic transfer switch reprogramming, 2000A feed connections). Reduces high-voltage equipment but increases low-voltage distribution scope.		**$7.77 M** Cost Range: -30% to +40% $5.44 M to $10.88 M	-	None.
Scenario 3	Full meter consolidation & sitewide reconfiguration: Physically consolidates all meters and reconfigures the electrical service. Adds substantial new switchgear, feeders, manholes/vaults, multi-building LV distribution, and utility meter enclosure work. Represents the highest-cost option due to sitewide electrical modifications.		**$14.16 M** Cost Range: -30% to +40% $9.91 M to $19.83 M	-	None.
On-site Sodium Hypochlorite Generation (OSHG) System	Includes complete OSHG system to disinfect surface water supply: two (2) generators, two (2) 5,000 gal Hypo storage tanks, 10,000 gal brine tank, and dosing pumps. Building costs not included, assumed located in new pretreatment building in future chemical space. Sized for full plant flow, 11.8 MGD (18.2 cfs) Space requirements based on MicroChlor system. Other options could include OSEC or Denora OSHG units.	Ch. 3	**$1.55 M** Cost Range: -50% to +100% $775 K to $3.10 M	Near-term: Incorporate into pretreatment design in 2027. Construction will be dependent upon funding.	Recommended to be incorporated into the pretreatment building design. Provides on-site oxidant capability for color events; bulk hypochlorite delivery via totes could be used as an interim option but would require additional safety and building provisions.
Solids Drying Beds	Provides onsite drying for settled solids to reduce reliance on the sewer system and improve resilience during high sediment events. Two (2) 250 ft x 100 ft concrete drying beds to manage solids generated from pretreatment and WFF operations. Beds are sized for one month of sludge production at 11.8 mgd (18.2 cfs) assuming 0.5% solids and three (3) days per month of rain-on-snow influent conditions, with operations alternating between two beds for filling, drying, and dredging. Lower flows or influent loading will extend fill time, and a third bed can be added for operational flexibility.	Ch. 3	**$1.64 M** Cost Range: -50% to +100% $821 k to $3.29 M	Near-term: Incorporate into pretreatment design in 2027. Construction will be dependent upon funding.	Residuals management is required as part of the pretreatment process. Existing sewer capacity is assumed adequate for typical operations; however, operations prefers on-site solids handling where practicable. Final solids handling approach to be confirmed during pretreatment facility design.
Reservoir Siting – Concept 2B (Preferred Concept)	Replaces existing facilities to provide chlorine contact time. Includes two (2) redundant concrete clearwell basins operating in parallel, level-controlled via a control valve on the outlet of the basins. Includes associated site piping and decommissioning of CT Basin and Outback Res 1. Concept does not include the additional Outback storage recommended in the iWSMP. See Concept 2C for the additional infrastructure needed to provide the storage requirement.	Ch. 5	**$7.16 M** Cost Range: -50% to +100% $ 3.58 M to $14.32 M	Near Term Improvement (Risk based) Implementation depends on the existing CT basin.	CT Basin and Outback Reservoir 1 are in poor condition with limited remaining service life. Clearwells may be constructed at the Outback Reservoir 1 site, requiring temporary CT and storage accommodations. Both clearwells are assumed to be constructed concurrently due to shared wall design.
Mixing Improvements (Additive)	Additional mixing improvements to Res 2 & 3	Ch. 5	**$93k to $387k** per reservoir	Completed alongside reservoir siting improvements	None.
Concept 2C	Addition of groundwater tank in future. Assumed volume is 5.2MG (usable).	Ch. 5	**$17.13 M** Cost Range: -50% to +100% $8.6 M to $34.3 M	Long-term triggered by system-wide storage requirements	Master plan update is recommended prior to adding additional storage to confirm volume requirements. Long-term storage numbers may be lower - the City hasn't experienced MDD increases.

Facility/Project	Description	Facility Plan Ref.	Project Subtotal (Including Engineering/Admin/Legal:25% and Contingency: 30%)	Implementation	Notes (Construction Phasing, etc.)
Water Supply – Groundwater Expansion	Retrofit to increase capacity of existing wells at the Outback Site. 300 gpm increase in multiple wells (3-6) with potential to increase.	Ch. 6	$490 K per well	Near-term: Within 5 years	Improvements are still in planning per **Section 6.5**. Expansion is planned to occur prior to new well facility.
	Long-term improvement includes constructing new well facility including drilling (1) new 1,000 gpm. Potentially expand capacity of existing wells to gain an additional 1,000 gpm. Includes associated site piping.	Ch. 6	**$4.35 M** Cost Range: -50% to +100% $2.17M to $8.70 M	New well planned for beyond 10 years	Timing of supply expansion at Outback is also dependent on continued viability of other wells located in the distribution system such as River Well 1.
Outback Site Transmission Main Project P-1	16-in & 30-in parallel pipes to connect north and south Outback transmission mains.	Ch 6	**$1.88 M** Cost Range: -50% to +100% $938 k to $3.75 M	In service by MDD threshold of 45.2 mgd	Re-evaluate P-1 prior to implementation depending on if additional groundwater storage is planned along with other revisions to site piping.
Outback Site Transmission Main Project P-2	30-in new pipe to replace existing north transmission parallel pipelines (14-in & 16-in).	Ch 6	**$5.97 M** Cost Range: -50% to +100% $2.98 M to $11.94 M	In service by MDD threshold of 45.2 mgd	Development-driven project; private development is expected to install approximately 1,000 LF of pipeline. City responsibility for remaining P-2 work should be reevaluated accordingly.
PFAS Treatment Space Allocation – Groundwater Scenario A	Provide facilities to remove PFAS from water supply if needed in the future. PFAS infrastructure: Limited groundwater treatment. Treatment of Wells 6 and 7 (~3.74 MGD or 18.2 cfs), 8 pressure vessels.	Ch. 6	**$8.34 M** Cost Range: -50% to +100% $4.17 M to $16.67 M	Trigger Based Only if PFAS is detected	Due to piping configuration of existing well discharge headers, assumption is that multiple wells would be provided PFAS treatment through similar pressure vessel configurations rather than separate treatment pods.
Groundwater Scenario B	PFAS infrastructure: Full treatment of groundwater: ~11 mgd (18.2 cfs) (28 filter banks).	Ch. 6	**$26.60 M** Cost Range: -50% to +100% $13.30 M to $53.20 M	Trigger Based Only if PFAS is detected	None.
Surface Water Scenario	PFAS infrastructure: Full surface water treatment: 11.8 mgd (18.2 cfs) (28 filter banks).	Ch. 6	**$26.60 M** Cost Range: -50% to +100% $13.30 M to $53.20 M	Trigger Based Only if PFAS is detected	None.
Forest Service Wildland Fire Fighting Infrastructure	Construction of a truck-accessible Forest Service water fill station, a temporary helicopter dip tank, and a helipad, along with associated site preparation, piping connections, and restoration.	Ch. 6	**$1.19 M** Cost Range: -50% to 100% $597k to $2.39 M	Coordination with Forest Service required	Fill line and infrastructure for helipad and dip tank to be coordinated with final siting of in-conduit hydropower and pretreatment facilities.

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APPENDIX A
2021 IWSMP PROJECT LIST

APPENDIX A

iWSMP Project List – Outback Site Specifically

Project ID (iWSMP ID)	Year of Improvement	Project Name	Type/Category and Description of Improvement
O-1	2021-2030 **ONGOING – This Project**	Outback Facility Plan	Planning/Conservation Comprehensive assessment of the Outback site
O-4	2021-2030 **COMPLETED 2024**	Hydropower Feasibility Study	Planning/Conservation Analysis of addition of hydropower in the system
O-11	2021-2030 **ONGOING**	Outback Land Acquisition	Planning/Conservation Land acquisition required for Outback Facility expansion
P-1	Beyond 2040	Outback Site Transmission	New Transmission Pipe for Hydraulic Performance 16-inch and 30-inch pipe parallel to connect North and South Outback Transmission Mains
P-2	Beyond 2040	Outback North Transmission Replacement	Upsize Transmission and Distribution Pipe for Hydraulic Performance 30-inch new pipe to replace existing 14-inch and 16-inch parallel pipe that is in poor condition
T-1	2021-2030	Outback Reservoir No. 1 (Reservoir 1)	Reservoir Capital Maintenance Condition related improvements
T-2	Beyond 2040	Replacement Outback Reservoir 2 (Reservoir 2)	Replace Reservoir New 7.0 MG prestressed concrete reservoir.
T-3	Beyond 2040	Outback Reservoir 3 (Reservoir 3)	Reservoir Capital Maintenance Condition related improvements to 3.6 MG reservoir
T-4	2021-2030	Outback CT Basin (CT Basin)	Decommission Reservoir Decommission existing reservoir
T-9	2031-2040	New Overturf Reservoir	4.0 MG, Zone 4
T-10	2031-2040	Decommission Existing Overturf Reservoirs	Decommission Existing Overturf Reservoirs, Zone 4
T-11	2031-2040	New Overturf Reservoir	3.0 MG, Zone 3
T-18	2021-2030 **COMPLETED 2025**	Reservoir 2 Interior Coating	Reservoir Capital Maintenance Reservoir 2 interior coating
TR-1	2021-2030 **ONGOING – This Project**	Pretreatment	Planning/Conservation Design and construction of pretreatment at WFF
W-1/W-2	2021-2030	Well Capital Maintenance	Outback Well 1 & 2 Condition related improvements to well

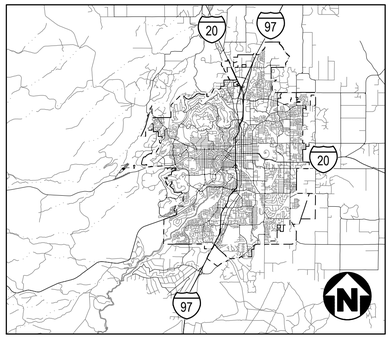
Project ID (iWSMP ID)	Year of Improvement	Project Name	Type/Category and Description of Improvement
W-3, W-4, & W-5,	2031-2040	Well Capital Maintenance	Outback Well 3, 4, & 5 Condition related improvements to well
W-6/W-7	Beyond 2040	Well Capital Maintenance	Outback Well 6 & 7 Condition related improvements to well
W-8	Beyond 2040	New Well[1]	New Outback Well 1 new 185 HP well.
W-12	Beyond 2040	New Well[1]	New Overturf Well, Zone 5
W-15	Beyond 2040	New Well[1]	New Bear Creek Well, Zone 4 1 new 300 HP well
W-23	Beyond 2040	New Well[1]	New Wilson Well 1, Zone 4 1 new 300 hp well
W-24	Beyond 2040	New Well[1]	New Wilson Well 2, Zone 4 1 new 300 hp well

Notes:

1. New wells shown in this table are not specific to the Outback site. All new wells identified in the iWSMP are included for reference to support future discussions on how additional groundwater supply at Outback might be addressed.

APPENDIX B
PRETREATMENT AND IN-CONDUIT HYDROPOWER CONCEPTUAL DRAWINGS

consor



VICINITY MAP

SCALE: 1" = 3 MILES

MAP FROM: GIS ©

CITY OF BEND

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES
PRELIMINARY DESIGN

APRIL 2026

[CITY PROJECT # 1WOFP]

CITY OF BEND, DESCHUTES COUNTY, OREGON

PRELIMINARY DESIGN PLAN REVIEW SET

OWNER:

CITY OF BEND - CONTACT: RAMSEY KRIEPS, PE

BEND, OREGON 97703

541-693-2182

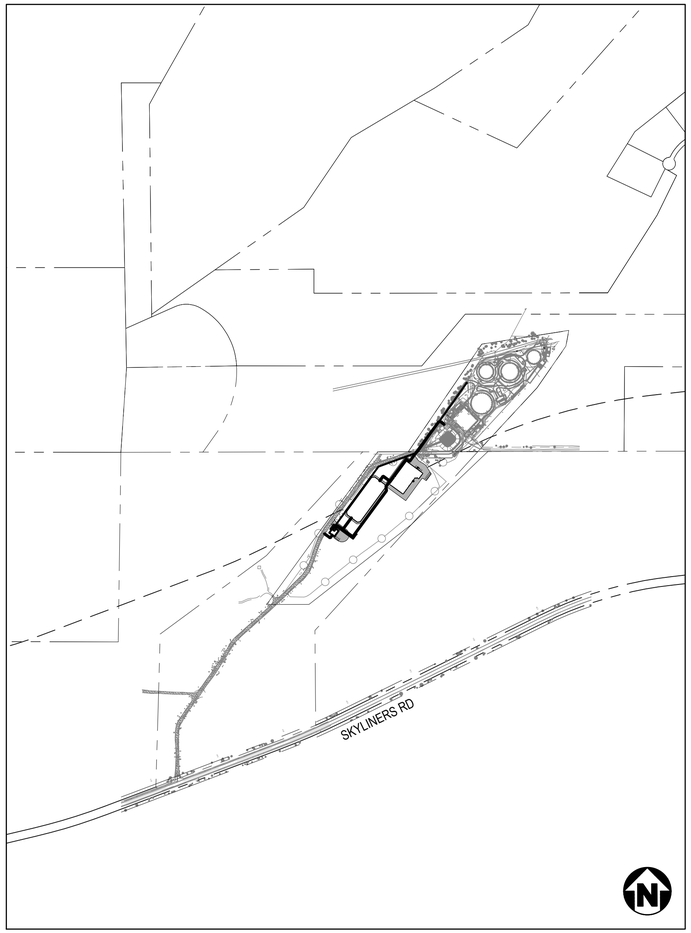
SCHEDULE OF IMPROVEMENTS:

CITY OF BEND:

# LF	FULL STREET IMPROVEMENT
# LF	SIDEWALK
# LF	STANDARD CURB
#	CURB RAMPS
#	STREET LIGHTS
# LF	#" PVC-3034 SEWER MAIN
#	MANHOLES
# LF	4" SEWER SERVICES

PRIVATE:

# LF	#" DI WATER MAIN
#	FIRE HYDRANTS
# LF	#" WATER SERVICES



SITE PLAN

SCALE: 1" = 400'

SHEET INDEX

SHEET NUMBER	SHEET TITLE
GENERAL	
.....	COVER SHEET
G-001	SYMBOLS AND LEGEND
G-002	ABBREVIATIONS
G-003	DESIGN CRITERIA
G-004	PROCESS FLOW DIAGRAM
G-005	HYDRAULIC PROFILE - SCENARIO 1A
G-006	HYDRAULIC PROFILE - SCENARIO 1B
G-007	HYDRAULIC PROFILE - SCENARIO 2
G-008	HYDRAULIC PROFILE - SCENARIO 3
G-009	HYDRAULIC PROFILE - SCENARIO 4
G-010	HYDRAULIC PROFILE - EXISTING
CIVIL	
C-100	EXISTING CONDITIONS AND SURVEY CONTROL
C-101	OUTBACK FACILITY IMPROVEMENTS SITE PLAN
C-102	IN-CONDUIT HYDROPOWER AND PRETREATMENT SITE PLAN
C-110	PRE-SEDIMENTATION POND PLAN
C-301	PRE-SEDIMENTATION POND SECTION
C-501	INLET/OUTLET STRUCTURE DETAILS
C-901	SEDIMENTATION BASIN PERSPECTIVES
PRETREATMENT BUILDING ARCHITECTURAL	
A-001	BUILDING CODE AND LIFE SAFETY PLAN
A-101	PRETREATMENT BUILDING ARCHITECTURAL OVERALL BOTTOM PLAN
A-102	PRETREATMENT BUILDING ARCHITECTURAL OVERALL INTERMEDIATE PLAN
A-103	PRETREATMENT BUILDING ARCHITECTURAL OVERALL TOP (ROOF) PLAN
A-301	PRETREATMENT BUILDING ARCHITECTURAL ENLARGED ADMINISTRATION BUILDING
PRETREATMENT PROCESS (PIPING)	
D-101	PRETREATMENT BASINS UPPER LEVEL PLAN
D-102	PRETREATMENT BASINS LOWER LEVEL PLAN
D-301	PRETREATMENT BASINS SECTIONS
D-901	PRETREATMENT BUILDING PERSPECTIVE
IN-CONDUIT HYDROPOWER FACILITY	
H-101	IN-CONDUIT HYDROPOWER FACILITY PLAN
H-301	IN-CONDUIT HYDROPOWER FACILITY SECTION A
H-302	IN-CONDUIT HYDROPOWER FACILITY SECTION B
H-303	IN-CONDUIT HYDROPOWER FACILITY SECTION C

APPROVALS:

CITY OF BEND ENGINEER:_____

***SIGNATURE DOES NOT GRANT APPROVAL TO COMMENCE CONSTRUCTION.*

[REQUIRED UTILITY]:_____

CITY OF BEND ENGINEER:_____

CITY OF BEND FIRE DEPT.:_____

PACIFICORP:_____

CENTRAL ELECTRIC COOP.:_____

CENTURY LINK:_____

TDS:_____

CASCADE NATURAL GAS:_____

REDMOND IRRIGATION DISTRICT:_____

DESCHUTES COUNTY ROAD DEPT.:_____

OREGON DEPT. OF TRANSPORTATION:_____

[OTHERS]:_____

PERMANENT BENCHMARKS USED

ID	NORTHING	EASTING	ELEVATION	DESCRIPTION
12	383253.40	3270012.52	3987.55	HWA FND CNTL MON
13	382307.39	3269389.25	4000.22	HWA FND CNTL MON
18	383516.54	3270748.16	3982.71	FND CNTL MON
169	383930.88	3270753.07	3977.31	FND CNTL MON
31738	383367.15	3270375.58	3985.66	FND CNTL MON
32276	383793.23	3270930.40	3980.82	FND CNTL MON

PRELIMINARY NOT FOR CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

COVER SHEET

DESCHUTES COUNTY, OREGON

CITY OF BEND

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

DESIGNED BY: HLB
DRAWN BY: NEM
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

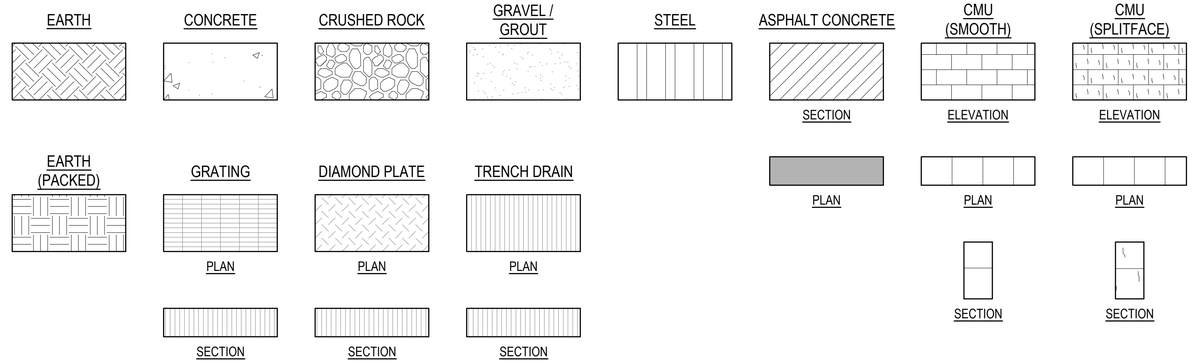
VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET:
G-000

COB # XXXX

Drawing Path and Name: A:_V-W\Projects\OR\Bend\2024\W243806OR.0012 CADD\12-5 Sheets\W243806OR_G-000.dwg, Plotted Date: April 30, 2026 11:40 AM By: Derek Cloud

MATERIAL PATTERNS



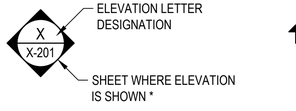
VIEW TITLE DESIGNATIONS

PLAN AND PROFILE

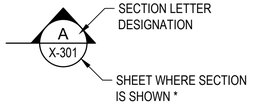
PLAN
SCALE: 1/4"=1'-0"

PROFILE
SCALE: 1"=X' HORIZ, 1"=X' VERT

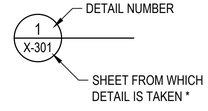
ELEVATION

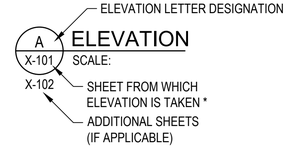


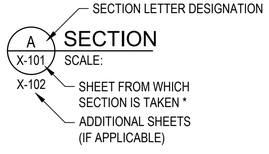
SECTION

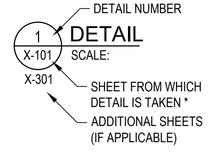


DETAIL



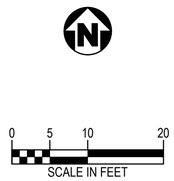






* NOTE: IF PLAN AND SECTION FOR DETAIL CALL-OUT AND DETAIL ARE SHOWN ON THE SAME DRAWING, DRAWING NUMBER IS REPLACED WITH A DASH.

NORTH ARROW AND SCALE BAR



GENERAL NOTE:

1. THIS IS A STANDARD GENERAL SHEET, NOT ALL OF THE INFORMATION SHOWN MAY BE USED ON THIS PROJECT.

PRELIMINARY NOT FOR CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

SYMBOLS AND LEGEND

CITY OF BEND
DESCHUTES COUNTY, OREGON

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

DESIGNED BY: HLB
DRAWN BY: JLC
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET: G-001

COB # XXXX

Drawing Path and Name: A:_V-WProjects\ORIBend\2024\W2438080R.00\12 CADD\12-5 Sheets\W2438080R_G-001.dwg, Plotted Date: April 30, 2026 11:40 AM By: Derek Cloud

@	AT
AASHTO	AMERICAN ASSOCIATION OF STATE HIGHWAY & TRANSPORTATION OFFICIALS
AB	ANCHOR BOLT
ABAN(D)	ABANDON(ED)
ABS	ACRYLONITRILE BUTADIENE STYRENE
ABV	ABOVE / ALCOHOL BY VOLUME
AC	ASPHALTIC CONCRETE
ACP	ASPHALTIC CONCRETE PAVING
ADJ	ADJUSTABLE
ADJC	ADJACENT
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AHR	ANCHOR
AL	ALUMINUM
ALT	ALTERNATE
AMP	AMPERE
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
APPROX	APPROXIMATE
APPVD	APPROVED
APWA	AMERICAN PUBLIC WORKS ASSOCIATION
ARCH	ARCHITECTURAL
ARV	AIR RELEASE VALVE
ASCE	AMERICAN SOCIETY OF CIVIL ENGINEERS
ASR	AQUIFER STORAGE & RECOVERY
ASSN	ASSOCIATION
ASSY	ASSEMBLY
ASTM	AMERICAN SOCIETY FOR TESTING & MATERIALS
ATM	ATMOSPHERE
AUTO	AUTOMATIC
AUX	AUXILIARY
AVE	AVENUE
AVG	AVERAGE
AWWA	AMERICAN WATER WORKS ASSOCIATION
B&S	BELL & SPIGOT
BC	BOLT CIRCLE
BD	BOARD
BETW	BETWEEN
BF	BOTH FACE
BFD	BACKFLOW PREVENTION DEVICE
BFILL	BACKFILL
BFV	BUTTERFLY VALVE
BHP	BRAKE HORSEPOWER
BKGD	BACKGROUND
BLDG	BUILDING
BLK	BLOCK
BLVD	BOULEVARD
BM	BENCHMARK / BEAM
BMP	BEST MANAGEMENT PRACTICES
BO	BLOW-OFF
BOC	BACK OF CURB
BS	BOTH SIDES
BSMT	BASEMENT
BTF	BOTTOM FACE
BTU	BRITISH THERMAL UNIT
BV	BALL VALVE
BW	BOTH WAYS
C	CELSIUS
C TO C	CENTER TO CENTER
CARV	COMBINATION AIR RELEASE VALVE
CATV	CABLE TELEVISION
CB	CATCH BASIN
CCP	CONCRETE CYLINDER PIPE
CCW	COUNTER CLOCKWISE
CDOT	COLORADO DEPARTMENT OF TRANSPORTATION
CFM	CUBIC FEET PER MINUTE
CFS	CUBIC FEET PER SECOND
CHAN	CHANNEL
CHEM	CHEMICAL
CHFR	CHAMFER
CHKV	CHECK VALVE
CI	CAST IRON
CIP	CAST IRON PIPE
CIPC	CAST IN PLACE CONCRETE
CISP	CAST IRON SOIL PIPE
CJ	CONSTRUCTION JOINT
CL OR C/L	CENTER LINE
CL2	CHLORINE
CLG	CEILING
CLJ	CONTROL JOINT
CLR	CLEAR
CLSM	CONTROLLED LOW STRENGTH MATERIAL
CMP	CORRUGATED METAL PIPE
CMU	CONCRETE MASONRY UNIT
CND	CONDUIT
CO	CLEANOUT
COL	COLUMN
COMB	COMBINATION

CONC	CONCRETE
CONN	CONNECTION
CONST	CONSTRUCTION
CONT	CONTINUOUS / CONTINUATION
CONTR	CONTRACT(OR)
COORD	COORDINATE
COP	COPPER
CORP	CORPORATION
CORR	CORRUGATED
CP	CONTROL POINT
CPLG	COUPLING
CPVC	CHLORINATED POLYVINYL CHLORIDE
CR	CRUSHED ROCK
CS	COMBINED SEWER
CSP	CONCRETE SEWER PIPE
CT	COURT
CTR	CENTER
CU	CUBIC
CULV	CULVERT
CV	CONTROL VALVE
CW	CLOCKWISE / COLD WATER
CY	CUBIC YARDS
CYL	CYLINDER LOCK
D	DRAIN
DC	DIRECT CURRENT
DEFL	DEFLECTION
DEMO(D)	DEMOLISH(ED)
DEQ	DEPARTMENT OF ENVIRONMENTAL QUALITY
DET	DETAIL
DI	DUCTILE IRON
DIA	DIAMETER
DIM	DIMENSION
DIR	DIRECTION
DIST	DISTANCE
DN	DOWN
DR	DRIVE
DS	DOWNSPOUT
DWG	DRAWING
DWL	DOWEL
DWV	DRAIN WASTE AND VENT
DWY	DRIVEWAY
E / ELEC	ELECTRICAL
EA	EACH
ECC	ECCENTRIC
EF	EACH FACE
EL	ELEVATION
ELB	ELBOW
ENCL	ENCLOSURE
EOP	EDGE OF PAVEMENT
EQ	EQUAL
EQL SP	EQUALLY SPACED
EQUIP	EQUIPMENT
ESMT	EASEMENT
EW	EACH WAY
EXC	EXCAVATE
EXIST	EXISTING
EXP	EXPANSION
EXP BT	EXPANSION BOLT
EXP JT	EXPANSION JOINT
EXT	EXTERIOR
F	FAHRENHEIT
F TO F	FACE TO FACE
FAB	FABRICATE
FB	FLAT BAR
FCA	FLANGED COUPLING ADAPTER
FCO	FLOOR CLEANOUT
FD	FLOOR DRAIN
FDN	FOUNDATION
FEXT	FIRE EXTINGUISHER
FF	FINISHED FLOOR / FAR FACE
FGL	FIBERGLASS
FH	FIRE HYDRANT
FIN	FINISH(ED)
FIPT	FEMALE IRON PIPE THREAD
FITG	FITTING
FL	FLOOR LINE
FLEX	FLEXIBLE
FLG	FLANGE
FLL	FLOW LINE
FLOC	FLOCCULATION
FLR	FLOOR
FM	FORCE MAIN
FO	FIBER OPTIC
FOC	FACE OF CONCRETE
FOF	FACE OF FINISH
FOM	FACE OF MASONRY
FOS	FACE OF STUDS
FPM	FEET PER MINUTE
FPS	FEET PER SECOND
FRP	FIBERGLASS REINFORCED PLASTIC
FS	FOREST SERVICE

FT	FEET / FOOT
FTG	FOOTING
FUT	FUTURE
FXTR	FIXTURE
G	GAS
GA	GAUGE
GAL	GALLON
GALV	GALVANIZED
GC	GROOVED COUPLING
GFA	GROOVED FLANGE ADAPTER
GI	GALVANIZED IRON
GIP	GALVANIZED IRON PIPE
GJ	GRIP JOINT
GL	GLASS
GLV	GLOBE VALVE
GND	GROUND
GPD	GALLONS PER DAY
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
GPS	GALLONS PER SECOND
GR	GRADE
GR LN	GRADE LINE
GRTG	GRATING
GV	GATE VALVE
GRVL	GRAVEL
GYP	GYPSUM
HB	HOSE BIBB
HC	HOLLOW CORE
HDPE	HIGH DENSITY POLYETHYLENE
HDR	HEADER
HDWE	HARDWARE
HGR	HANGER
HGT	HEIGHT
HH	HANDHOLD
HM	HOLLOW METAL
HMAC	HOT MIX ASPHALT CONCRETE
HNDRL	HANDRAIL
HOA	HAND-OFF-AUTO
HOR	HAND-OFF-REMOTE
HORIZ	HORIZONTAL
HP	HIGH PRESSURE / HORSEPOWER
HPG	HIGH PRESSURE GAS
HPRW	HIGH PRESSURE RAW WATER TRANSMISSION
HPT	HIGH POINT
HR	HOUR
HSB	HIGH STRENGTH BOLT
HV	HOSE VALVE
HVAC	HEATING, VENTILATION, AIR CONDITIONING
HWL	HIGH WATER LINE
HWY	HIGHWAY
HYD	HYDRANT
HYDR	HYDRAULIC
I&C	INSTRUMENTATION & CONTROL
IAW	IN ACCORDANCE WITH
ID	INSIDE DIAMETER
IE	INVERT ELEVATION
IF	INSIDE FACE
IMPVT	IMPROVEMENT
IN	INCH
INCC	INCLUDE(D)(ING)
INFL	INFLUENT
INJ	INJECTION
INSTL	INSTALLATION
INSUL	INSULATION
INTER	INTERCEPTOR
INTR	INTERIOR
INV	INVERT
IP	IRON PIPE
IPT	IRON PIPE THREAD
IR	IRON ROD
IRRIG	IRRIGATION
JT	JOINT
JUNC	JUNCTION
KPL	KICK PLATE
KVA	KILOVOLT AMPERE
KW	KILOWATT
KWY	KEYWAY
L	LENGTH
LAB	LABORATORY
LAV	LAVATORY
LB	POUND
LF	LINEAR FOOT
LIN	LINEAL
LM	LANDSCAPE MANAGEMENT
LN	LANE
LOC	LOCATION
LONG	LONGITUDINAL

LP	LOW PRESSURE
LPRW	LOW PRESSURE RAW WATER TRANSMISSION
LPT	LOW POINT
LRG	LARGE
LS	LONG SLEEVE / LUMP SUM
LT	LEFT
LV	LOW VOLTAGE
LVL	LEVEL
LWL	LOW WATER LINE
MAN	MANUAL
MAT	MATERIAL
MAX	MAXIMUM
MCC	MOTOR CONTROL CENTER
MCP	MASTER CONTROL PANEL
MECH	MECHANICAL
MET	METAL
MFR	MANUFACTURER
MGD	MILLION GALLONS PER DAY
MH	MANHOLE
MIN	MINIMUM
MIPT	MALE IRON PIPE THREAD
MISC	MISCELLANEOUS
MJ	MECHANICAL JOINT
MON	MONUMENT / MONOLITHIC
MOT	MOTOR
MP	MILEPOST
MSL	MEAN SEAL LEVEL
MTD	MOUNTED
MV	MEDIUM VOLTAGE
NA	NOT APPLICABLE
NAVD	NORTH AMERICAN VERTICAL DATUM
NC	NORMALLY CLOSED
NF	NEAR FACE
NIC	NOT IN CONTRACT
NO / NO.	NORMALLY OPEN / NUMBER
NOM	NOMINAL
NORM	NORMAL
NRS	NON-RISING STEM
NTS	NOT TO SCALE
O TO O	OUT TO OUT
OC	ON CENTER
OD	OUTSIDE DIAMETER
OF	OVERFLOW / OUTSIDE FACE
OPNG	OPENING
OPP	OPPOSITE
ORIG	ORIGINAL
OSHA	OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
OVHD	OVERHEAD
P&ID	PROCESS & INSTRUMENTATION DIAGRAM
PC	POINT OF CURVE
PCC	POINT OF COMPOUND CURVE
PCVC	POINT OF CURVATURE ON VERTICAL CURVE
PE	PLAIN END
PERF	PERFORATED
PERM	PERMANENT
PERP	PERPENDICULAR
PG	PRESSURE GAUGE
PH	PIPE HANGER
PI	POINT OF INTERSECTION
PIVC	POINT OF INTERSECTION ON VERTICAL CURVE
PL OR P/L	PROPERTY LINE / PLATE / PLASTIC
PLBG	PLUMBING
PNL	PANEL
POC	POINT OF CURVATURE
POLY	POLYETHYLENE
PP	POWER POLE / PURPLE PIPE
PRC	POINT OF REVERSE CURVATURE
PRCST	PRECAST
PREP	PREPARATION
PRESS	PRESSURE
PRKG	PARKING
PROP	PROPERTY
PRV	PRESSURE REDUCING VALVE
PS	PUMP STATION
PSIG	POUNDS PER SQUARE INCH GAUGE
PSL	PIPE SLEEVE
PSPT	PIPE SUPPORT
PT	POINT OF TANGENCY
PTVC	POINT OF TANGENCY ON VERTICAL CURVE
PTW	PUMP TO WASTE
PV	PLUG VALVE
PVC	POLYVINYL CHLORIDE
PVMT	PAVEMENT
PW	POTABLE WATER
PWR	POWER

QTY	QUANTITY
RAD	RADIUS
RC	REINFORCED CONCRETE
RCP	REINFORCED CONCRETE PIPE
RD	ROAD / ROOF DRAIN
RDCR	REDUCER
REF	REFERENCE
REINF	REINFORCE(D)(ING)(MENT)
RES	RESERVOIR
REQ'D	REQUIRED
RESTR	RESTRAINED
RFCA	RESTRAINED FLANGE COUPLING ADAPTER
RM	ROOM
RND	ROUND
RO	ROUGH OPENING
R/W	RIGHT-OF-WAY
RPBPD	REDUCED PRESSURE BACKFLOW PREVENTION DEVICE
RPM	REVOLUTIONS PER MINUTE
RR	RAILROAD
RST	REINFORCED STEEL
RT	RIGHT
RW	RAW WATER
SALV	SALVAGE
SAN	SANITARY
SC	SOLID CORE
SCHED	SCHEDULE
SD	STORM DRAIN
SDL	SADDLE
SDR	STANDARD DIMENSION RATIO
SECT	SECTION
SHLDR	SHOULDER
SHT	SHEET
SIM	SIMILAR
SLP	SLOPE
SLV	SLEEVE
SOLN	SOLUTION
SP	SOIL PIPE / SEWER PIPE
SPCL	SPECIAL
SPEC(S)	SPECIFICATION(S)
SPG	SPACING
SPL	SPOOL
SPRT	SUPPORT
SQ	SQUARE
SQ FT	SQUARE FOOT
SQ IN	SQUARE INCH
SQ YD	SQUARE YARD
SS	SANITARY SEWER
SST	STAINLESS STEEL
ST	STREET
STA	STATION
STD	STANDARD
STL	STEEL
STOR	STORAGE
STR	STRAIGHT
STRUCT	STRUCTURE / STRUCTURAL
SUBMG	SUBMERGED
SUCT	SUCTION
SUP	SPECIAL USE PERMIT
SV	SOLENOID VALVE
S/W	SIDEWALK
SWD	SIDEWATER DEPTH
SWGR	SWITCH GEAR
SYMM	SYMMETRICAL
SYS	SYSTEM
T OR TEL	TELEPHONE
T&B	TOP & BOTTOM
TAN	TANGENCY
TB	THRUST BLOCK
TBM	TEMPORARY BENCHMARK
TC	TOP OF CONCRETE / TOP OF CURB
TCE	TEMPORARY CONSTRUCTION EASEMENT
TDH	TOTAL DYNAMIC HEAD
TEMP	TEMPERATURE / TEMPORARY
T&G	TONGUE & GROOVE
THK	THICK / THICKNESS
THRD	THREAD (ED)
THRU	THROUGH
TP	TEST PIT / TOP OF PAVEMENT / TURNING POINT
TRANS	TRANSITION
TSP	TRI-SODIUM PHOSPHATE
TST	TOP OF STEEL
TW	TOP OF WALL
TYP	TYPICAL
UG	UNDERGROUND
UH	UNIT HEATER
UN	UNION
UON	UNLESS OTHERWISE NOTED

USGS	UNITED STATES GEOLOGIC SURVEY
V	VENT / VOLT
VAC	VACUUM
VB	VACUUM BREAKER
VBOX	VALVE BOX
VC	VERTICAL CURVE
VERT	VERTICAL
VFD	VARIABLE FREQUENCY DRIVE
VOL	VOLUME
VCP	VITRIFIED CLAY PIPE
VTR	VENT THROUGH ROOF
W	WATER
W/	WITH
W/IN	WITHIN
W/O	WITHOUT
W/W	WALL TO WALL
WD	WOOD
WF	WIDE FLANGE
WFF	WATER FILTRATION FACILITY
WH	WATER HEATER
WI	WROUGHT IRON
WM	WATER METER
WP	WORKING POINT / WATERPROOFING
WS	WATER SERVICE
WT	WEIGHT
WTP	WATER TREATMENT PLANT
WTRT	WATERTIGHT
WWF	WELDED WIRE FABRIC
WWTF	WASTEWATER TREATMENT FACILITY
WWTP	WASTEWATER TREATMENT PLANT
X SECT	CROSS SECTION
XFMR	TRANSFORMER
YD	YARD DRAIN / YARD
YH	YARD HYDRANT
YR	YEAR
ZN	ZINC

GENERAL NOTE:

1. THESE ARE STANDARD ABBREVIATIONS, NOT ALL OF THESE MAY BE USED ON THIS PROJECT.

PRELIMINARY NOT FOR CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

ABBREVIATIONS

DESCHUTES COUNTY, OREGON

CITY OF BEND

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

DESIGNED BY: HLB
DRAWN BY: NEM
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET:
G-002

COB # XXXX

Drawing Path and Name: A:_V-W\Projects\OR\Bend\2024\W243806OR.00\12 CADD\12-5 Sheets\W243806OR_G-002.dwg, Plotted Date: May 7, 2026 8:22 AM By: Derek Cloud

DESIGN CRITERIA

OUTBACK WFF PLANT FLOWS

DESIGN FLOW, MAX	11.8 MGD (18.2 CFS)
DESIGN FLOW, MIN	4.0 MGD (6.2 CFS)
DESIGN FLOW, AVG	9.0 MGD (13.9 CFS)

PRELIMINARY TREATMENT PROCESS

NO. OF PRE-SEDIMENTATION POND BASINS	2, PARALLEL
PRE-SEDIMENTATION POND DIMENSIONS, TOP	330' L X 120' W X 12' H
PRE-SEDIMENTATION POND WATER DEPTH	6' DESIGN - 10' MAX
PRE-SEDIMENTATION POND VOLUME	1.25 MG/6' DEEP 2.35 MG/10' DEEP
PRE-SEDIMENTATION POND DETENTION TIME, MAX FLOW	2.5 HOURS @ 11.8 MGD/6' DEEP
PRE-SEDIMENTATION POND DETENTION TIME, AVG FLOW	3.3 HOURS @ 9.0 MGD/6' DEPTH
PRE-SEDIMENTATION POND DETENTION TIME, MAX DEPTH	4.8 HOURS @ 11.8 MGD/10' DEPTH
RAPID MIX TYPE	VERTICAL MIXER
RAPID MIX DESIGN INTENSITY, G	500-900 1/SEC
NO. OF RAPID MIX STAGES	2
RAPID MIX DETENTION TIME, MIN	32 SEC @ 11.8 MGD (16 SEC PER STAGE)
RAPID MIX VOLUME	2200 GAL PER STAGE
RAPID MIX MOTORS, HP/MGD	0.85 - 1.0
pH ADJUSTMENT	SODIUM HYDROXIDE, SULFURIC ACID
COAGULANT	POLYALUMINUM CHLORIDE
FLOCCULATOR TYPE	HORIZONTAL PADDLE
FLOCCULATOR DETENTION TIME, MIN	16 MIN @ 11.8 MGD (5 MIN PER STAGE)
NO. OF FLOCCULATION STAGES	3
FLOCCULATOR MIX DESIGN INTENSITY, G	60, 45, 30 1/SEC
NO. OF PLATE SETTLER BASINS	3, PARALLEL
PLATE SETTLER DETENTION TIME, MIN	17 MIN @ 11.8 MGD
PLATE SETTLER BASIN REDUNDANCY	2+1
PLATE SETTLER BASIN DIMENSIONS	52.5' L X 22' W X 17.7' H
PLATE PACKS PER BASIN	3
SLUDGE REMOVAL SYSTEM	SLUDGE VACUUM SYSTEM
EXISTING RAW WATER CONDUIT TOTAL LENGTH	50,204FT
EXISTING RAW WATER CONDUIT MATERIAL/SIZE	36-INCH HDPE 30-INCH RESTR DI 30-INCH WELDED STL
EXISTING RAW WATER CONDUIT FLOW/VELOCITY	36CFS / 2.58 FPS
PROPOSED RAW WATER CONDUIT TOTAL LENGTH	1,545FT
PROPOSED RAW WATER CONDUIT MATERIAL/SIZE	30-INCH WELDED STL
PROPOSED RAW WATER CONDUIT FLOW/VELOCITY	36CFS / 2.58 FPS

MEMBRANE FEED PUMPING CRITERIA

TYPE	VERTICAL TURBINE
NUMBER OF PUMPS	4
PUMP CAPACITY, EACH	3,500 GPM
MOTOR SIZE, EACH	200 HP AT 130FT TDH
MOTOR SPEED, EACH	1,200 RPM
DRIVE	VFD

MEMBRANE FILTRATION CRITERIA

MEMBRANE FILTERS

PRIMARY SKIDS	3+1 FUTURE
COMMON STANDBY SKID	1
BACKWASH RECOVERY SKID	1
NUMBER OF MODULES PER SKID, PRIMARY COMMON	132
NUMBER OF MODULES PER SKID, BACKWASH RECOVERY	50
SURFACE AREA PER MODULE	538 SF
FLUX	62 GAL/SF/DAY
MINIMUM RECOVERY	97%

REVERSE FILTRATION PUMPS

TYPE	SPLIT-CASE CENTRIFUGAL
NUMBER OF PUMPS	2
PUMP CAPACITY, EACH	1,056 GPM AT 70FT TDH
MOTOR SIZE, EACH	30 HP
MOTOR SPEED, EACH	1,756 RPM
DRIVE	VFD

BACKWASH RECOVERY SYSTEM

NUMBER OF TANKS	2
TANK CAPACITY, EACH	6,000 GAL
NUMBER OF PUMPS	2
PUMP CAPACITY, EACH	1,650 GPM AT 115FT TDH

CHEMICAL CRITERIA

CITRIC ACID

CONCENTRATION	50%
PERMANENT TOTE STORAGE CAPACITY	330 GAL

SODIUM HYDROXIDE

CONCENTRATION	25%
PERMANENT TOTE STORAGE CAPACITY	330 GAL

SH METERING PUMPS

TYPE	PERISTALTIC
NUMBER OF PUMPS	2
PUMP CAPACITY, EACH	21 GPH

SODIUM HYPOCHLORITE

CONCENTRATION	12.5%
NUMBER OF BULK TANKS	1+1 FUTURE
CAPACITY, EACH	8,000 GAL
DIAMETER	10FT
HEIGHT	14FT

SHC RECIRC/TRANSFER PUMPS

TYPE	PROGRESSING CAVITY
NUMBER OF PUMPS	2
PUMP CAPACITY, EACH	30 GPM
MOTOR SIZE, EACH	2 HP

SHC METERING PUMPS

TYPE	PERISTALTIC
NUMBER OF PUMPS	2
PUMP CAPACITY, EACH	20 GPH

ALUMINUM CHLOROHYDRATE

CONCENTRATION	45-55%
NUMBER OF BULK TANKS	1
CAPACITY, EACH	8,000 GAL
DIAMETER	10FT
HEIGHT	14FT

DOSING PUMPS

TYPE	PERISTALTIC
NUMBER OF PUMPS	3
PUMP CAPACITY, EACH	5.5 GPH

CALCIUM THIOSULFATE

CONCENTRATION	30%
PERMANENT TOTE STORAGE CAPACITY	330 GAL

CTS TRANSFER PUMPS

TYPE	PROGRESSING CAVITY
NUMBER OF PUMPS	1
PUMP CAPACITY, EACH	3 GPM
MOTOR SIZE, EACH	1 HP

SULFURIC ACID

CONCENTRATION	96%
SA METERING PUMPS TYPE	PERISTALTIC
NUMBER OF PUMPS	1
PUMP CAPACITY, EACH	18 GPH

CLEARWELL CRITERIA

EXISTING CHLORINE CONTACT BASIN VOLUME	1.5 MGAL
EXISTING RESERVOIR #1 VOLUME	2.0 MGAL
EXISTING RESERVOIR #2 VOLUME	3.0 MGAL
EXISTING RESERVOIR #3 VOLUME	3.6 MGAL
FUTURE RESERVOIR #6 VOLUME	3.3 MGAL
FUTURE RESERVOIR #7 VOLUME	4.0 MGAL
FUTURE RESERVOIR #8 VOLUME	4.0 MGAL

OVERLOW POND

TOTAL VOLUME	1.22 MG
APPROXIMATE INFILTATION RATE RANGE	$1.1x10^{-4}$ - $1.0x10^{-5}$ CM/S
TOP OF POND ELEVATION	3,981.00
BOTTOM OF POND ELEVATION	3,969.00
EMERGENCY OVERFLOW DESIGN FLOWRATE	18.2 CFS
APPROXIMATE VOLUME AT SPECIFIED DEPTH:	
2'	0.13 MG
4'	0.28 MG
6'	0.46 MG
8'	0.68 MG
10'	0.93 MG
12'	1.22 MG

PRELIMINARY
NOT FOR
CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

DESIGN CRITERIA

CITY OF BEND
DESCHUTES COUNTY, OREGON

REVISIONS:

consor
550 NW FRANKLIN AVENUE,
SUITE 428
BEND, OREGON 97703

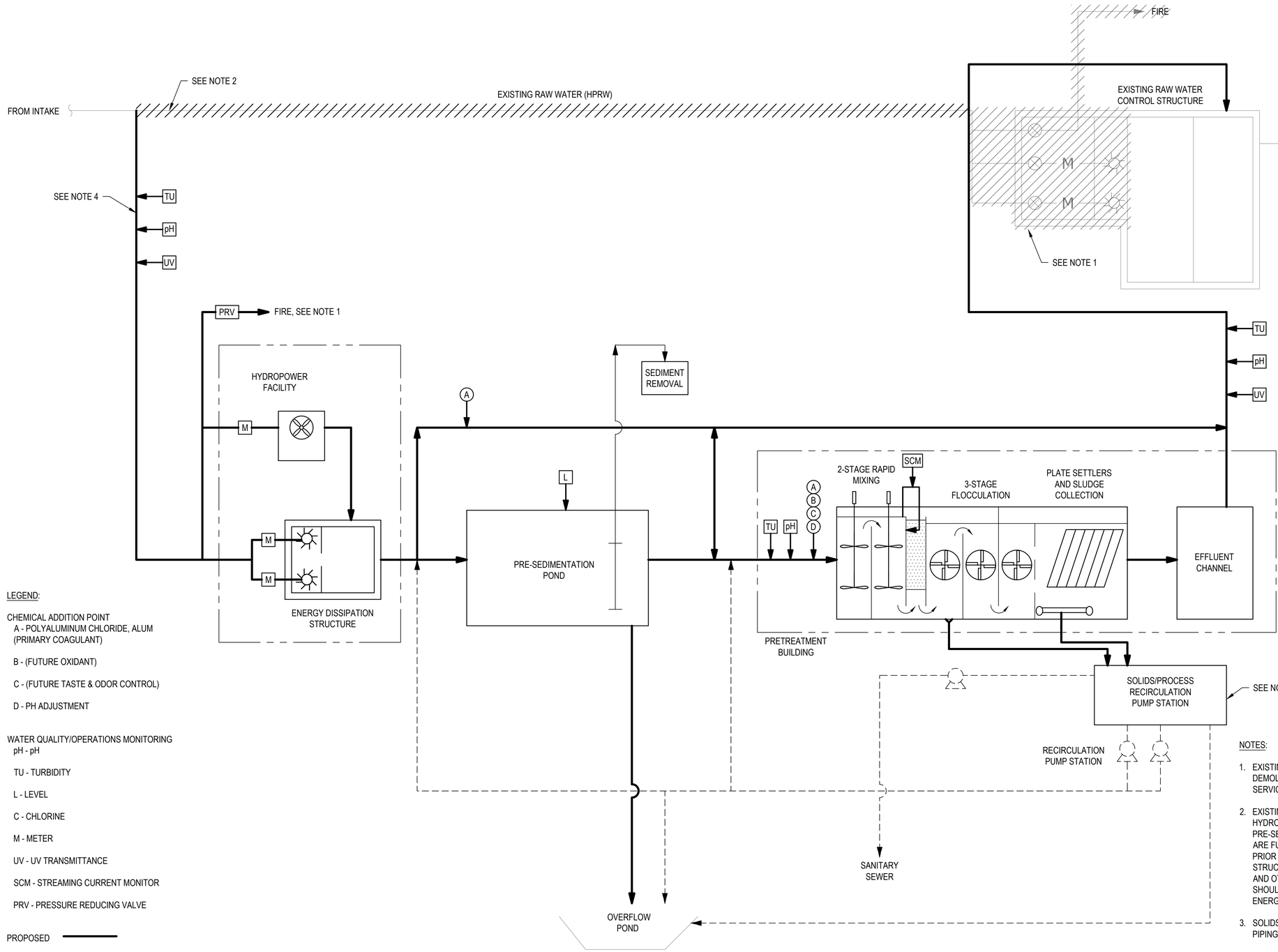
DESIGNED BY: HLB
DRAWN BY: NEM
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH
ON ORIGINAL DRAWING

SHEET:
G-003

COB # XXXX

Drawing Path and Name: A:_V-W\Projects\ORBend\2024\W243806OR.0012 CADD\12-5 Sheets\W243806OR_G-003.dwg, Plotted Date: April 30, 2026 11:40 AM By: Derek Cloud



LEGEND:

CHEMICAL ADDITION POINT
- A - POLYALUMINUM CHLORIDE, ALUM (PRIMARY COAGULANT)
- B - (FUTURE OXIDANT)
- C - (FUTURE TASTE & ODOR CONTROL)
- D - PH ADJUSTMENT

WATER QUALITY/OPERATIONS MONITORING
- pH - pH
- TU - TURBIDITY
- L - LEVEL
- C - CHLORINE
- M - METER
- UV - UV TRANSMITTANCE
- SCM - STREAMING CURRENT MONITOR
- PRV - PRESSURE REDUCING VALVE

PROPOSED
EXISTING
FUTURE
DEMO

NOTES:

1. EXISTING RAW WATER CONTROL STRUCTURE TO BE DEMOLISHED, WETWELL BASIN TO REMAIN. SITE FIRE SERVICE SUPPLY TO BE COMPLETED IN FINAL DESIGN.
2. EXISTING RAW WATER MAIN TO REMAIN IN SERVICE UNTIL HYDRO FACILITY, NEW CONTROL STRUCTURE, PRE-SEDIMENTATION POND, AND PRETREATMENT FACILITY ARE FULLY OPERATIONAL, THEN ABANDONED IN PLACE PRIOR TO DEMOLITION OF EXISTING RAW WATER CONTROL STRUCTURE. RAW WATER CONTROLS, SLEEVE VALVES, AND OTHER EXISTING RAW WATER CONTROL EQUIPMENT SHOULD REMAIN IN PLACE UNTIL STARTUP OF NEW ENERGY DISSIPATION STRUCTURE.
3. SOLIDS/PROCESS RECIRCULATION PUMP STATION AND PIPING TO BE COMPLETED IN FINAL DESIGN.

PRELIMINARY NOT FOR CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

PROCESS FLOW DIAGRAM

DESCHUTES COUNTY, OREGON

CITY OF BEND

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

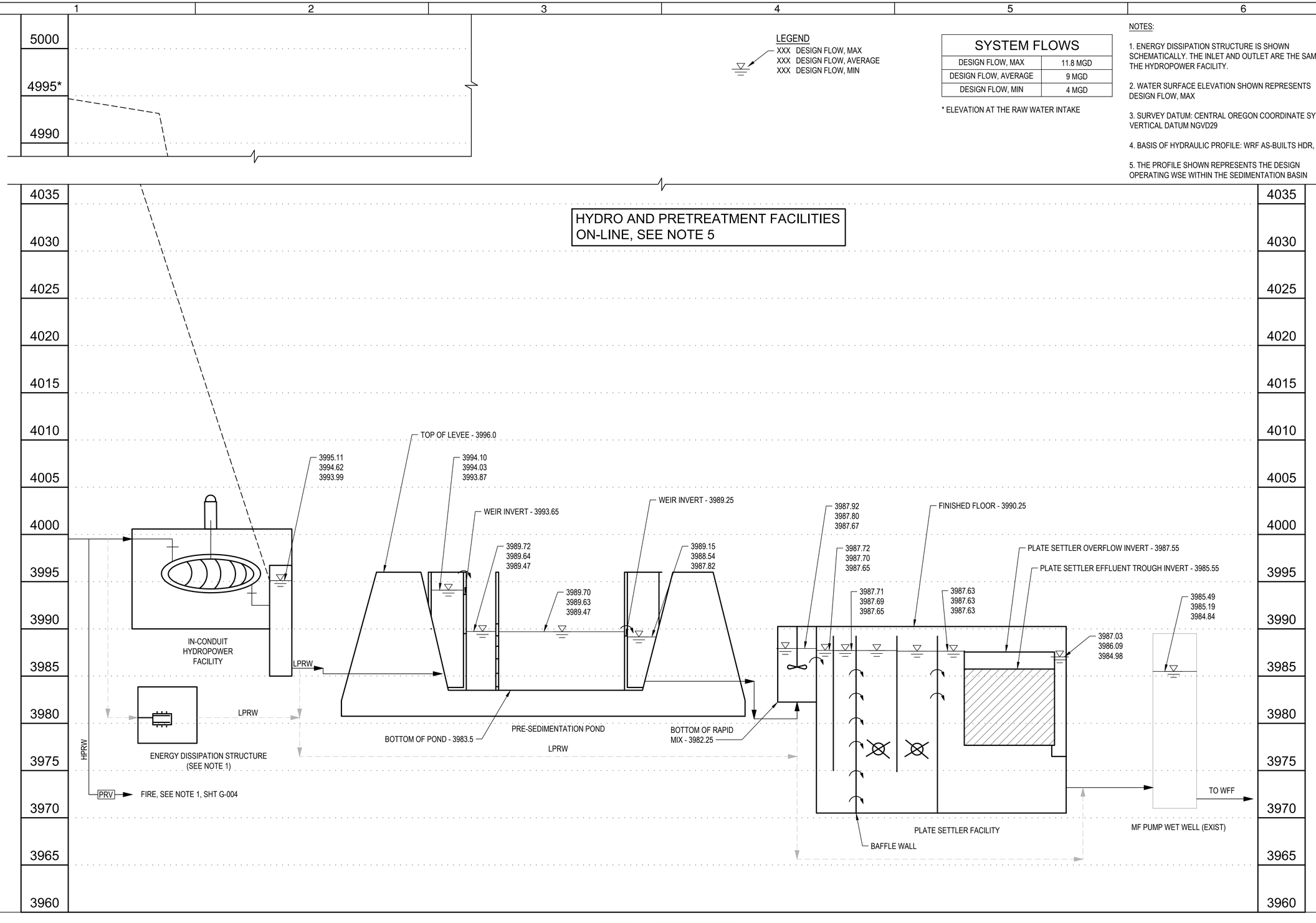
DESIGNED BY: HLB
DRAWN BY: NEM
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 — 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET: G-004

COB # XXXX

Drawing Path and Name: A:_V-W\Projects\ORBend\2024\W243806OR.00\12 CADD\12-5 Sheets\W243806OR_G-004.dwg, Plotted Date: April 30, 2026 11:41 AM By: Derek Cloud



HYDRAULIC PROFILE

SCALE: 1"=5' VERT

LEGEND

XXX DESIGN FLOW, MAX
XXX DESIGN FLOW, AVERAGE
XXX DESIGN FLOW, MIN

SYSTEM FLOWS	
DESIGN FLOW, MAX	11.8 MGD
DESIGN FLOW, AVERAGE	9 MGD
DESIGN FLOW, MIN	4 MGD

* ELEVATION AT THE RAW WATER INTAKE

NOTES:

1. ENERGY DISSIPATION STRUCTURE IS SHOWN SCHEMATICALLY. THE INLET AND OUTLET ARE THE SAME AS THE HYDROPOWER FACILITY.
2. WATER SURFACE ELEVATION SHOWN REPRESENTS DESIGN FLOW, MAX
3. SURVEY DATUM: CENTRAL OREGON COORDINATE SYSTEM VERTICAL DATUM NGVD29
4. BASIS OF HYDRAULIC PROFILE: WRF AS-BUILTS HDR, 2014
5. THE PROFILE SHOWN REPRESENTS THE DESIGN OPERATING WSE WITHIN THE SEDIMENTATION BASIN

PRELIMINARY NOT FOR CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

HYDRAULIC PROFILE - SCENARIO 1A

CITY OF BEND
DESCHUTES COUNTY, OREGON

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

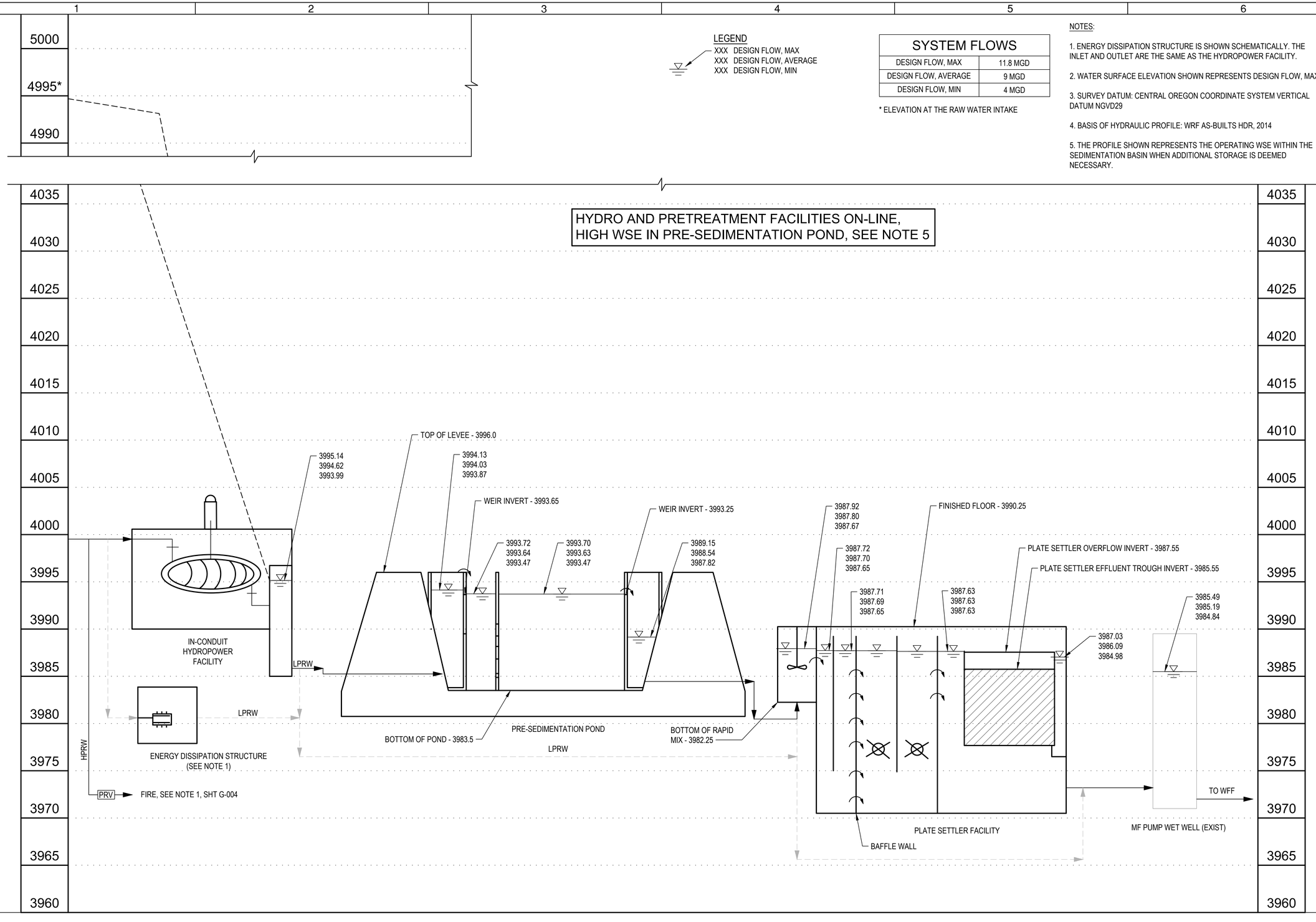
DESIGNED BY: HLB
DRAWN BY: NEM
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET: G-005

COB # XXXX

Drawing Path and Name: A:_V-WProjects\OR\Bend\2024\W243806OR.00\12 CADD\12-5 Sheets\W243806OR_G-005-010.dwg, Plotted Date: April 30, 2026 11:41 AM By: Derek Cloud



HYDRAULIC PROFILE

SCALE: 1"=5' VERT

LEGEND

XXX DESIGN FLOW, MAX
XXX DESIGN FLOW, AVERAGE
XXX DESIGN FLOW, MIN

SYSTEM FLOWS	
DESIGN FLOW, MAX	11.8 MGD
DESIGN FLOW, AVERAGE	9 MGD
DESIGN FLOW, MIN	4 MGD

* ELEVATION AT THE RAW WATER INTAKE

NOTES:

1. ENERGY DISSIPATION STRUCTURE IS SHOWN SCHEMATICALLY. THE INLET AND OUTLET ARE THE SAME AS THE HYDROPOWER FACILITY.
2. WATER SURFACE ELEVATION SHOWN REPRESENTS DESIGN FLOW, MAX
3. SURVEY DATUM: CENTRAL OREGON COORDINATE SYSTEM VERTICAL DATUM NGVD29
4. BASIS OF HYDRAULIC PROFILE: WRF AS-BUILTS HDR, 2014
5. THE PROFILE SHOWN REPRESENTS THE OPERATING WSE WITHIN THE SEDIMENTATION BASIN WHEN ADDITIONAL STORAGE IS DEEMED NECESSARY.

PRELIMINARY NOT FOR CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

HYDRAULIC PROFILE - SCENARIO 1B

CITY OF BEND
DESCHUTES COUNTY, OREGON

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

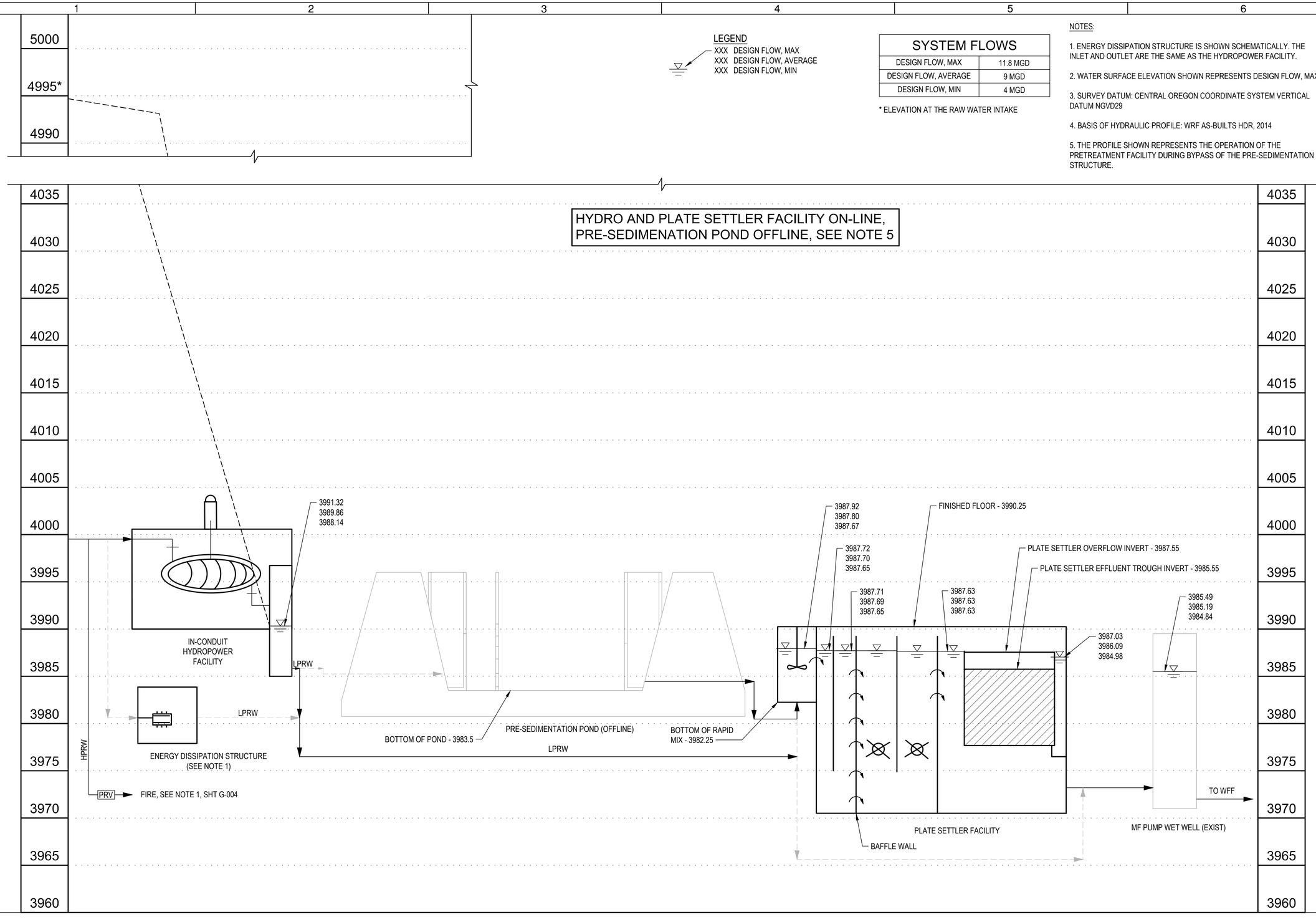
DESIGNED BY: HLB
DRAWN BY: NEM
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET: G-006

COB # XXXX

Drawing Path and Name: A:_V-WProjects\OR\Bend\2024\W243806OR.00\12 CADD\12-5 Sheets\W243806OR_G-005-010.dwg, Plotted Date: April 30, 2026 11:41 AM By: Derek Cloud



HYDRAULIC PROFILE

SCALE: 1"=5' VERT

PRELIMINARY
NOT FOR
CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

HYDRAULIC PROFILE - SCENARIO 2

CITY OF BEND
DESCHUTES COUNTY, OREGON

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

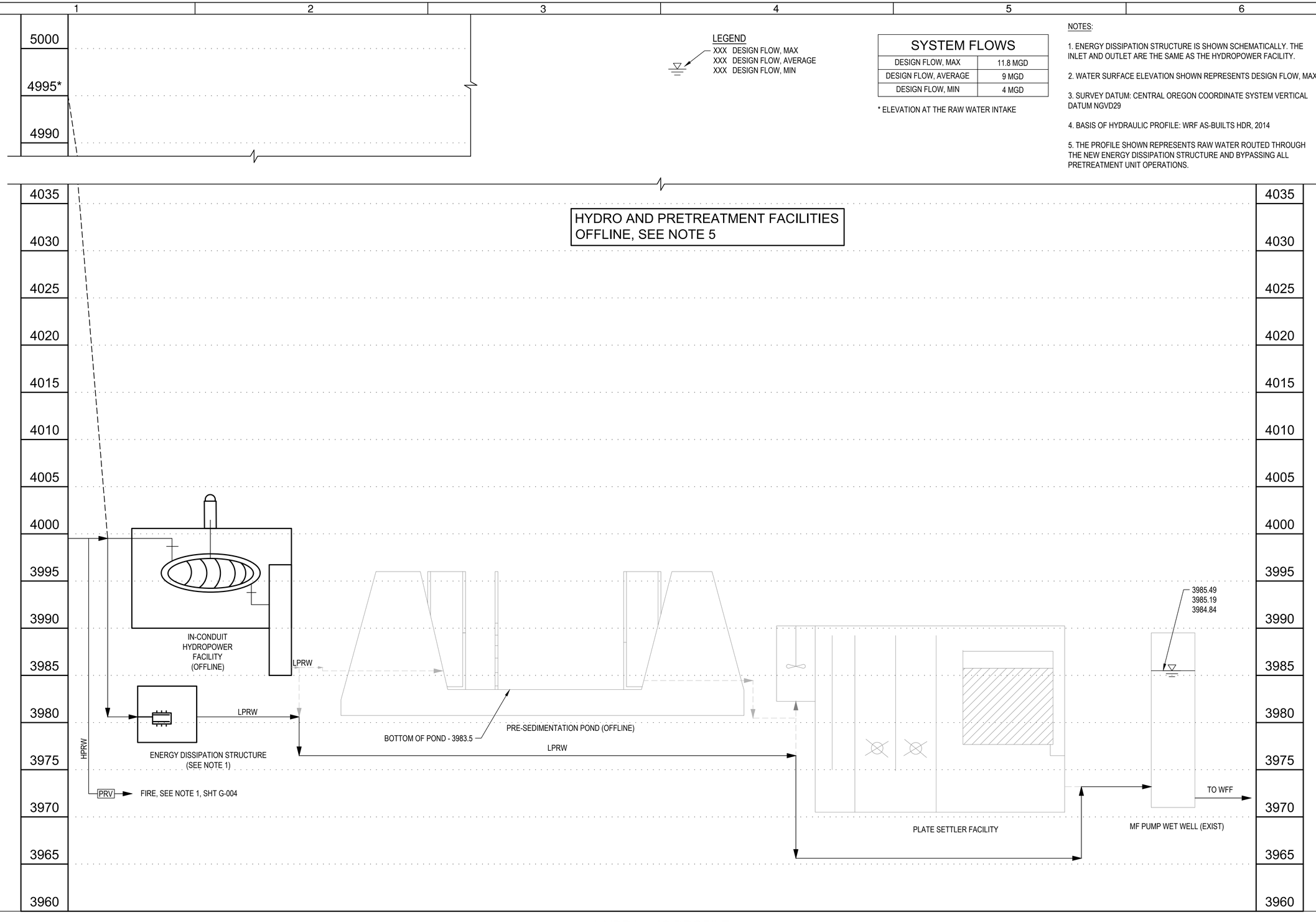
DESIGNED BY: HLB
DRAWN BY: NEM
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET:
G-007

COB # XXXX

Drawing Path and Name: A:_V-WProjects\OR\Bend\2024\W243806OR.00\12 CADD\12-5 Sheets\W243806OR_G-005-010.dwg, Plotted Date: April 30, 2026 11:41 AM By: Derek Cloud



LEGEND

XXX DESIGN FLOW, MAX
XXX DESIGN FLOW, AVERAGE
XXX DESIGN FLOW, MIN

SYSTEM FLOWS	
DESIGN FLOW, MAX	11.8 MGD
DESIGN FLOW, AVERAGE	9 MGD
DESIGN FLOW, MIN	4 MGD

* ELEVATION AT THE RAW WATER INTAKE

NOTES:

1. ENERGY DISSIPATION STRUCTURE IS SHOWN SCHEMATICALLY. THE INLET AND OUTLET ARE THE SAME AS THE HYDROPOWER FACILITY.
2. WATER SURFACE ELEVATION SHOWN REPRESENTS DESIGN FLOW, MAX
3. SURVEY DATUM: CENTRAL OREGON COORDINATE SYSTEM VERTICAL DATUM NGVD29
4. BASIS OF HYDRAULIC PROFILE: WRF AS-BUILTS HDR, 2014
5. THE PROFILE SHOWN REPRESENTS RAW WATER ROUTED THROUGH THE NEW ENERGY DISSIPATION STRUCTURE AND BYPASSING ALL PRETREATMENT UNIT OPERATIONS.

HYDRAULIC PROFILE

SCALE: 1"=5' VERT

PRELIMINARY NOT FOR CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

HYDRAULIC PROFILE - SCENARIO 3

CITY OF BEND
DESCHUTES COUNTY, OREGON

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

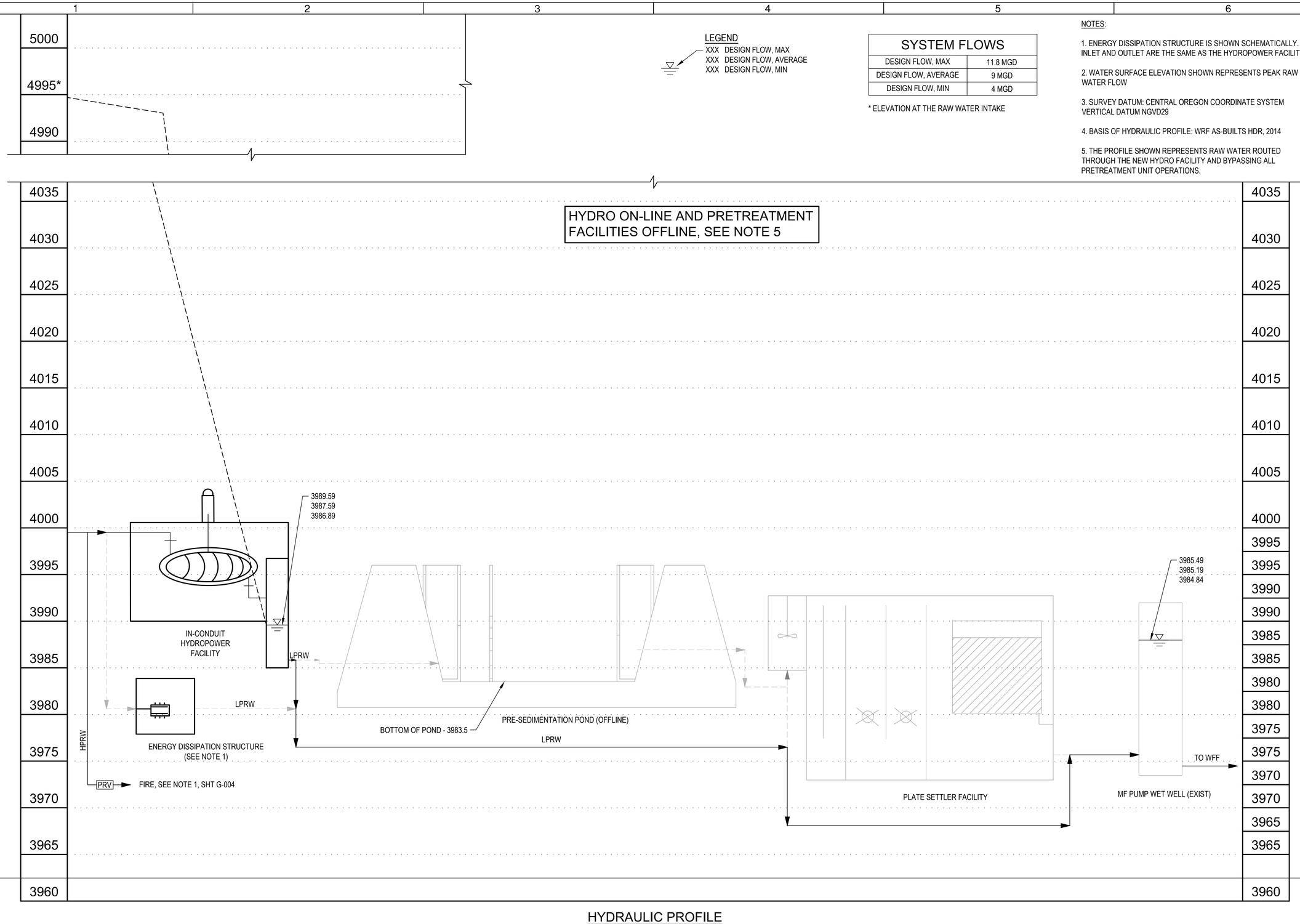
DESIGNED BY: HLB
DRAWN BY: NEM
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET: G-008

COB # XXXX

Drawing Path and Name: A:_V-WProjects\OR\Bend\2024\W243806OR.00\12 CADD\12-5 Sheets\W243806OR_G-005-010.dwg, Plotted Date: April 30, 2026 11:41 AM By: Derek Cloud



LEGEND

XXX DESIGN FLOW, MAX
XXX DESIGN FLOW, AVERAGE
XXX DESIGN FLOW, MIN

SYSTEM FLOWS	
DESIGN FLOW, MAX	11.8 MGD
DESIGN FLOW, AVERAGE	9 MGD
DESIGN FLOW, MIN	4 MGD

* ELEVATION AT THE RAW WATER INTAKE

NOTES:

1. ENERGY DISSIPATION STRUCTURE IS SHOWN SCHEMATICALLY. THE INLET AND OUTLET ARE THE SAME AS THE HYDROPOWER FACILITY.
2. WATER SURFACE ELEVATION SHOWN REPRESENTS PEAK RAW WATER FLOW
3. SURVEY DATUM: CENTRAL OREGON COORDINATE SYSTEM VERTICAL DATUM NGVD29
4. BASIS OF HYDRAULIC PROFILE: WRF AS-BUILTS HDR, 2014
5. THE PROFILE SHOWN REPRESENTS RAW WATER ROUTED THROUGH THE NEW HYDRO FACILITY AND BYPASSING ALL PRETREATMENT UNIT OPERATIONS.

HYDRAULIC PROFILE

SCALE: 1"=5' VERT

PRELIMINARY NOT FOR CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

HYDRAULIC PROFILE - SCENARIO 4

DESCHUTES COUNTY, OREGON

CITY OF BEND

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

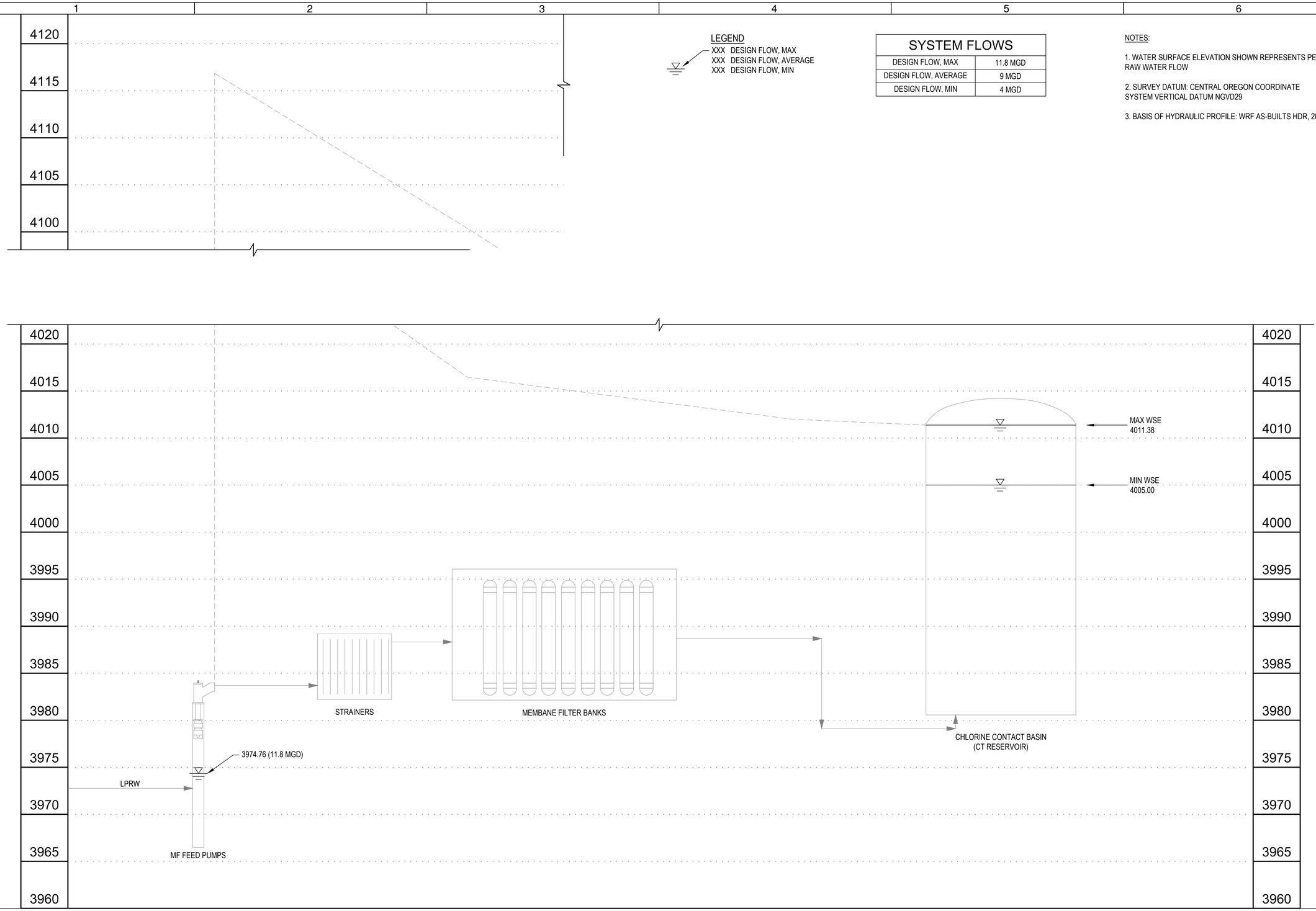
DESIGNED BY: HLB
DRAWN BY: NEM
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET: G-009

COB # XXXX

Drawing Path and Name: A:_V-WProjects\OR\Bend\2024\W243806OR.00\12 CADD\12-5 Sheets\W243806OR_G-005-010.dwg, Plotted Date: April 30, 2026 11:41 AM By: Derek Cloud



SYSTEM FLOWS	
DESIGN FLOW, MAX	11.8 MGD
DESIGN FLOW, AVERAGE	9 MGD
DESIGN FLOW, MIN	4 MGD

NOTES:

1. WATER SURFACE ELEVATION SHOWN REPRESENTS PEAK RAW WATER FLOW
2. SURVEY DATUM: CENTRAL OREGON COORDINATE SYSTEM VERTICAL DATUM NGVD29
3. BASIS OF HYDRAULIC PROFILE: WRF AS-BUILTS HDR, 2014

HYDRAULIC PROFILE

SCALE: 1"=5' VERT

PRELIMINARY NOT FOR CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

HYDRAULIC PROFILE - EXISTING

CITY OF BEND
DESCHUTES COUNTY, OREGON

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

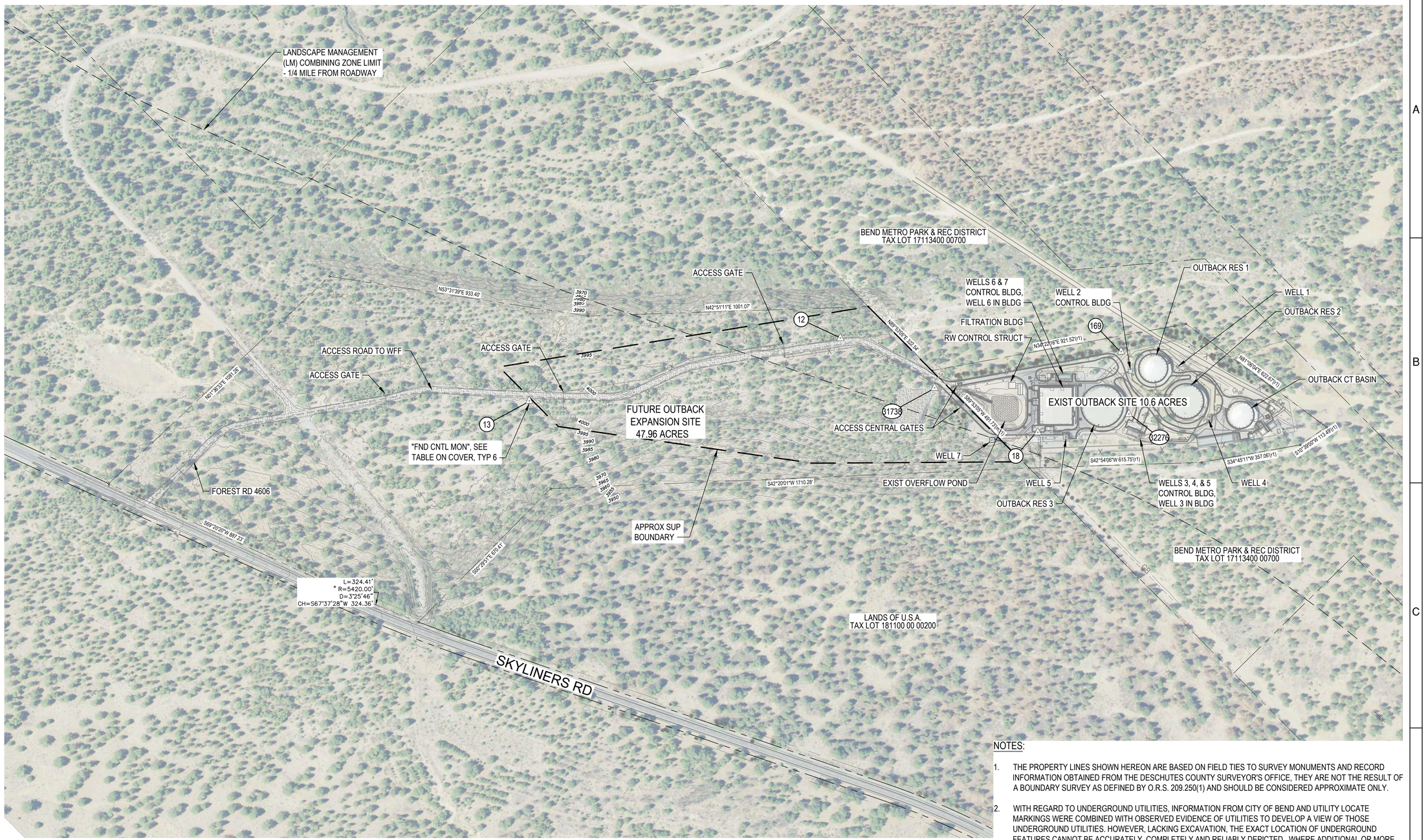
DESIGNED BY: HLB
DRAWN BY: NEM
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET:
G-010

COB # XXXX

Drawing Path and Name: A:\...V-W\Projects\OR\Bend\2024\W243806OR.00\12 CADD\12-5 Sheets\W243806OR_G-005-010.dwg, Plotted Date: April 30, 2026 11:42 AM By: Derek Cloud



PLAN
SCALE: 1"=175'

NOTES:

1. THE PROPERTY LINES SHOWN HEREON ARE BASED ON FIELD TIES TO SURVEY MONUMENTS AND RECORD INFORMATION OBTAINED FROM THE DESCHUTES COUNTY SURVEYOR'S OFFICE, THEY ARE NOT THE RESULT OF A BOUNDARY SURVEY AS DEFINED BY O.R.S. 209.250(1) AND SHOULD BE CONSIDERED APPROXIMATE ONLY.
2. WITH REGARD TO UNDERGROUND UTILITIES, INFORMATION FROM CITY OF BEND AND UTILITY LOCATE MARKINGS WERE COMBINED WITH OBSERVED EVIDENCE OF UTILITIES TO DEVELOP A VIEW OF THOSE UNDERGROUND UTILITIES. HOWEVER, LACKING EXCAVATION, THE EXACT LOCATION OF UNDERGROUND FEATURES CANNOT BE ACCURATELY, COMPLETELY AND RELIABLY DEPICTED. WHERE ADDITIONAL OR MORE DETAILED INFORMATION IS REQUIRED, EXCAVATION MAY BE NECESSARY.
3. THIS PROPERTY IS SUBJECT TO ALL EASEMENTS, RESTRICTIONS, AND RIGHT-OF-WAYS OF RECORD AND THOSE COMMON AND APPARENT ON THE LAND.
4. NO TITLE REPORT OR RESULTS OF A TITLE SEARCH HAVE BEEN FURNISHED TO HWA FOR THE PURPOSE OF SHOWING ON THIS MAP. THERE MAY BE EASEMENTS, RESTRICTIONS OR OTHER DOCUMENTS OF RECORD THAT ARE NOT SHOWN HEREON WHICH A CURRENT TITLE SEARCH MAY DISCLOSE.
5. THE COORDINATES SHOWN ARE BASED ON THE CENTRAL OREGON COORDINATE SYSTEM. ELEVATIONS SHOWN ARE BASED ON THE VERTICAL DATUM NGVD29 AND WERE DERIVED FROM PUBLISHED CENTRAL OREGON COORDINATE SYSTEM BENCHMARKS.

PRELIMINARY NOT FOR CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

EXISTING CONDITIONS AND SURVEY CONTROL

CITY OF BEND
DESCHUTES COUNTY, OREGON

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

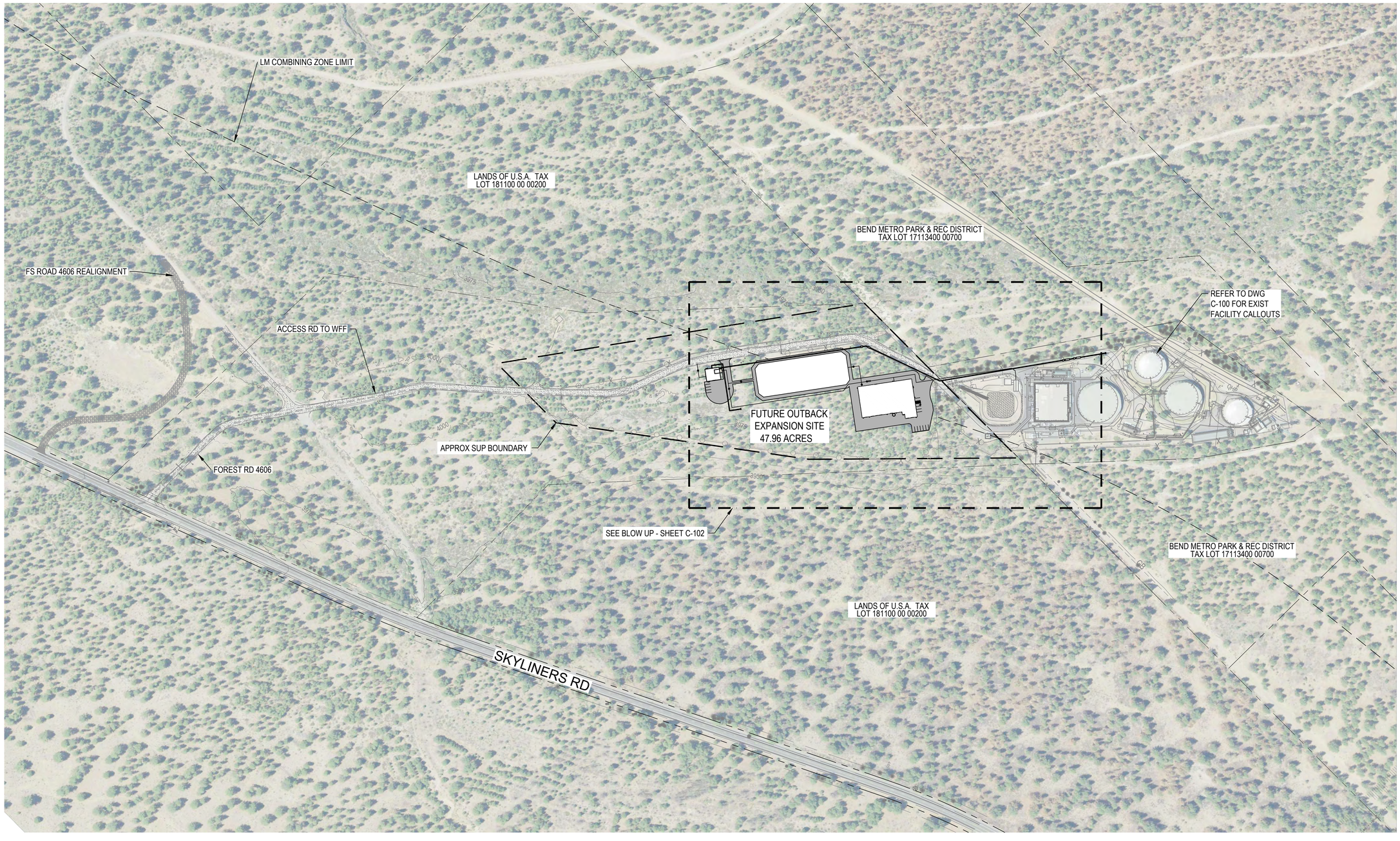
DESIGNED BY: HLB
DRAWN BY: NEM
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET: C-100

COB # XXXX

Drawing Path and Name: A:_V-W\Projects\OR\Bend\2024\W243806OR.00\12 CADD\12-5 Sheets\W243806OR_C-100.dwg, Plotted Date: May 7, 2026 8:22 AM By: Derek Cloud



PLAN
SCALE: 1"=175'

PRELIMINARY
NOT FOR
CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

CITY OF BEND OUTBACK FACILITY IMPROVEMENTS SITE PLAN
DESCHUTES COUNTY, OREGON

REVISIONS:

consor
550 NW FRANKLIN AVENUE,
SUITE 428
BEND, OREGON 97703

DESIGNED BY: HLB
DRAWN BY: NEM
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH
ON ORIGINAL DRAWING

SHEET:
C-101

COB # XXXX

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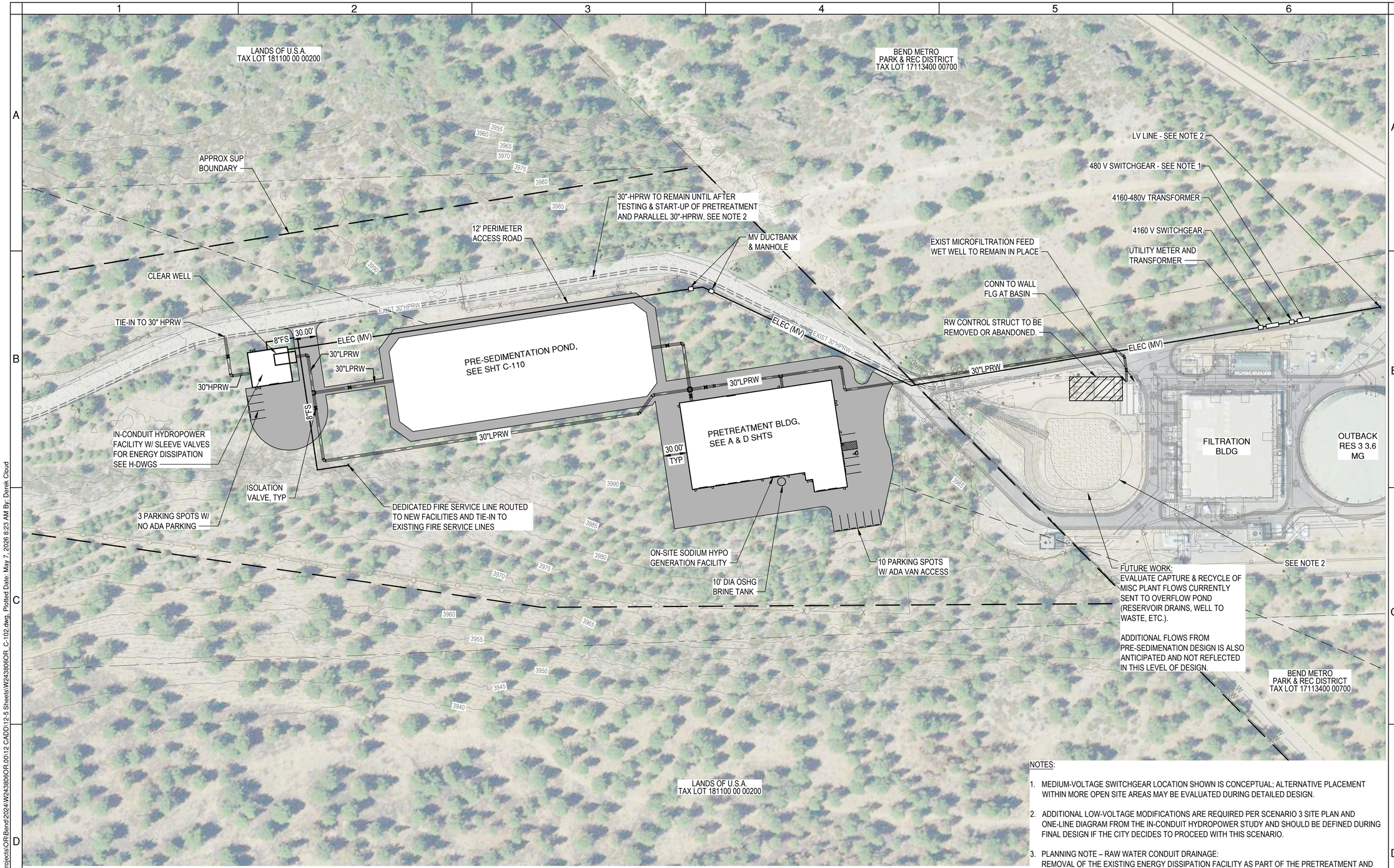


PLAN
SCALE: 1" = 60'

NOTES:

1. MEDIUM-VOLTAGE SWITCHGEAR LOCATION SHOWN IS CONCEPTUAL; ALTERNATIVE PLACEMENT WITHIN MORE OPEN SITE AREAS MAY BE EVALUATED DURING DETAILED DESIGN.
2. ADDITIONAL LOW-VOLTAGE MODIFICATIONS ARE REQUIRED PER SCENARIO 3 SITE PLAN AND ONE-LINE DIAGRAM FROM THE IN-CONDUIT HYDROPOWER STUDY AND SHOULD BE DEFINED DURING FINAL DESIGN IF THE CITY DECIDES TO PROCEED WITH THIS SCENARIO.
3. PLANNING NOTE – RAW WATER CONDUIT DRAINAGE:
REMOVAL OF THE EXISTING ENERGY DISSIPATION FACILITY AS PART OF THE PRETREATMENT AND IN-CONDUIT HYDROPOWER IMPROVEMENTS WILL REQUIRE RE EVALUATION OF HOW THE 30-INCH RAW WATER TRANSMISSION MAIN IS DRAINED FOR MAINTENANCE AND OPERATIONAL NEEDS. WHILE CURRENT OPERATIONS ALLOW DRAINING TO THE EXISTING OVERFLOW POND, FUTURE SITE CONFIGURATION MAY REQUIRE A NEW DRAINAGE APPROACH, SUCH AS A MODIFIED POND CONNECTION, NEW PIPING, OR SELECTIVE REUSE OF EXISTING PIPELINE SEGMENTS. FINAL DRAINAGE CONFIGURATION WILL BE EVALUATED AND CONFIRMED DURING SUBSEQUENT DESIGN PHASES.

PRELIMINARY NOT FOR CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

IN-CONDUIT HYDROPOWER AND PRETREATMENT SITE PLAN
DESCHUTES COUNTY, OREGON

CITY OF BEND

REVISIONS:

consor
550 NW FRANKLIN AVENUE,
SUITE 428
BEND, OREGON 97703

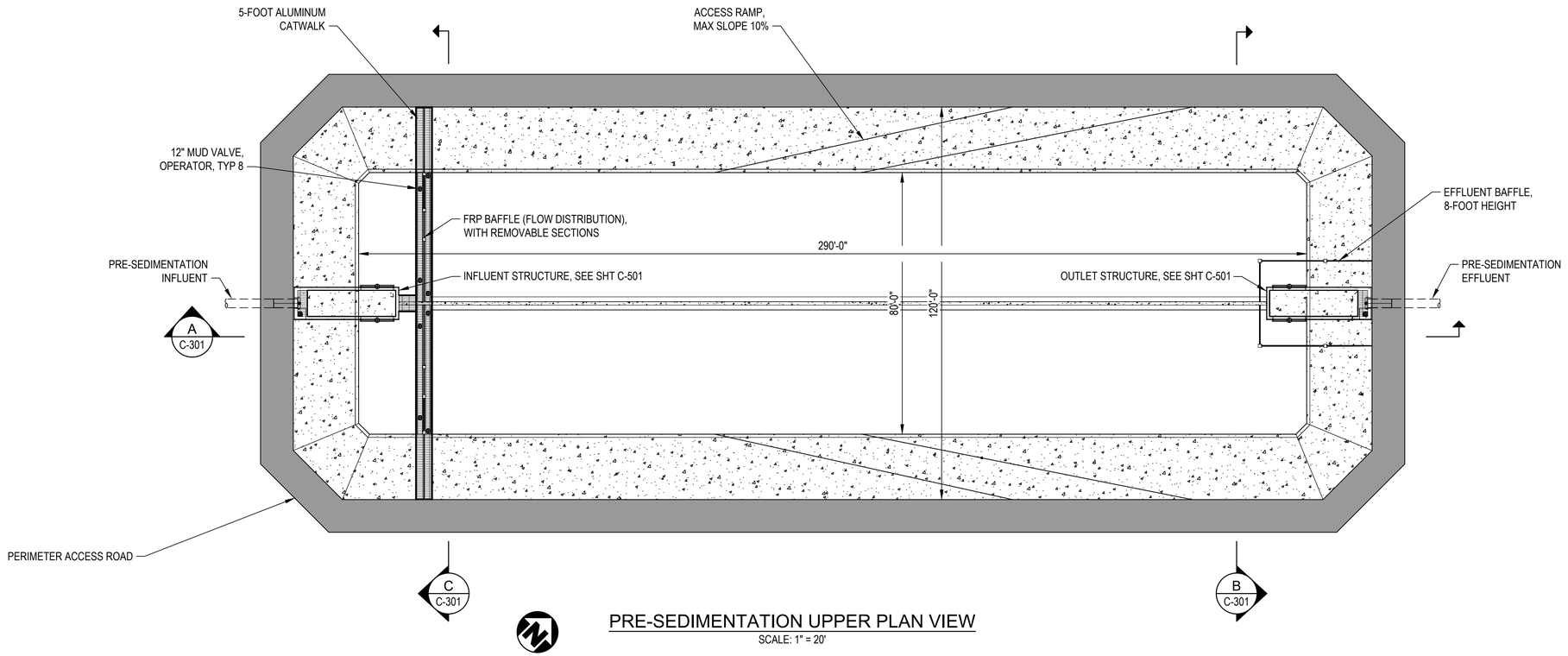
DESIGNED BY: HLB
DRAWN BY: NEM
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH
ON ORIGINAL DRAWING

SHEET:
C-102

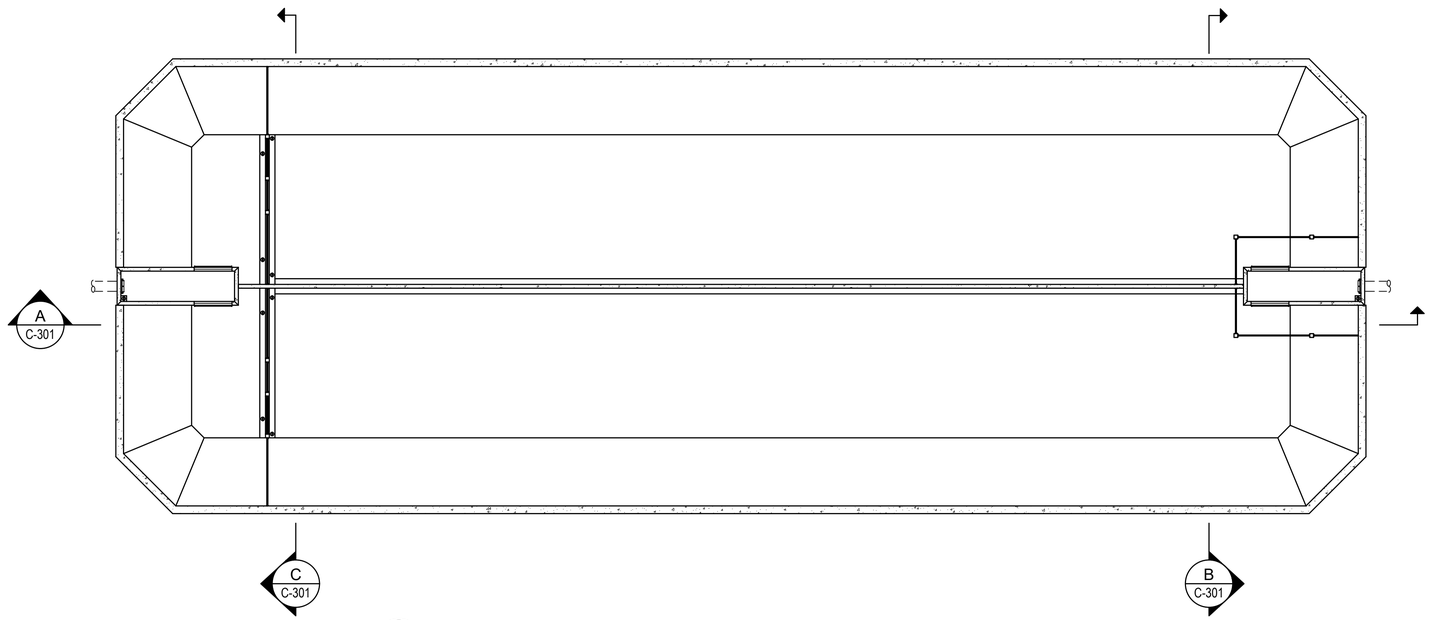
COB # XXXX

Drawing Path and Name: A:\...V:\W\Projects\OR\Bend\2024\W243806OR.00\12 CADD\12-5 Sheets\W243806OR_C-102.dwg, Plotted Date: May 7, 2026 8:23 AM By: Derek Cloud



PRE-SEDIMENTATION UPPER PLAN VIEW

SCALE: 1" = 20'



PRE-SEDIMENTATION LOWER PLAN VIEW

SCALE: 1" = 20'

PRELIMINARY NOT FOR CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

PRE-SEDIMENTATION POND PLAN

DESCHUTES COUNTY, OREGON

CITY OF BEND

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

DESIGNED BY: HLB
DRAWN BY: NEM
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

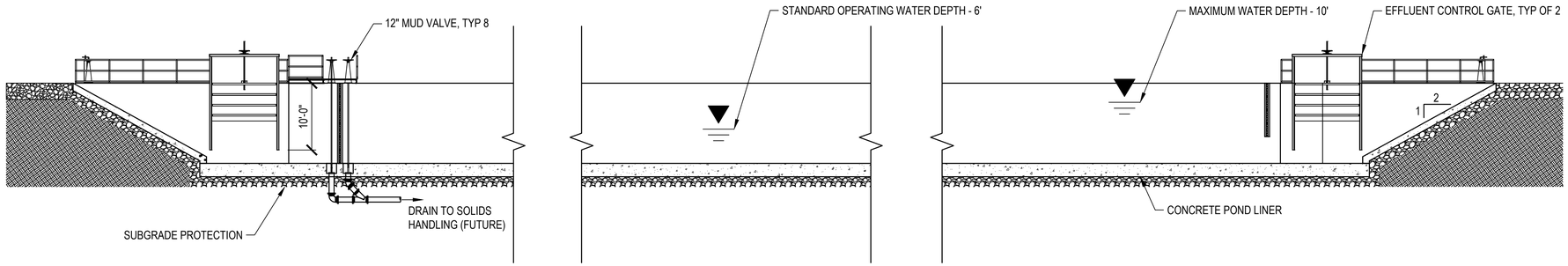
SHEET: C-110

COB # XXXX

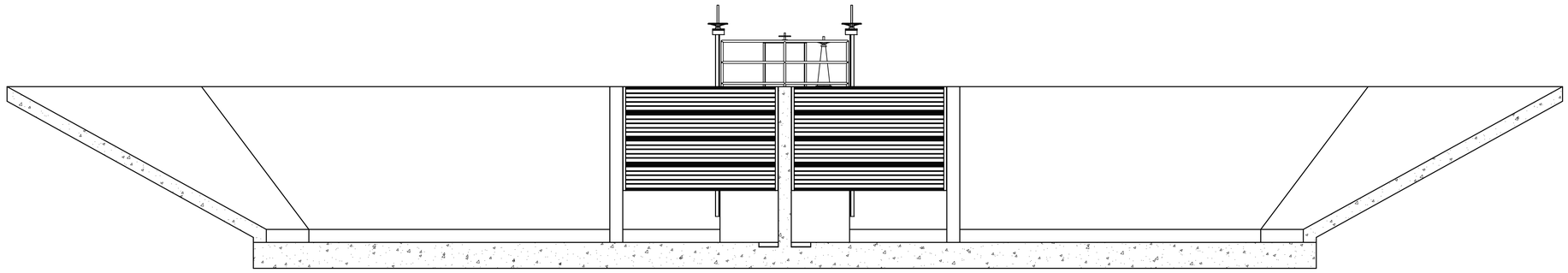
Drawing Path and Name: A:_V-W\Projects\OR\Bend\2024\W2438096OR.00\12 CADD\12-5 Sheets\W2438096OR_C-110.dwg, Plotted Date: April 30, 2026 11:44 AM By: Derek Cloud

NOTES:

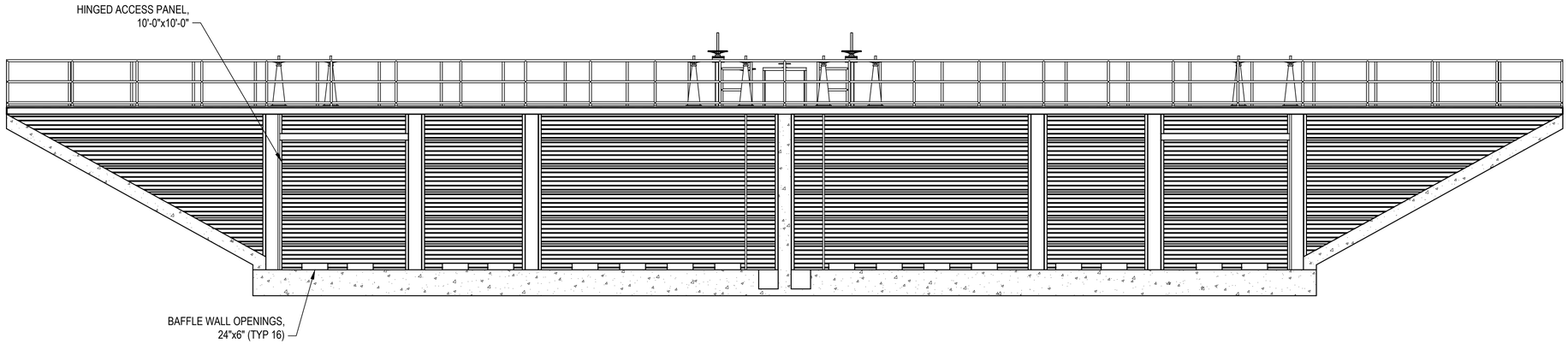
1. EFFLUENT GATES MINIMUM ELEVATION SHALL BE 3989.25 CORRESPONDING TO A STANDARD OPERATING DEPTH FOR PRE-SEDIMENTATION POND OF 6'.



A C-110 PRE-SEDIMENTATION POND SECTION
SCALE: 1" = 10'



B C-110 PRE-SEDIMENTATION POND SECTION
SCALE: 1"=5'



C C-110 PRE-SEDIMENTATION POND SECTION
SCALE: 1"=5'

PRELIMINARY
NOT FOR
CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

PRE-SEDIMENTATION POND SECTION

CITY OF BEND
DESCHUTES COUNTY, OREGON

REVISIONS:

consor
550 NW FRANKLIN AVENUE,
SUITE 428
BEND, OREGON 97703

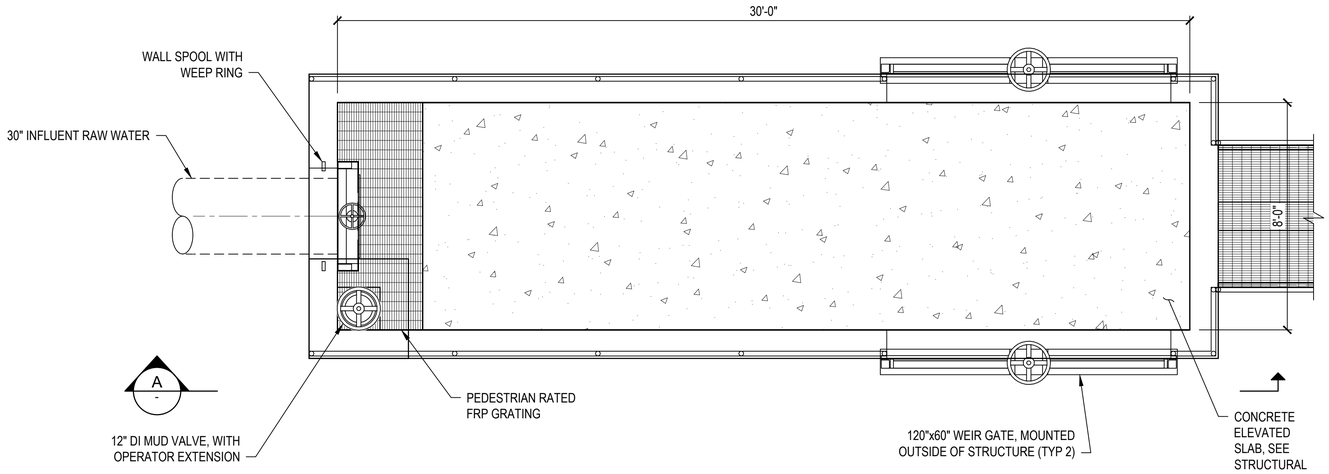
DESIGNED BY: HLB
DRAWN BY: NEM
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH
ON ORIGINAL DRAWING

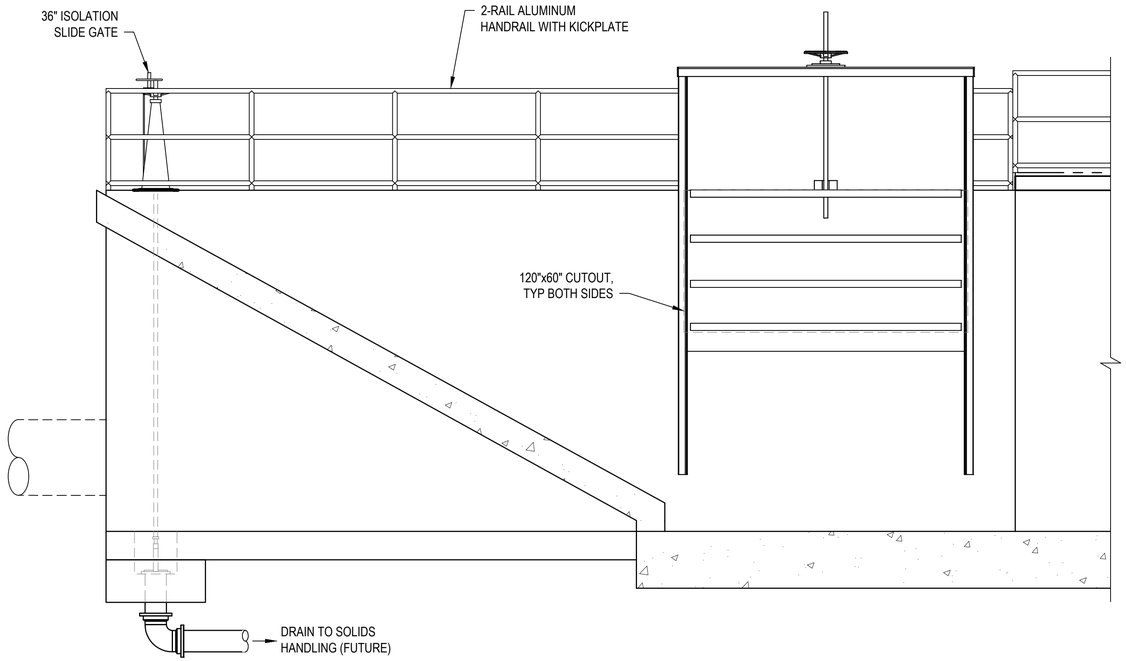
SHEET:
C-301

COB # XXXX

Drawing Path and Name: A:_V-W\Projects\OR\Bend\2024\W243806OR.0012 CADD\12-5 Sheets\W243806OR_C-301.dwg, Plotted Date: April 30, 2026 11:44 AM By: Derek Cloud



PLAN
SCALE: 3/8" = 1'-0"



A
-
SECTION
SCALE: 3/8" = 1'-0"

NOTES:

1. ALL HARDWARE SHALL BE 316 SST, UNLESS SPECIFIED OTHERWISE.
2. HYDRAULIC GATES ACTUATORS SHALL HAVE 2" OPERATING NUTS.
3. MOUNT HYDRAULIC GATES TO THE OUTSIDE WALL OF THE INLET/OUTLET STRUCTURES. GATE GUIDES SHALL BE THE WALL MOUNTED TYPE.
4. MUD VALVE OPERATOR SHALL EXTEND THROUGH THE FRP GRATING TERMINATING AT 3' ABOVE THE TOP OF INLET/OUTLET STRUCTURE.
5. STRUCTURAL ELEMENTS ARE SHOWN FOR REFERENCE ONLY. SEE STRUCTURAL SHEETS FOR DETAILED DESIGN (STRUCTURAL SHEETS TO FOLLOW).
6. FRP GRATING SUPPORTS SHALL BE SURFACE MOUNTED 316 SST. GRATING SHALL BE PEDESTRIAN RATED. SEE STRUCTURAL SHEETS FOR DETAILED DESIGN (STRUCTURAL SHEETS TO FOLLOW).
7. INLET AND OUTLET STRUCTURE SHALL BE THE MIRROR IMAGE OF ONE ANOTHER. DESIGN ELEMENTS SHALL BE THE SAME FOR BOTH STRUCTURES.

PRELIMINARY NOT FOR CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

INLET/OUTLET STRUCTURE DETAILS

DESCHUTES COUNTY, OREGON

CITY OF BEND

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

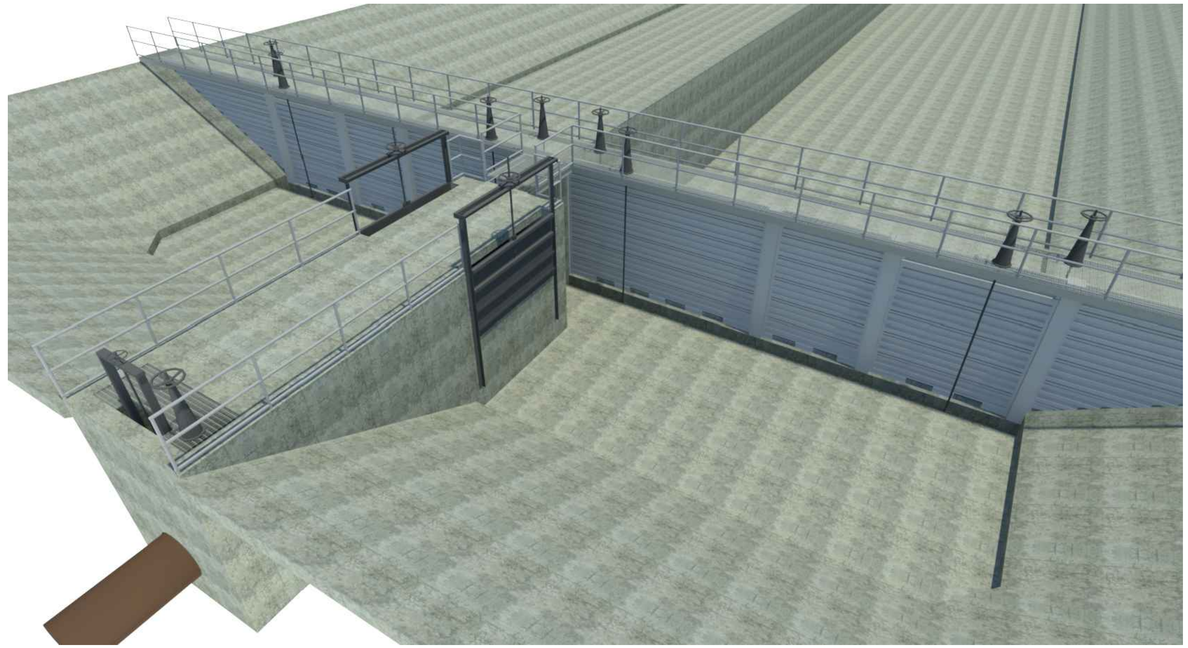
DESIGNED BY: HLB
DRAWN BY: TMB
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

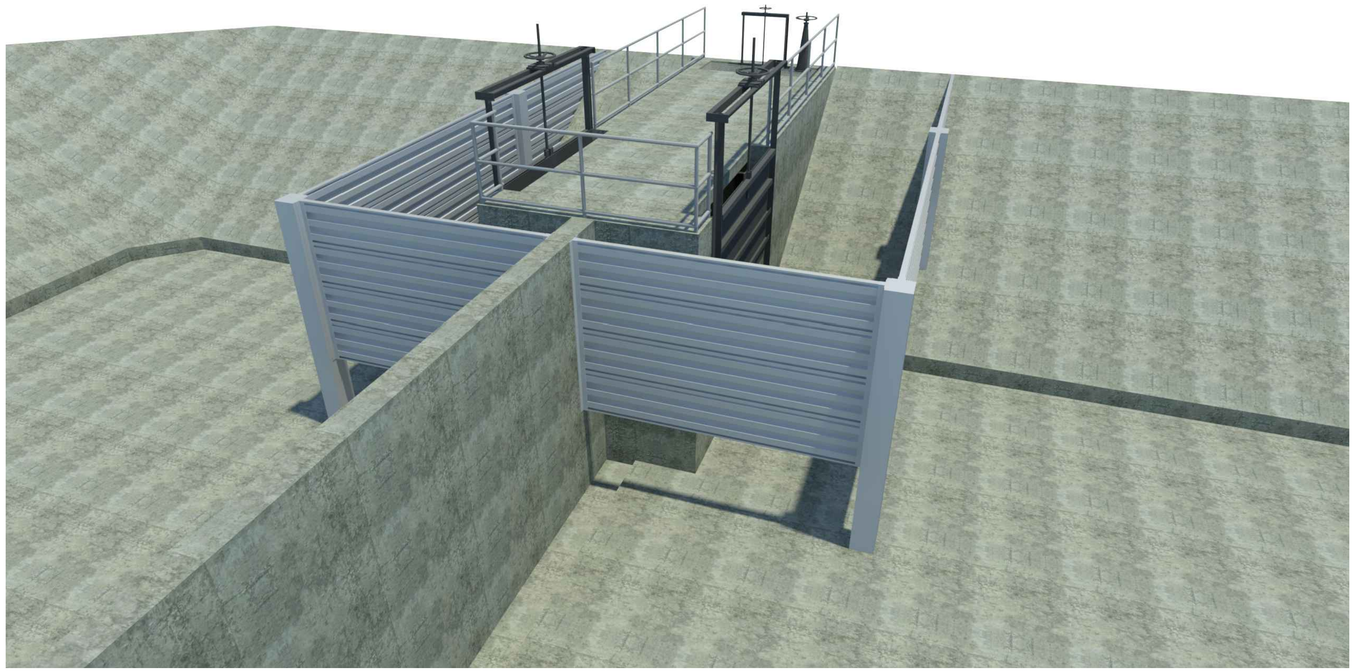
SHEET:
C-501

COB # XXXX

Drawing Path and Name: A:\...V-W\Projects\OR\Bend\2024\W2438006OR.00\12 CADD\12-5 Sheets\W2438006OR_C-501.dwg, Plotted Date: April 30, 2026 11:44 AM By: Derek Cloud



INLET STRUCTURE PERSPECTIVE
SCALE: NTS



OUTLET STRUCTURE PERSPECTIVE
SCALE: NTS

NOTE:
PERSPECTIVE VIEW IS FOR GENERAL REFERENCE ONLY. DO NOT USE FOR CONSTRUCTION. NOT ALL WORK ELEMENTS SHOWN.

PRELIMINARY
NOT FOR
CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

SEDIMENTATION BASIN PERSPECTIVES

DESCHUTES COUNTY, OREGON

CITY OF BEND

REVISIONS:

consor
550 NW FRANKLIN AVENUE,
SUITE 428
BEND, OREGON 97703

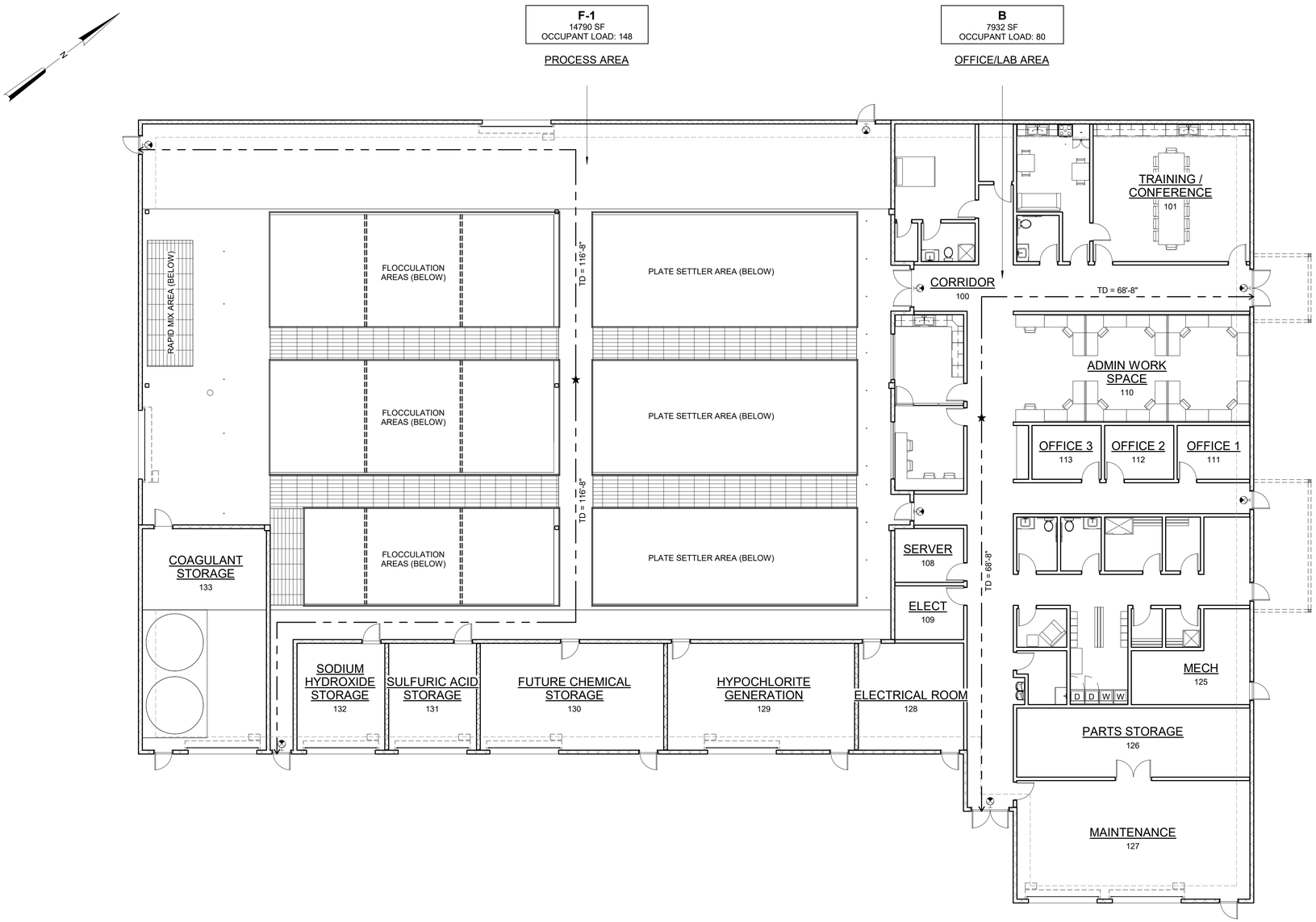
DESIGNED BY: HLB
DRAWN BY: TMB
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH
ON ORIGINAL DRAWING

SHEET:
C-901

COB # XXXX

Drawing Path and Name: A:\...V-W\Projects\OR\Bend\2024\W2438906OR.001\12 CADD\12-5 Sheets\W2438906OR_C-901.dwg, Plotted Date: April 30, 2026 11:45 AM By: Derek Cloud



INTERMEDIATE LIFE SAFETY PLAN

3/32" = 1'-0"

OREGON STRUCTURAL SPECIALTY CODE (OSSC) 2022		
CODE ITEM	CODE REFERENCE	100-PTF BLDG
OCCUPANCY CLASSIFICATION: PROCESS	CHAPTER 3	GROUP F-1
OCCUPANCY CLASSIFICATION: OFFICE/LAB	CHAPTER 3	GROUP B
CONSTRUCTION CLASSIFICATION: BOTH	CHAPTER 6	TYPE IIB
TABULAR HEIGHT ALLOWED	CHAPTER 5 - TABLE 504.3	55'-0" = F-1 55'-0" = B
ACTUAL HEIGHT AS DESIGNED		TBD
TABULAR AREA ALLOWED	CHAPTER 5 - TABLE 506.2	15,500 SF = F-1 23,500 SF = B
ACTUAL AREA AS DESIGNED		14,790 SF = F-1 7,932 SF = B
STORIES ALLOWED	CHAPTER 5 - TABLE 504.4	2 = F-1 3 = B
ACTUAL STORIES		2
FIRE RESISTANCE RATING REQUIREMENTS		
STRUCTURAL FRAME	CHAPTER 6 - TABLE 601	0
EXTERIOR BEARING WALLS	CHAPTER 6 - TABLE 601 & 602	0
INTERIOR BEARING WALLS	CHAPTER 6 - TABLE 601	0
EXTERIOR NON-BEARING WALLS AND PARTITIONS	CHAPTER 6 - TABLE 602	N/A
INTERIOR NON-BEARING WALLS AND PARTITIONS	CHAPTER 6 - TABLE 601	N/A
FLOOR CONSTRUCTION	CHAPTER 6 - TABLE 601	0
ROOF CONSTRUCTION	CHAPTER 6 - TABLE 601	0
SHAFT ENCLOSURES - EXIT	CHAPTER 7 - SECTION 708.4	N/A
OPENING PROTECTIVES	CHAPTER 7 - SECTION 716	0
EGRESS WIDTH PER OCCUPANT SERVED		
STAIRWAYS	TABLE 1005.3.1	N/A
OTHER EGRESS COMPONENTS	SECTION 1005.3.2	0.2" PER OCC. = F-1 0.2" PER OCC. = B
OCCUPANT LOAD: PROCESS	TABLE 1004.5	14,790/100 = 148 OCCUPANTS
OCCUPANT LOAD: OFFICE/LAB	TABLE 1004.5	7,932/100 = 80 OCCUPANTS
ALLOWABLE TRAVEL DISTANCE	TABLE 1017.2	200'-0" = F-1 200'-0" = B
ACTUAL TRAVEL DISTANCE		116'-8" = F-1 68'-8" = B
LIFE SAFETY SYSTEM REQUIREMENTS		
EMERGENCY LIGHTING	SECTION 1008.2	YES
EXIT SIGNS	SECTION 1013	YES
AUTOMATIC SPRINKLERS	SECTION 903.2	YES
FIRE ALARM	SECTION 907	YES
SMOKE DETECTION SYSTEMS	SECTION 907	NO
PANIC HARDWARE	SECTION 1010.1.10	YES
STRUCTURAL AND SEISMIC DESIGN LOADS - SEE STRUCTURAL DRAWINGS		

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER: A. DUKE
DESIGNED BY: J. SHELTON
DRAWN BY: D. DAHL
CHECKED BY: B. RUSSELL
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

PRELIMINARY DRAWING
DO NOT USE FOR CONSTRUCTION

Hazen
H&S ENGINEERING AND ARCHITECTURE
4011 WESTCHASE BLVD, SUITE 500
RALEIGH, NC 27607
REGISTRATION NUMBER 54078

CONSOR NORTH AMERICA
BEND, OREGON

OUTBACK FACILITY PLAN
CITY OF BEND
PRE-TREATMENT FACILITIES

PRE-TREATMENT BUILDING
ARCHITECTURAL
BUILDING CODE AND LIFE SAFETY PLAN

DATE: APRIL 2026
HAZEN NO.: 80020-000
CONTRACT NO.: 1
DRAWING NUMBER: A-001

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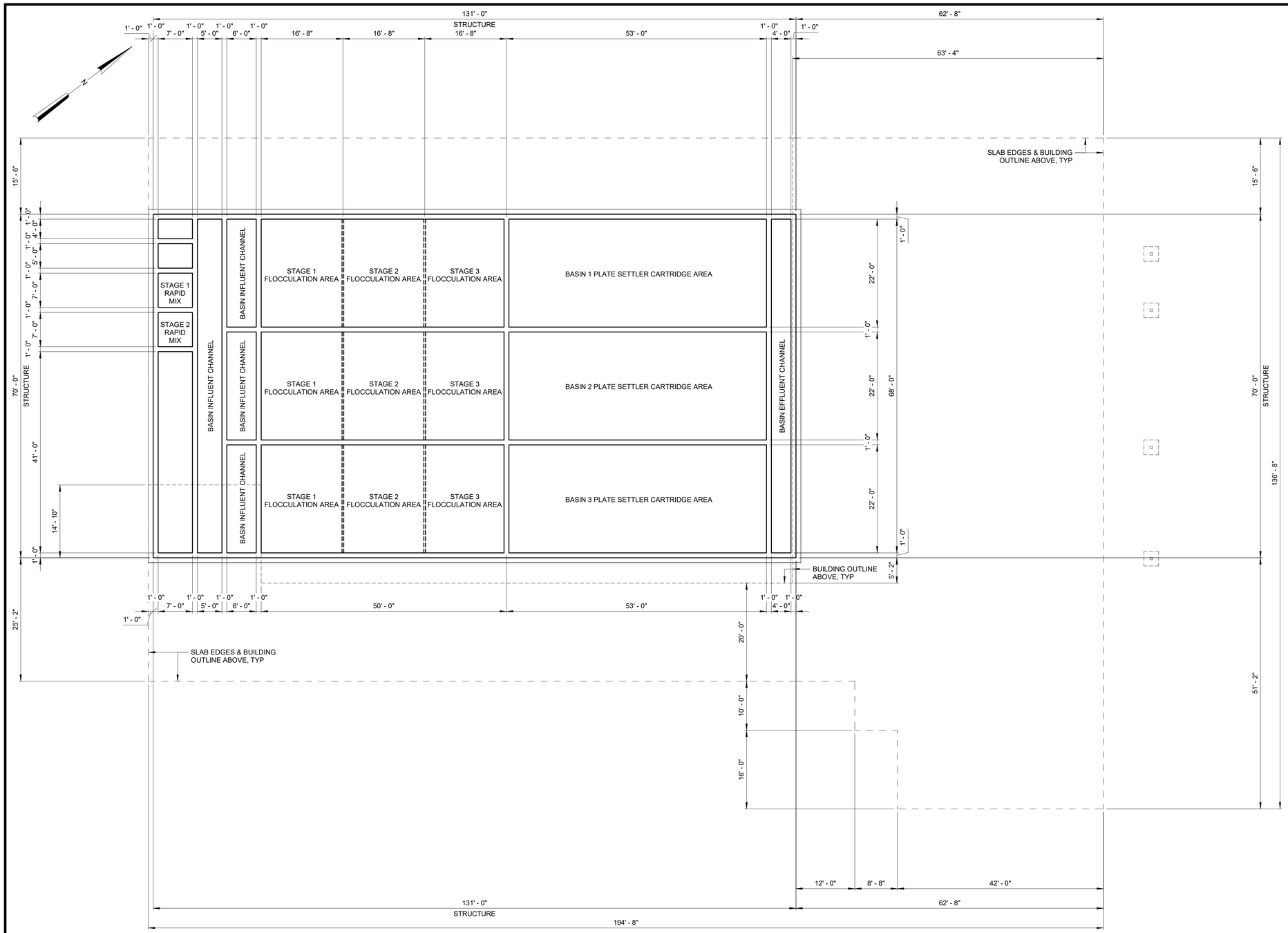

OVERALL BOTTOM PLAN

3/32" = 1'-0"

NOTES:

1. FOUNDATION INFORMATION PROVIDED HEREIN IS FOR REFERENCE ONLY. REFER TO CONSOR DOCUMENTATION FOR VERIFICATION AND ACCURACY.
2. THE INDOOR PLATE SETTLER FACILITY IS EXPECTED TO GENERATE SIGNIFICANT NOISE AND MOISTURE. FINAL DESIGN SHALL INCLUDE EVALUATION OF ACOUSTIC SEPARATION, VIBRATION ISOLATION, VENTILATION, AND HUMIDITY CONTROL, PARTICULARLY WHERE ADMINISTRATION OR OCCUPIED SPACES ARE CO-LOCATED WITHIN THE SAME BUILDING.

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	A. DUKE
DESIGNED BY:	J. SHELTON
DRAWN BY:	D. DAHL
CHECKED BY:	B. RUSSELL

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

PRELIMINARY DRAWING
DO NOT USE FOR CONSTRUCTION

Hazen
H&S ENGINEERING AND ARCHITECTURE
4011 WESTCHASE BLVD, SUITE 500
RALEIGH, NC 27607
REGISTRATION NUMBER 54078

CONSOR NORTH AMERICA
BEND, OREGON

OUTBACK FACILITY PLAN
CITY OF BEND
PRE-TREATMENT FACILITIES

PRE-TREATMENT BUILDING
ARCHITECTURAL
OVERALL BOTTOM PLAN

DATE:	APRIL 2026
HAZEN NO.:	80020-000
CONTRACT NO.:	1
DRAWING NUMBER:	A-101

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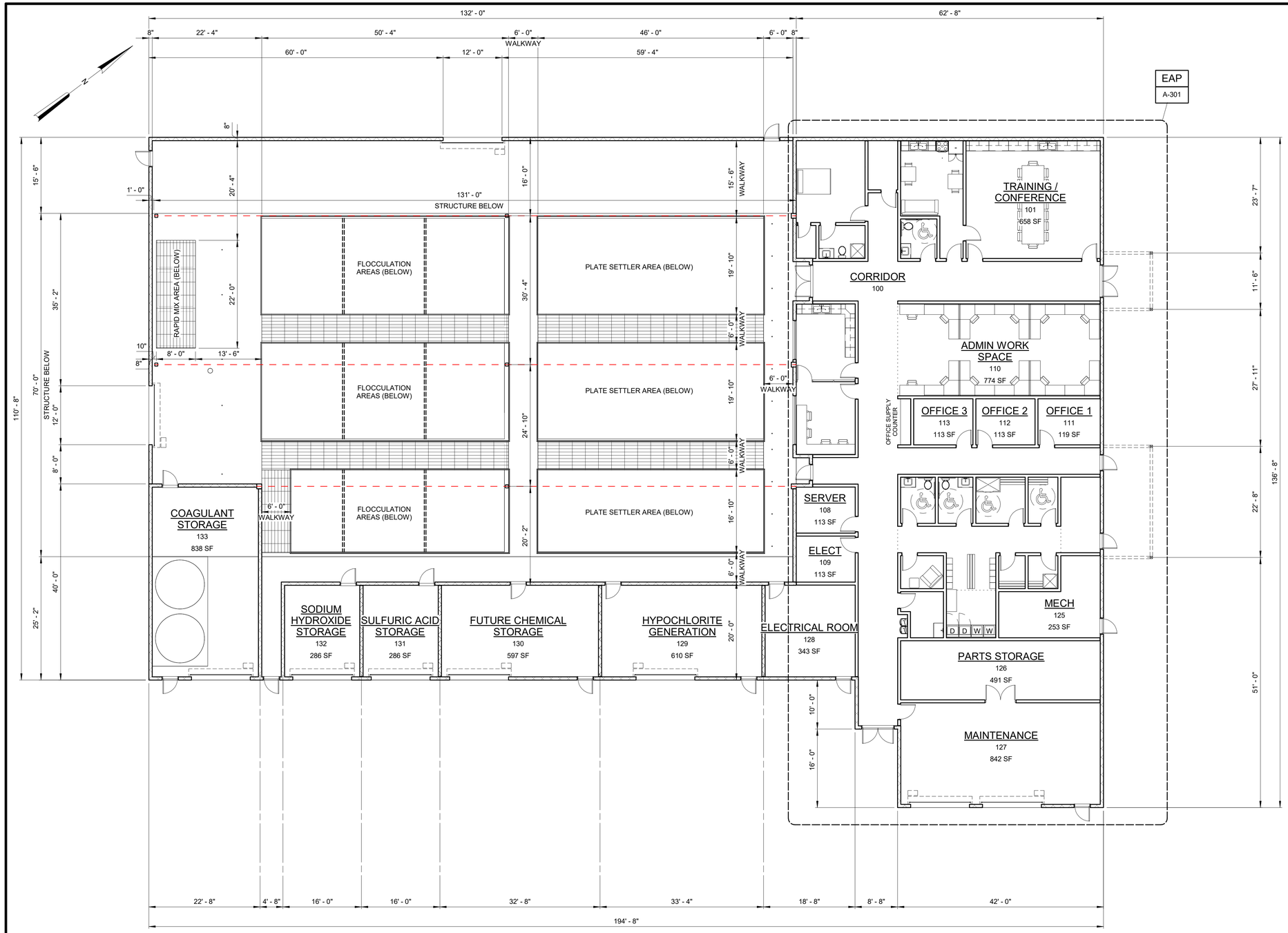

OVERALL INTERMEDIATE PLAN

3/32" = 1'-0"

NOTES:

1. FOUNDATION INFORMATION PROVIDED HEREIN IS FOR REFERENCE ONLY. REFER TO CONSOR DOCUMENTATION FOR VERIFICATION AND ACCURACY.
2. THE INDOOR PLATE SETTLER FACILITY IS EXPECTED TO GENERATE SIGNIFICANT NOISE AND MOISTURE. FINAL DESIGN SHALL INCLUDE EVALUATION OF ACOUSTIC SEPARATION, VIBRATION ISOLATION, VENTILATION, AND HUMIDITY CONTROL, PARTICULARLY WHERE ADMINISTRATION OR OCCUPIED SPACES ARE CO-LOCATED WITHIN THE SAME BUILDING.

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	A. DUKE
DESIGNED BY:	J. SHELTON
DRAWN BY:	D. DAHL
CHECKED BY:	B. RUSSELL

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0, 1/2", 1")

PRELIMINARY DRAWING
DO NOT USE FOR CONSTRUCTION

Hazen
H&S ENGINEERING AND ARCHITECTURE
4011 WESTCHASE BLVD, SUITE 500
RALEIGH, NC 27607
REGISTRATION NUMBER 54078

CONSOR NORTH AMERICA
BEND, OREGON

OUTBACK FACILITY PLAN
CITY OF BEND
PRE-TREATMENT FACILITIES

PRE-TREATMENT BUILDING
ARCHITECTURAL
OVERALL INTERMEDIATE PLAN

DATE:	APRIL 2026
HAZEN NO.:	80020-000
CONTRACT NO.:	1
DRAWING NUMBER:	A-102

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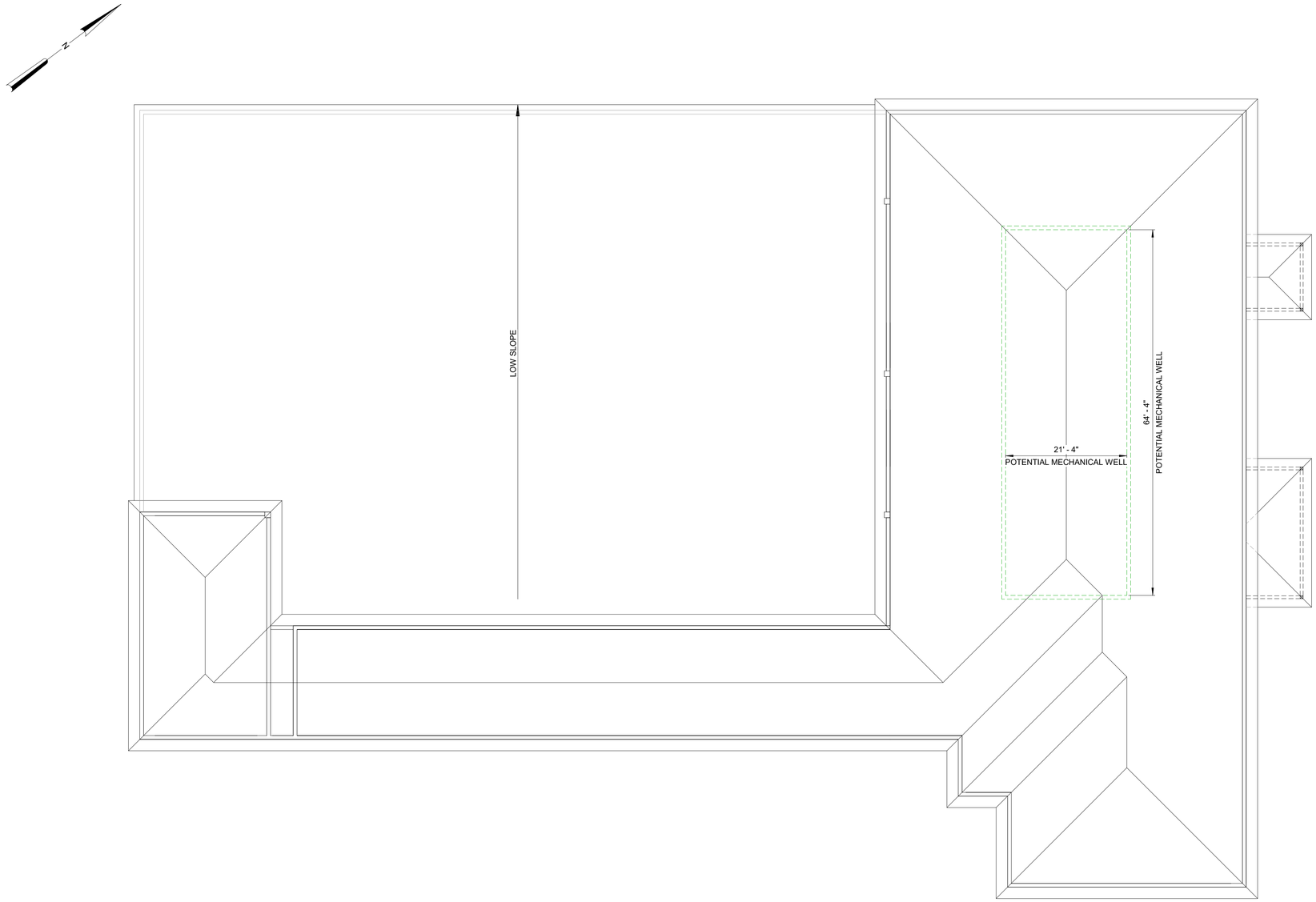

NOTES:

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2. THE INDOOR PLATE SETTLER FACILITY IS EXPECTED TO GENERATE SIGNIFICANT NOISE AND MOISTURE. FINAL DESIGN SHALL INCLUDE EVALUATION OF ACOUSTIC SEPARATION, VIBRATION ISOLATION, VENTILATION, AND HUMIDITY CONTROL, PARTICULARLY WHERE ADMINISTRATION OR OCCUPIED SPACES ARE CO-LOCATED WITHIN THE SAME BUILDING.

OVERALL TOP (ROOF) PLAN

3/32" = 1'-0"

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4/23/2026 3:37:53 PM

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	A. DUKE
DESIGNED BY:	J. SHELTON
DRAWN BY:	D. DAHL
CHECKED BY:	B. RUSSELL

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

PRELIMINARY DRAWING
DO NOT USE FOR CONSTRUCTION

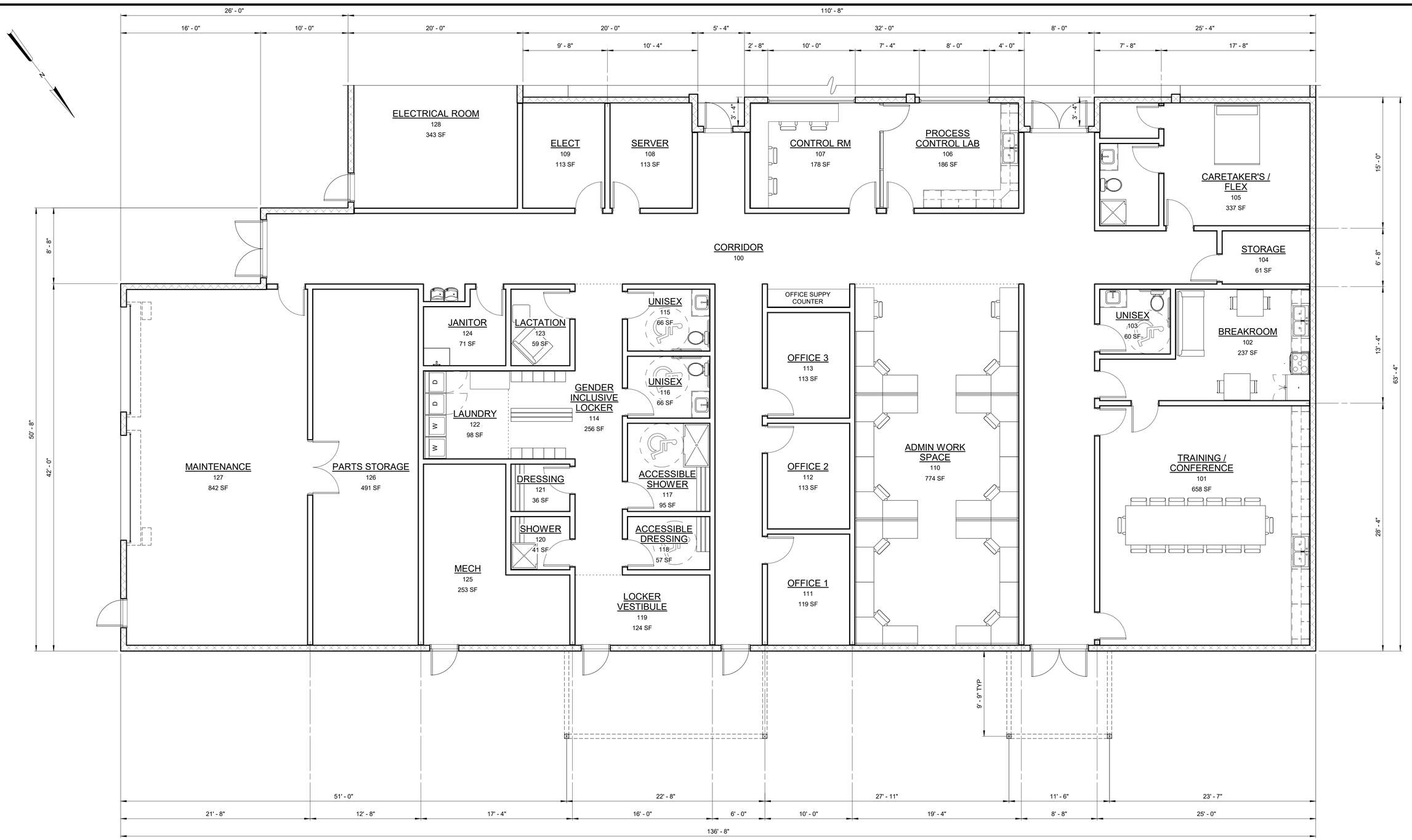
Hazen
H&S ENGINEERING AND ARCHITECTURE
4011 WESTCHASE BLVD, SUITE 500
RALEIGH, NC 27607
REGISTRATION NUMBER 54078

CONSOR NORTH AMERICA
BEND, OREGON

OUTBACK FACILITY PLAN
CITY OF BEND
PRE-TREATMENT FACILITIES

PRE-TREATMENT BUILDING
ARCHITECTURAL
OVERALL TOP (ROOF) PLAN

DATE:	APRIL 2026
HAZEN NO.:	80020-000
CONTRACT NO.:	1
DRAWING NUMBER:	A-103



ENLARGED ADMINISTRATION PLAN (EAP)

3/16" = 1'-0"

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	A. DUKE
DESIGNED BY:	J. SHELTON
DRAWN BY:	D. DAHL
CHECKED BY:	B. RUSSELL

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE — 0 1/2" 1"

PRELIMINARY DRAWING
DO NOT USE FOR CONSTRUCTION

Hazen
H&S ENGINEERING AND ARCHITECTURE
4011 WESTCHASE BLVD, SUITE 500
RALEIGH, NC 27607
REGISTRATION NUMBER 54078

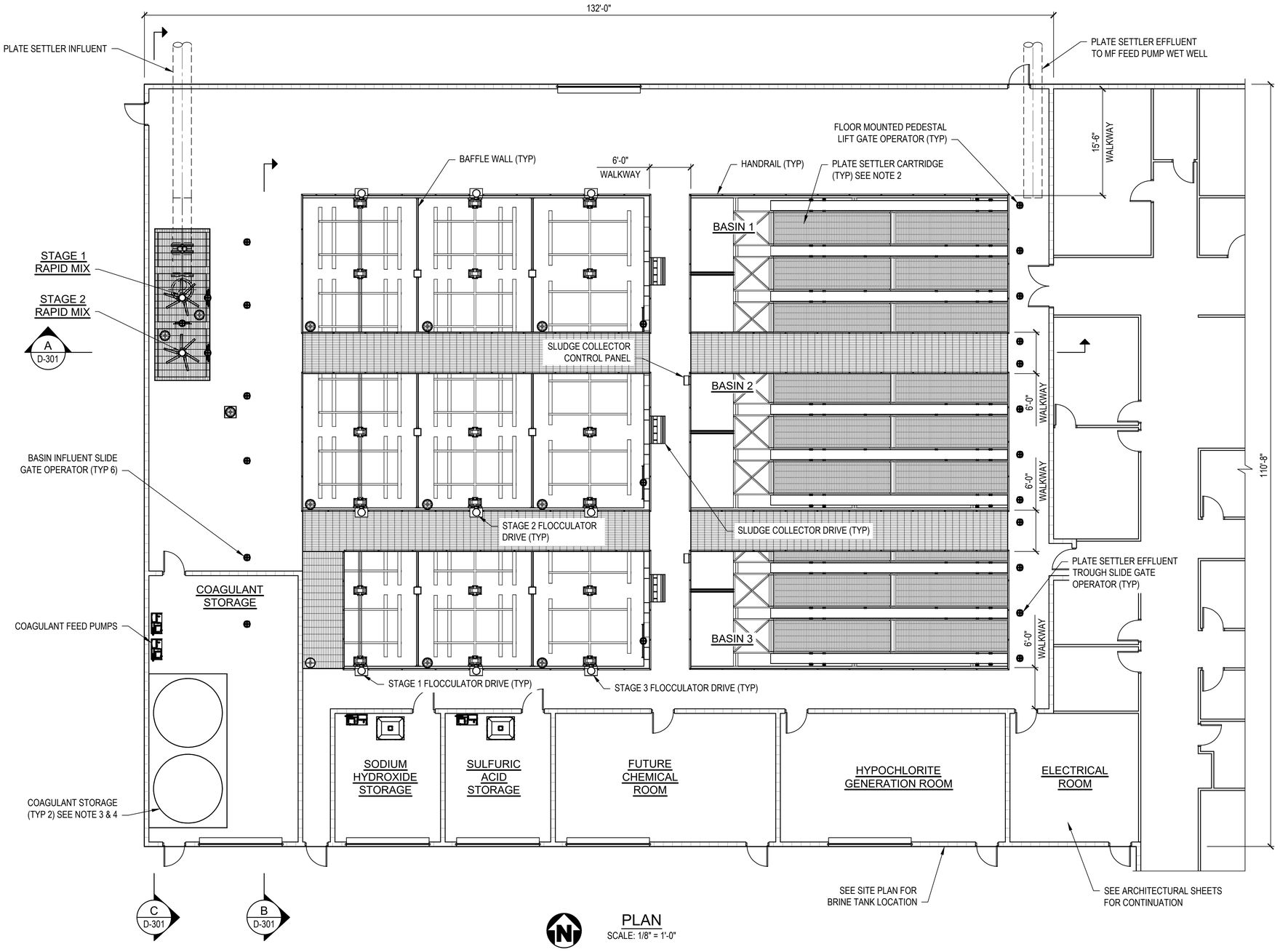
CONSOR NORTH AMERICA
BEND, OREGON

OUTBACK FACILITY PLAN
CITY OF BEND
PRE-TREATMENT FACILITIES

PRE-TREATMENT BUILDING
ARCHITECTURAL
ENLARGED ADMINISTRATION BUILDING

DATE:	APRIL 2026
HAZEN NO.:	80020-000
CONTRACT NO.:	1
DRAWING NUMBER:	A-301

Autodesk Docs://80020-000/80020-000-100-PTF-A.rvt
4/23/2026 3:38:13 PM



PLAN
SCALE: 1/8" = 1'-0"

NOTES:

1. BRIDGE CRANE AND SKYLIGHT SYSTEM FOR REMOVAL OF FLOCCULATOR DRIVES AND SLUDGE CONNECTOR DRIVES, TO FOLLOW.
2. BASIS OF PRE-DESIGN FOR PLATE SETTLERS IS MEURER RESEARCH INC. WITH SLUDGE COLLECTOR SYSTEM, FINAL PLATE SETTLER CARTRIDGE AND EFFLUENT TROUGH DIMENSIONS TO BE DETERMINED BY PLATE SETTLER MANUFACTURER.
3. USE OF FLOC AID POLYMERS UPSTREAM OF EXIST MEMBRANE FILTERS IS NOT RECOMMENDED. FINAL DESIGN TO DETERMINE OPTIMAL CHEMICAL DOSING AND CONFIRM COMPATIBILITY OF CHEMICALS WITH DOWNSTREAM MEMBRANE FILTERS.
4. EXIST PLANT COAGULANT IS POLYALUMINUM CHLORIDE. FINAL DESIGN SHOULD CONSIDER ALUM OR FERRIC AS AN ALTERNATE COAGULANT IF SOLIDS DEWATERING IS ADDED TO TREATMENT IN FUTURE.

PRELIMINARY NOT FOR CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

PRETREATMENT BASINS UPPER LEVEL PLAN

CITY OF BEND
DESCHUTES COUNTY, OREGON

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

DESIGNED BY: HLB
DRAWN BY: TMB
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

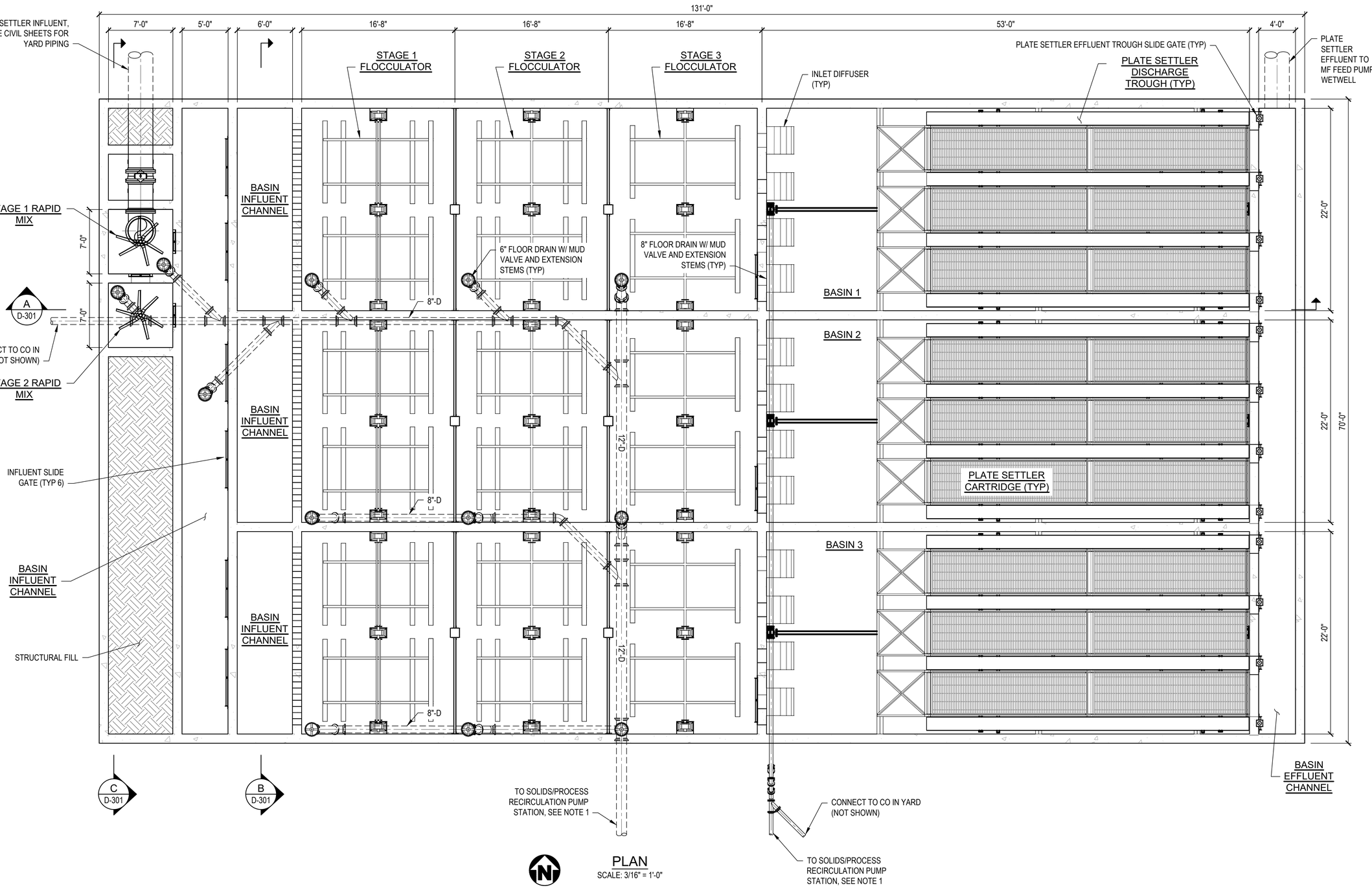
SHEET:
D-101

COB # XXXX

Drawing Path and Name: A:_V-W\Projects\OR\Bend\2024\W243806OR.00\12 CADD\12-5 Sheets\W243806OR_D-101.dwg, Plotted Date: April 30, 2026 11:45 AM By: Derek Cloud

NOTES:

1. SOLIDS/PROCESS RECIRCULATION PUMP STATION DESIGN TO BE DEVELOPED IN DETAILED DESIGN AS WET WELL WITH SUBMERSIBLE SOLIDS PUMPS. SOLIDS TO BE PUMPED TO SOLIDS HANDLING FACILITY OR SEWER, TO BE DETERMINED.



PLAN
SCALE: 3/16" = 1'-0"

PRELIMINARY NOT FOR CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

PRETREATMENT BASINS LOWER LEVEL PLAN

CITY OF BEND
DESCHUTES COUNTY, OREGON

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

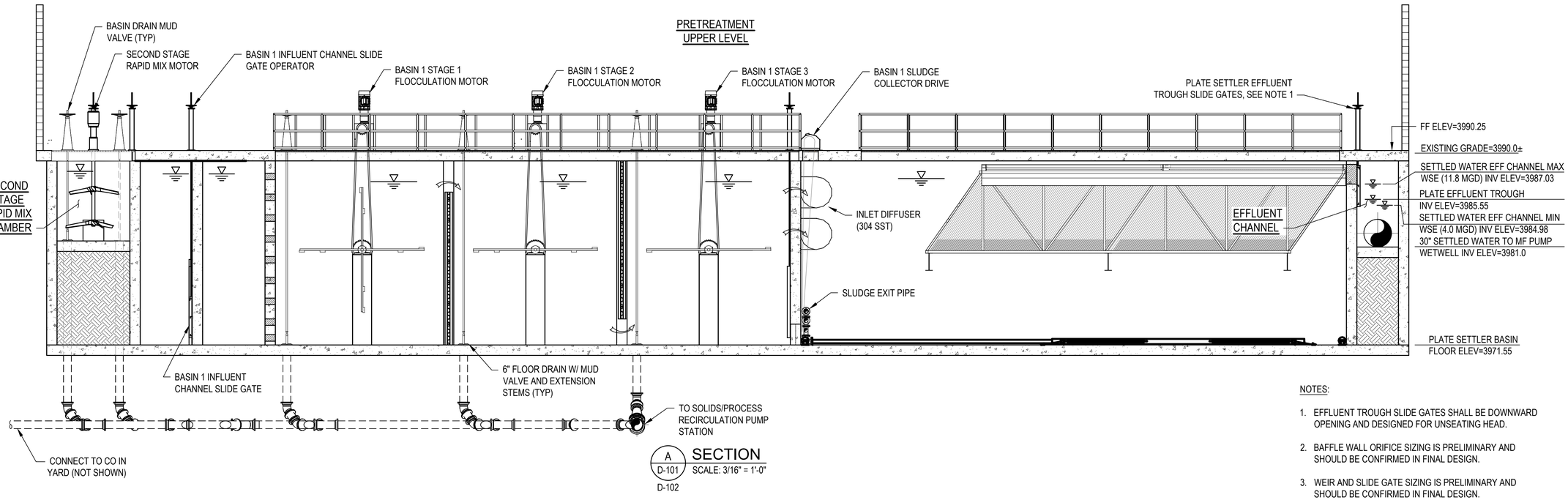
DESIGNED BY: HLB
DRAWN BY: TMB
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET:
D-102

COB # XXXX

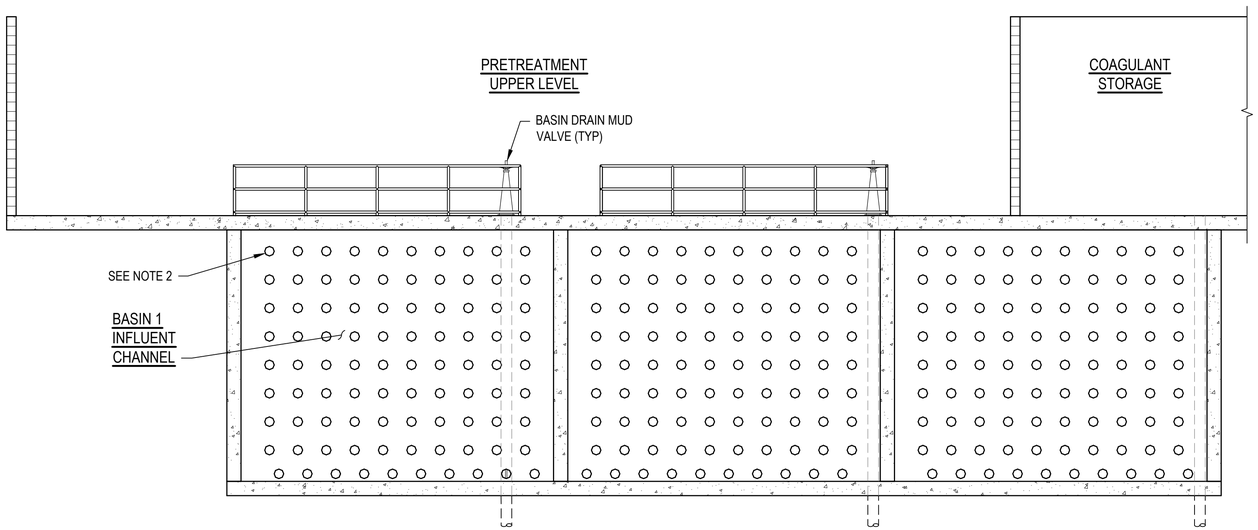
Drawing Path and Name: A:_V-WProjects\ORBend\2024\W243806OR.00\12 CADD\12-5 Sheets\W243806OR_D-102.dwg, Plotted Date: April 30, 2026 11:46 AM By: Derek Cloud



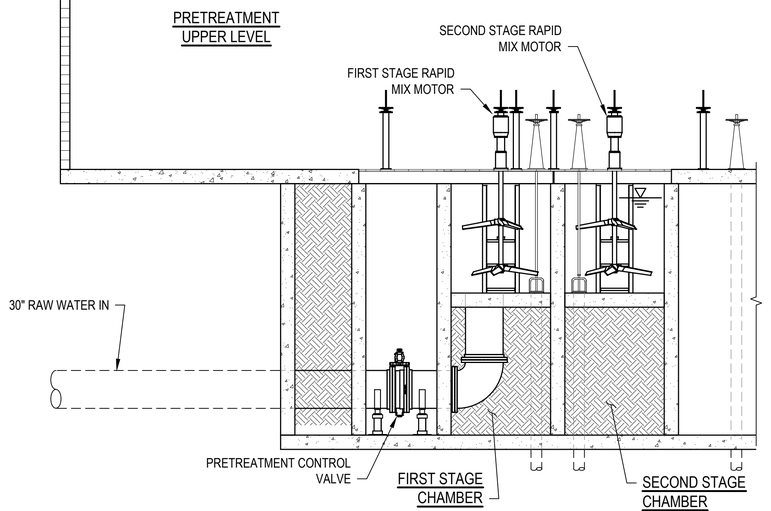
A D-101 D-102 SECTION SCALE: 3/16" = 1'-0"

NOTES:

1. EFFLUENT TROUGH SLIDE GATES SHALL BE DOWNWARD OPENING AND DESIGNED FOR UNSEATING HEAD.
2. BAFFLE WALL ORIFICE SIZING IS PRELIMINARY AND SHOULD BE CONFIRMED IN FINAL DESIGN.
3. WEIR AND SLIDE GATE SIZING IS PRELIMINARY AND SHOULD BE CONFIRMED IN FINAL DESIGN.



B D-101 D-102 SECTION SCALE: 3/16" = 1'-0"



C D-101 D-102 SECTION SCALE: 3/16" = 1'-0"

PRELIMINARY NOT FOR CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

PRETREATMENT BASINS SECTIONS

DESCHUTES COUNTY, OREGON

CITY OF BEND

REVISIONS:

consor
550 NW FRANKLIN AVENUE, SUITE 428
BEND, OREGON 97703

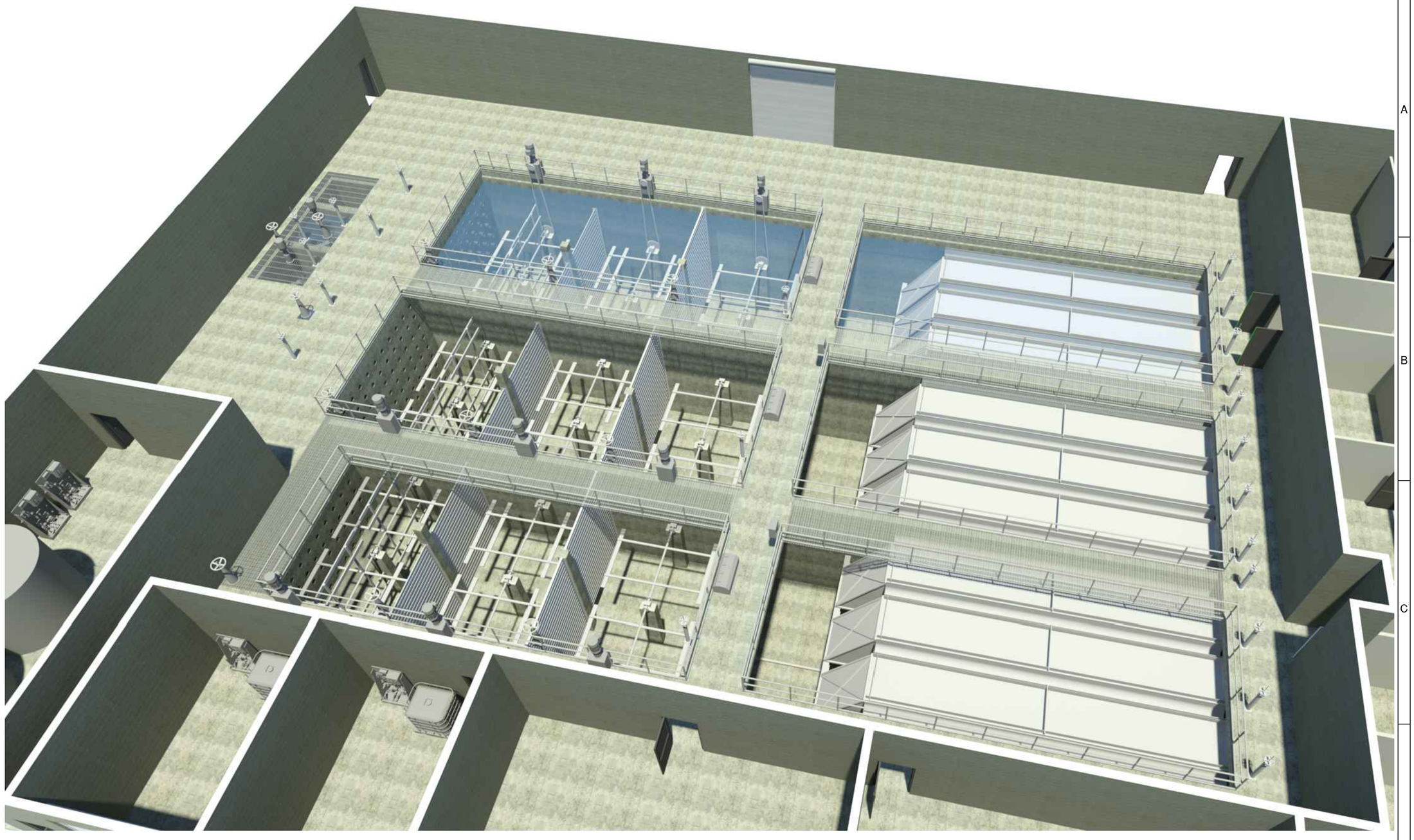
DESIGNED BY: HLB
DRAWN BY: TMB
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET: D-301

COB # XXXX

Drawing Path and Name: A:_V-W\Projects\OR\Bend\2024\W243806OR.0012 CADD\12-5 Sheets\W243806OR_D-301.dwg, Plotted Date: April 30, 2026 11:46 AM By: Derek Cloud



PERSPECTIVE
SCALE: NTS

NOTE:
PERSPECTIVE VIEW IS FOR GENERAL REFERENCE ONLY. DO NOT USE FOR CONSTRUCTION. NOT ALL WORK ELEMENTS SHOWN.

PRELIMINARY
NOT FOR
CONSTRUCTION

OUTBACK FACILITY PLAN
PRETREATMENT FACILITIES PRELIMINARY DESIGN
CITY PROJECT # 1WOFP

PRETREATMENT BUILDING PERSPECTIVE

DESCHUTES COUNTY, OREGON

CITY OF BEND

REVISIONS:

consor
550 NW FRANKLIN AVENUE,
SUITE 428
BEND, OREGON 97703

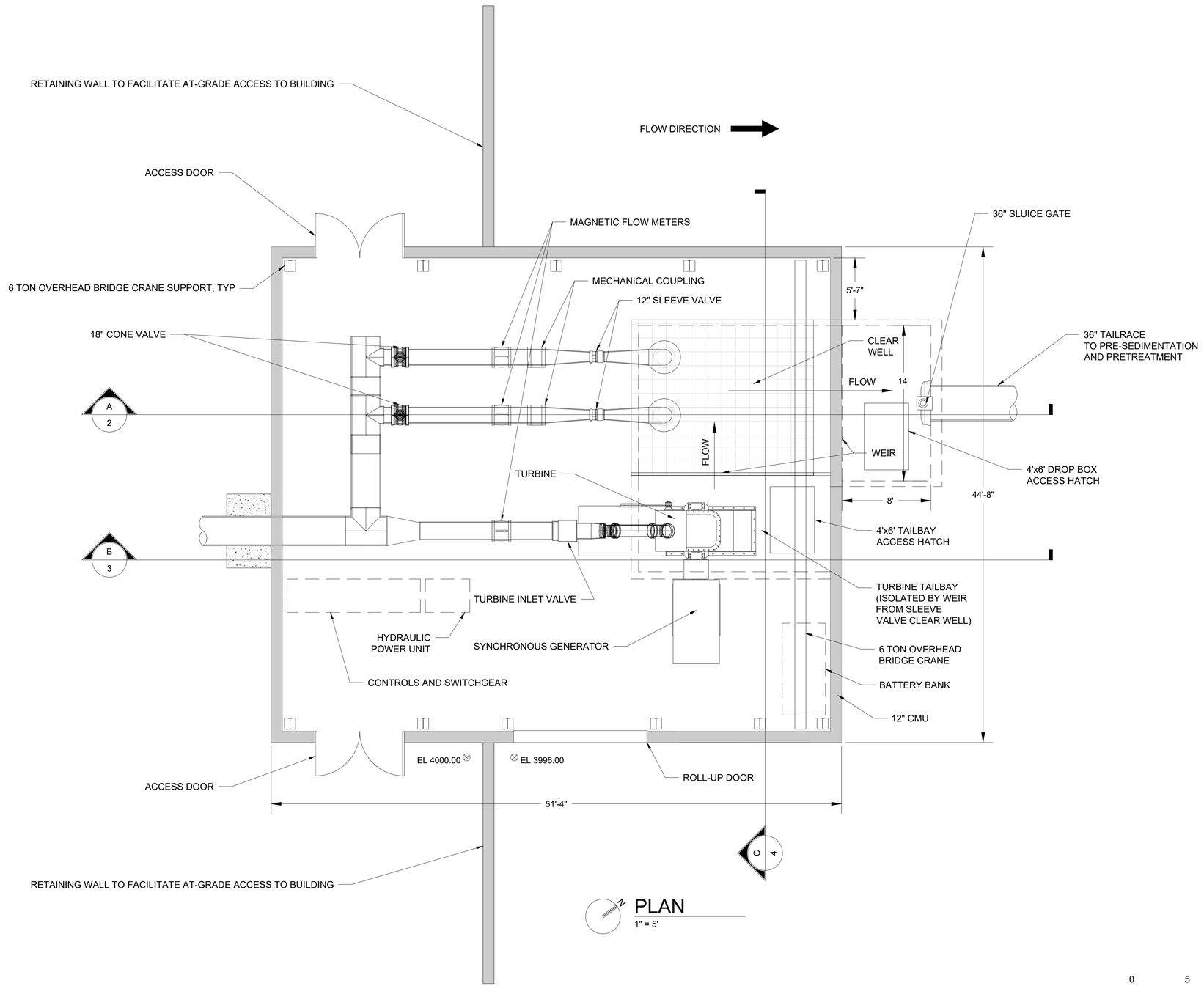
DESIGNED BY: HLB
DRAWN BY: TMB
SCALE: PER PLANS
FILE: XXXX
DATE: APRIL 2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH
ON ORIGINAL DRAWING

SHEET:
D-901

COB # XXXX

Drawing Path and Name: A:_V-W\Projects\OR\Bend\2024\W2438006OR.0012 CADD\12-5 Sheets\W2438006OR_D-901.dwg, Plotted Date: April 30, 2026 11:47 AM By: Derek Cloud



PLAN

1" = 5'

0 5 10 15

1"=5'

OUTBACK-PLAN AND PROFILE.dwg

CITY OF BEND, OREGON

OUTBACK WATER FILTRATION FACILITY FACILITIES PLAN
IN-CONDUIT HYDROPOWER FACILITY

IN-CONDUIT HYDRO FACILITY PLAN

CITY OF BEND

DESCHUTES COUNTY, OREGON

REVISIONS:
1.
2.
3.

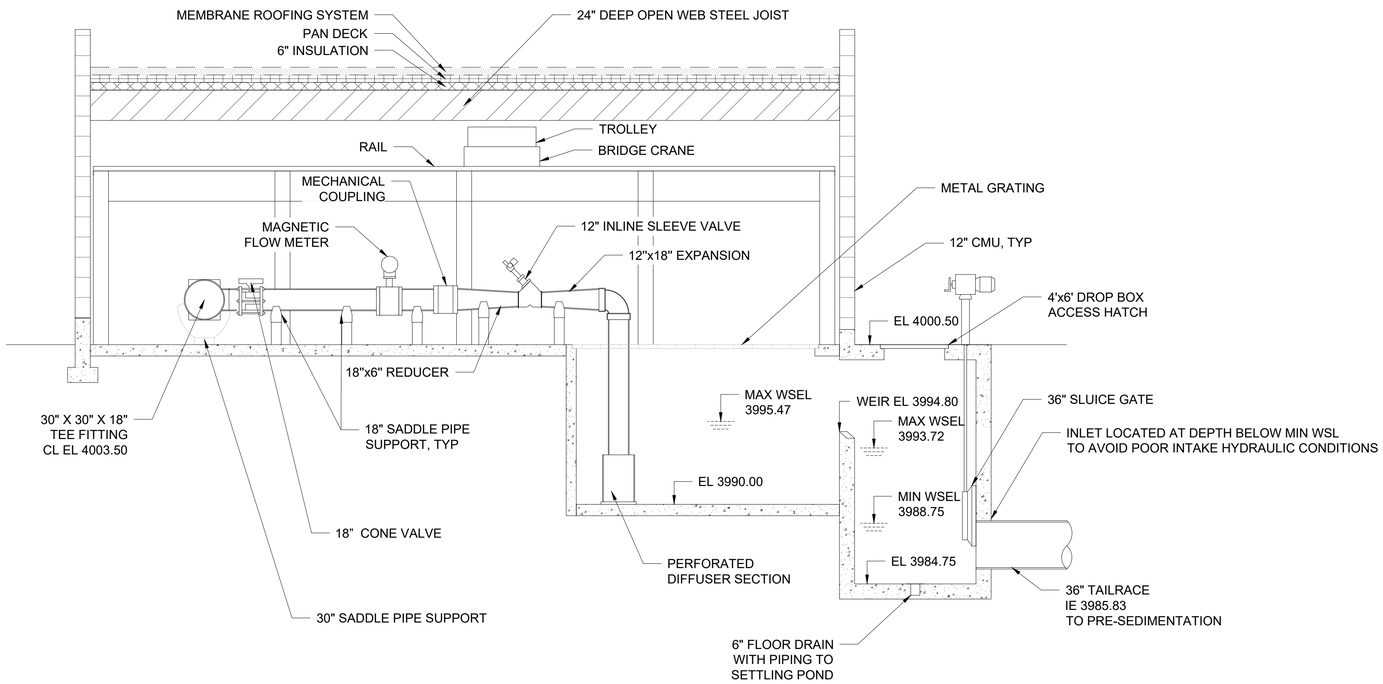
Jacobs
377 SW CENTURY DR STE 201
BEND, OREGON 97702

DESIGNED BY: B FULLER
DRAWN BY: J WOHLWEND
SCALE: 1" = 5'
FILE: C-02
DATE: 04/27/2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET:
H-101

COB # 1WOFP



SECTION A

1" = 5'

0 5 10 15

1"=5'

CITY OF BEND, OREGON

OUTBACK WATER FILTRATION FACILITY FACILITIES PLAN
IN-CONDUIT HYDROPOWER FACILITY

IN-CONDUIT HYDRO SECTION A

DESCHUTES COUNTY, OREGON

CITY OF BEND

REVISIONS:
1.
2.
3.

Jacobs
377 SW CENTURY DR STE 201
BEND, OREGON 97702

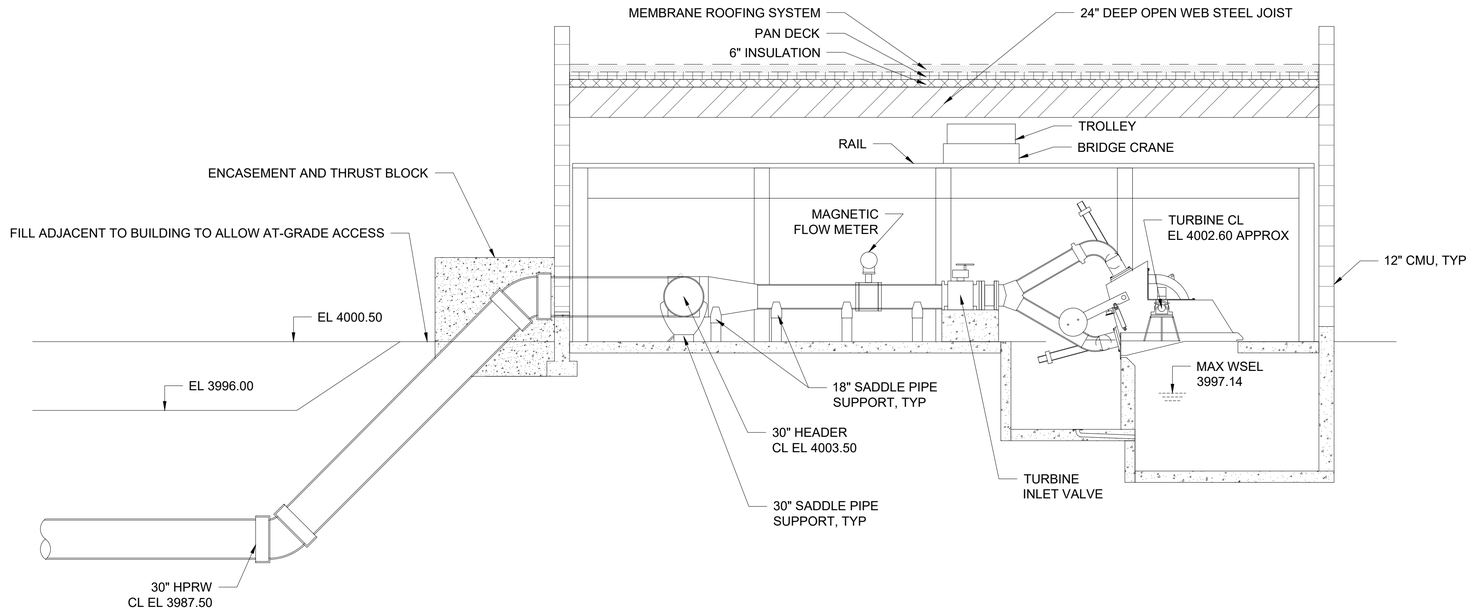
DESIGNED BY: B FULLER
DRAWN BY: J WOHLWEND
SCALE: 1" = 5'
FILE: C-03
DATE: 04/27/2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET:
H-301

COB # 1WOFP

OUTBACK-PLAN AND PROFILE.dwg



SECTION B

1" = 5'

0 5 10 15

1"=5'

OUTBACK-PLAN AND PROFILE.dwg

CITY OF BEND, OREGON

OUTBACK WATER FILTRATION FACILITY FACILITIES PLAN
IN-CONDUIT HYDROPOWER FACILITY

IN-CONDUIT HYDRO SECTION B

DESCHUTES COUNTY, OREGON

CITY OF BEND

REVISIONS:
1.
2.
3.

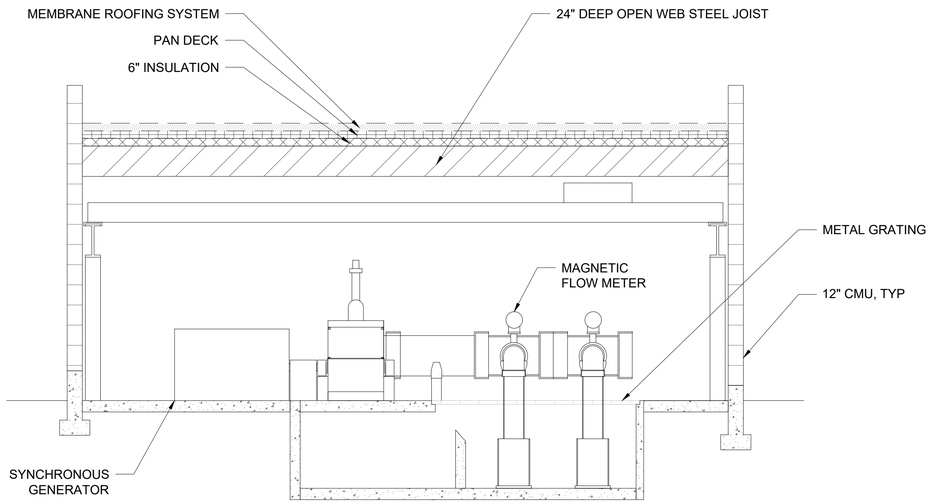
Jacobs
377 SW CENTURY DR STE 201
BEND, OREGON 97702

DESIGNED BY: B FULLER
DRAWN BY: J WOHLWEND
SCALE: 1" = 5'
FILE: C-04
DATE: 04/27/2026

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH
ON ORIGINAL DRAWING

SHEET:
H-302

COB # 1WHCD



SECTION C

1" = 5'

0 5 10 15

1"=5'

OUTBACK-PLAN AND PROFILE.dwg

CITY OF BEND, OREGON

OUTBACK WATER FILTRATION FACILITY FACILITIES PLAN
IN-CONDUIT HYDROPOWER FACILITY

IN-CONDUIT HYDRO SECTION C

DESCHUTES COUNTY, OREGON

CITY OF BEND

REVISIONS:
1.
2.
3.

Jacobs
377 SW CENTURY DR STE 201
BEND, OREGON 97702

DESIGNED BY: B FULLER
DRAWN BY: J WOHLWEND
SCALE: 1" = 5'
FILE: C-04
DATE: 04/27/2026

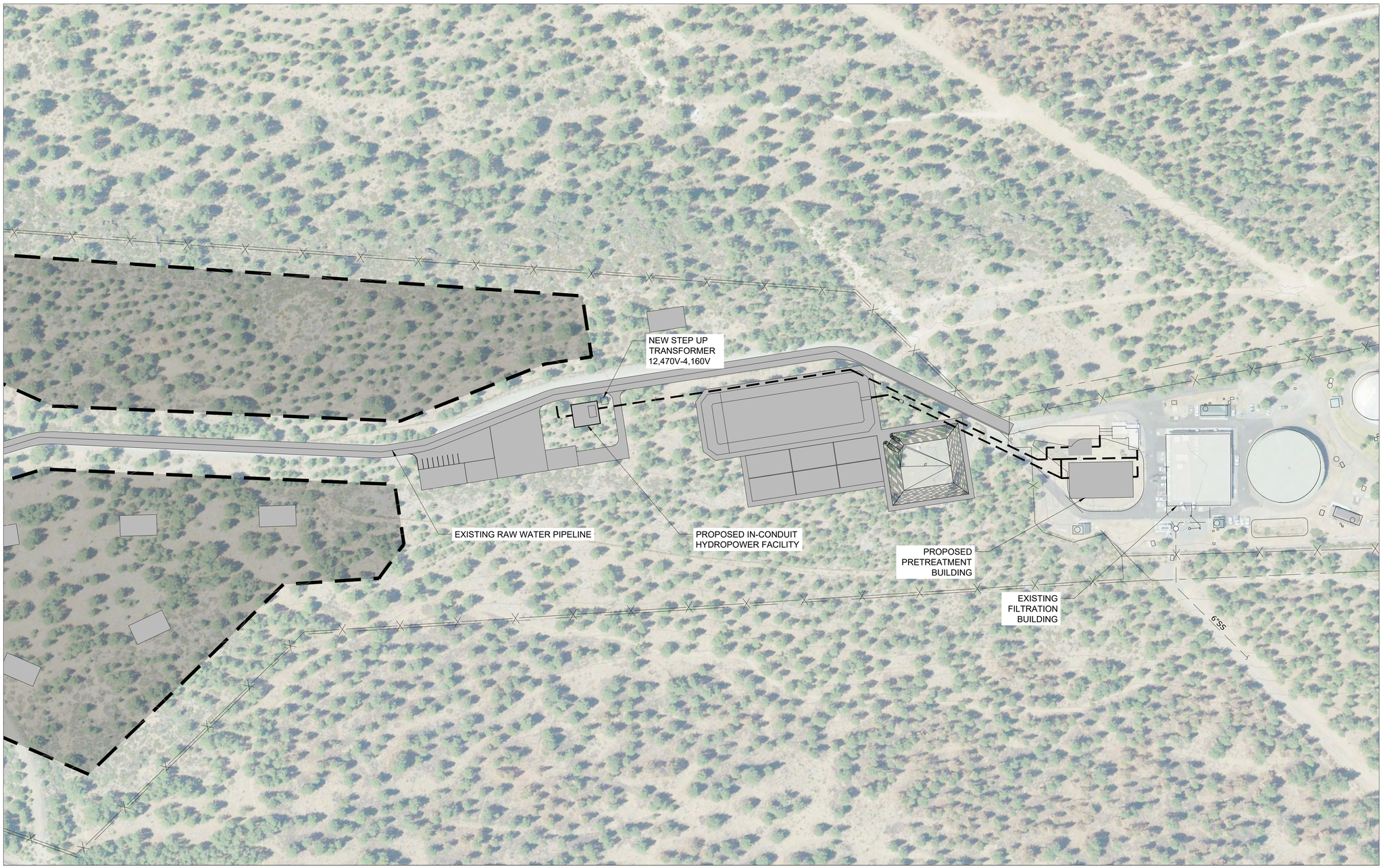
VERIFY SCALES
0 1"
BAR EQUALS ONE INCH
ON ORIGINAL DRAWING

SHEET:
H-303

COB # 1WHCD

APPENDIX C
IN-CONDUIT HYDROPOWER STUDY
FIGURES

consor



SITE PLAN SCENARIO 1A/1B

1" = 100'

0 5 10 15

1"=5'

CITY OF BEND, OREGON

IN-CONDUIT HYDROPOWER FEASIBILITY STUDY

CITY OF BEND OUTBACK SITE - SITE PLAN SCENARIO 1A/1B

DESCHUTES COUNTY, OREGON

REVISIONS:
1.
2.
3.

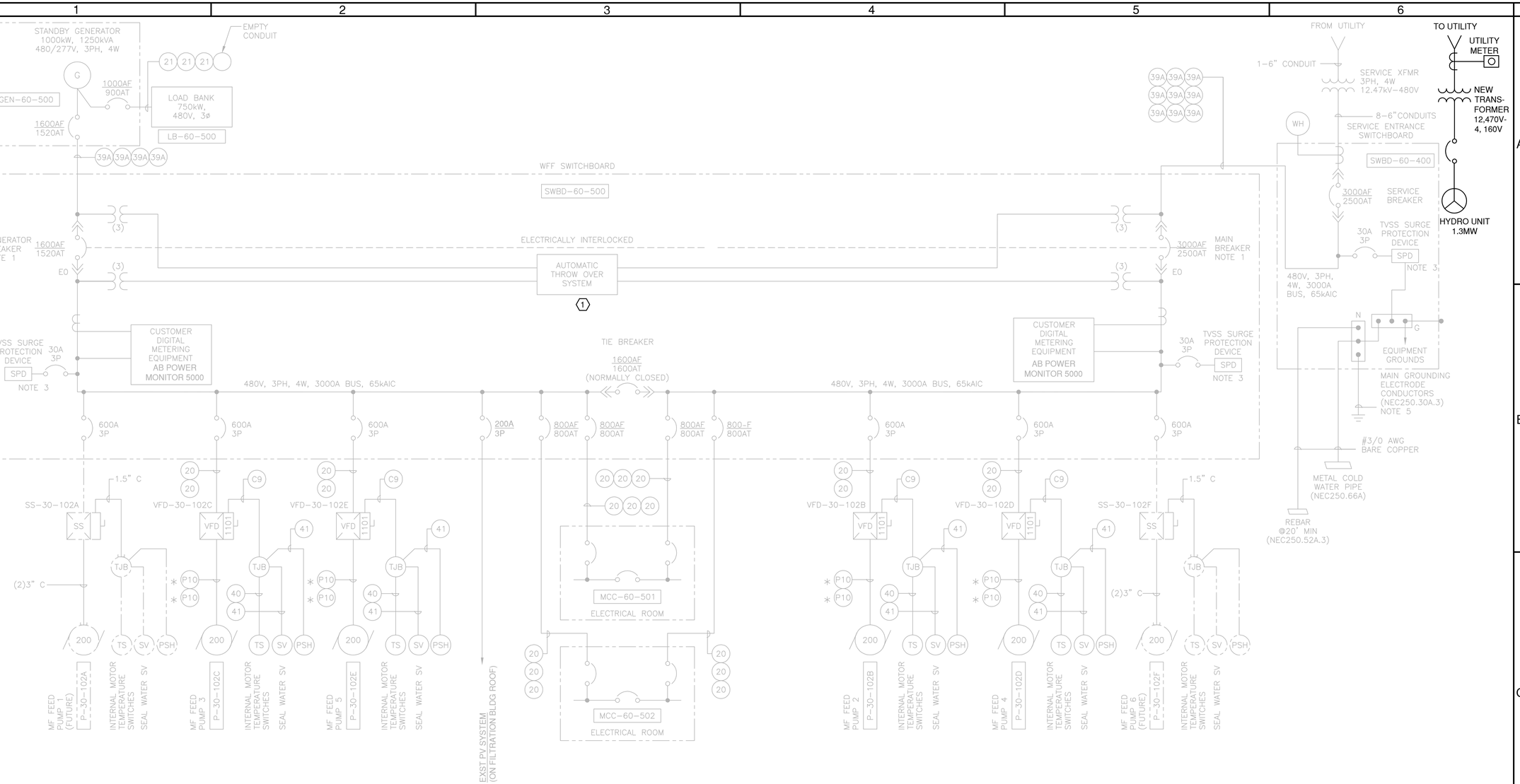
Jacobs
377 SW CENTURY DR STE 201
BEND, OREGON 97702

DESIGNED BY: M MACROSTIE
DRAWN BY: C MCCOY
SCALE: 1" = 100'
FILE: E-01
DATE: 06/06/2023

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH
ON ORIGINAL DRAWING

SHEET:
5/8

COB # 1WHCD



NOTES:

1. THE HYDRO UNIT WILL BE CONNECTED TO THE UTILITY DIRECTLY.
2. THE UTILITY WILL CONSOLIDATE THE POWER USAGE FROM ALL THE METERS ON THE SITE. THE TOTAL CONSOLIDATED POWER WILL BE DEDUCTED FROM THE HYDRO POWER PRODUCED.

ONE-LINE DIAGRAM SCENARIO 1A/1B

[STAMP]
[ENGINEERS]

CITY OF BEND, OREGON

IN-CONDUIT HYDROPOWER FEASIBILITY STUDY

CITY OF BEND — ONE-LINE DIAGRAM - SCENARIO 1A/1B

DESCHUTES COUNTY, OREGON

REVISIONS:
1
2
3

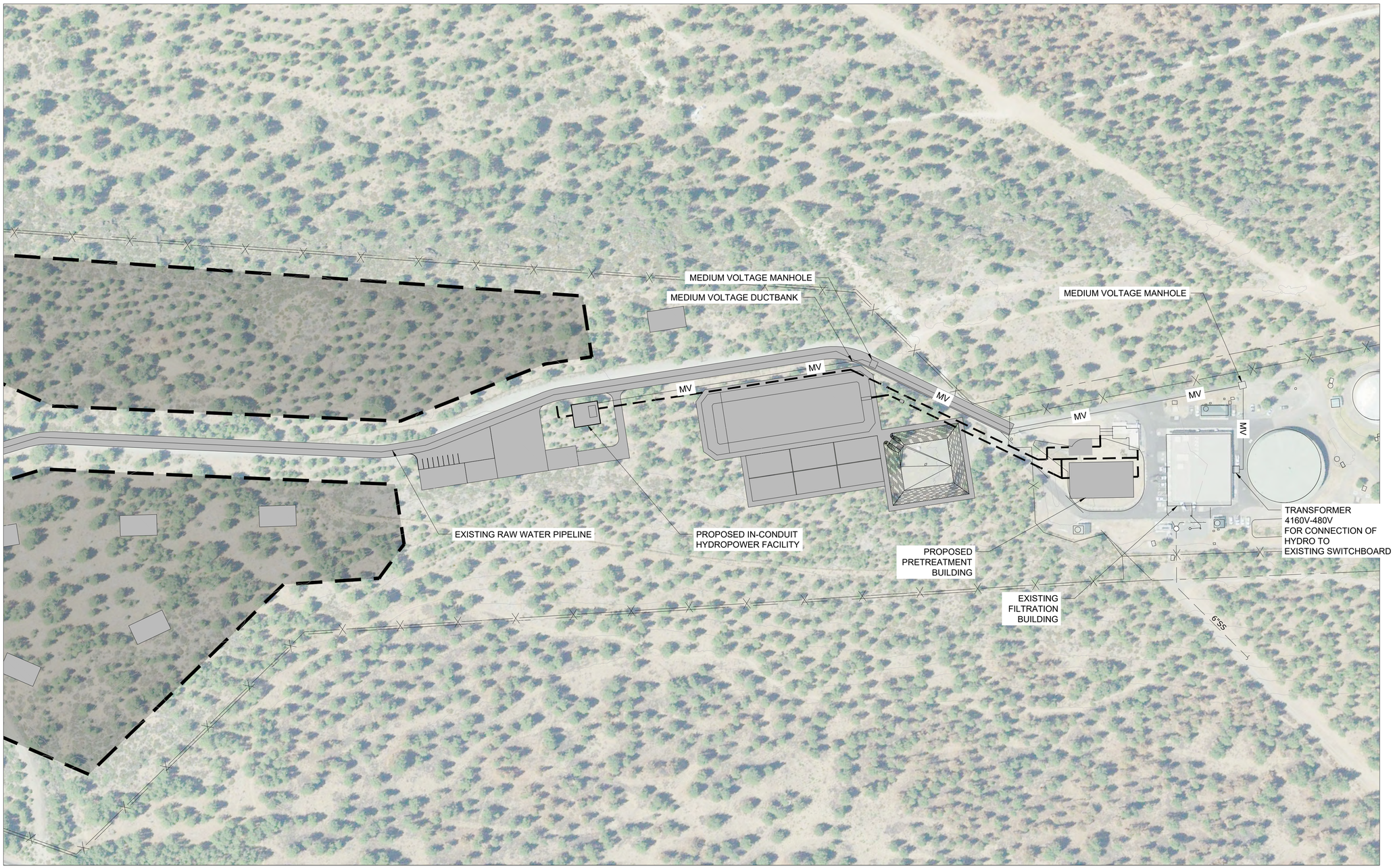
[COMPANY NAME]
[COMPANY ADDRESS]

DESIGNED BY:
DRAWN BY:
SCALE:
FILE:
DATE: / /

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET:
7/8

COB #



SITE PLAN SCENARIO 2A/2B

1" = 100'

0 5 10 15

1"=5'

CITY OF BEND, OREGON

IN-CONDUIT HYDROPOWER FEASIBILITY STUDY

CITY OF BEND OUTBACK SITE - SITE PLAN SCENARIO 2A/2B

DESCHUTES COUNTY, OREGON

REVISIONS:
1.
2.
3.

Jacobs
377 SW CENTURY DR STE 201
BEND, OREGON 97702

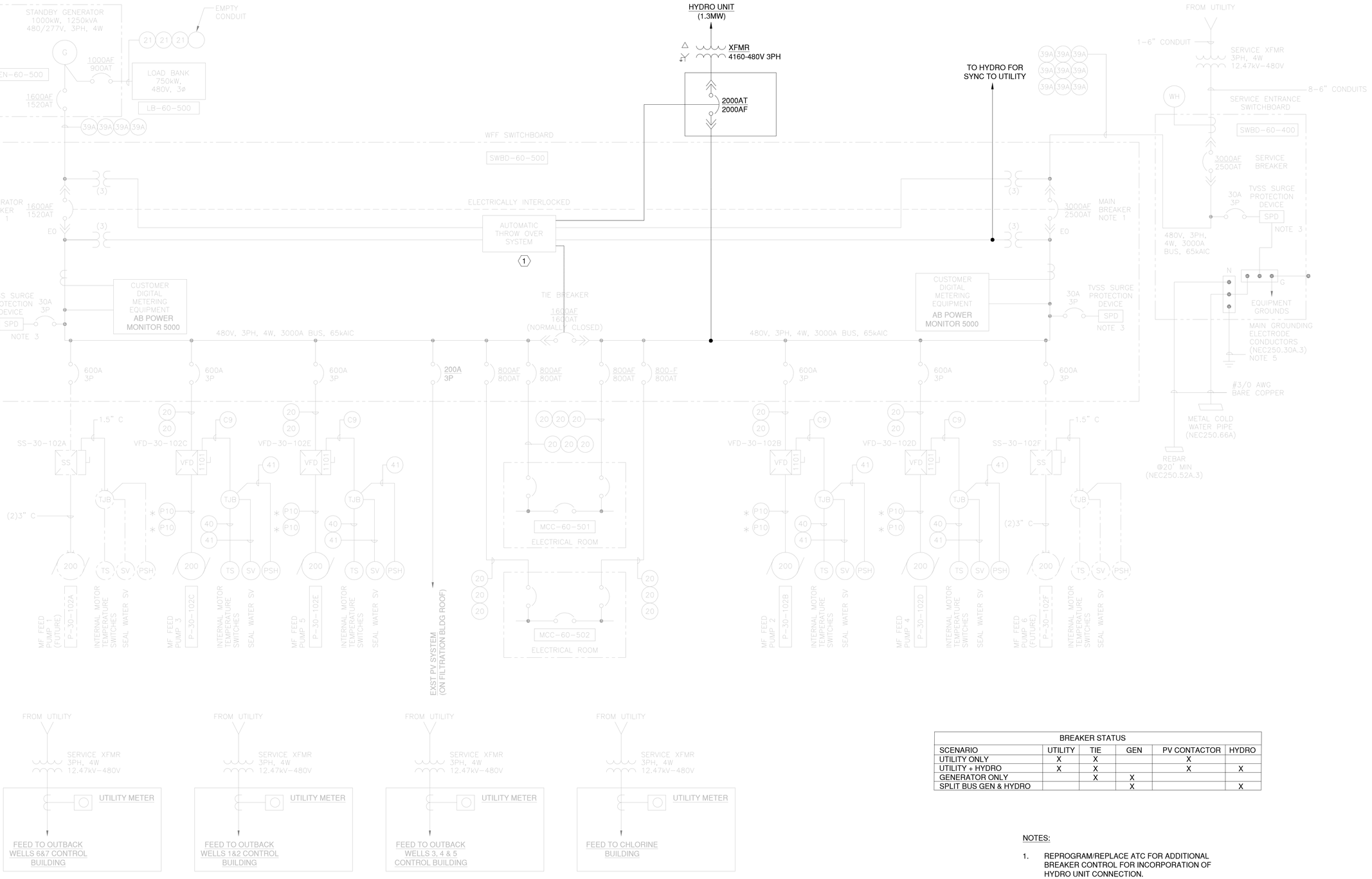
DESIGNED BY: M MACROSTIE
DRAWN BY: C MCCOY
SCALE: 1" = 100'
FILE: E-01
DATE: 06/06/2023

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET:
5/8

COB # 1WHCD

OUTBACK-ELECTRICAL SITE PLAN SCENARIO 2A_2B.dwg



BREAKER STATUS					
SCENARIO	UTILITY	TIE	GEN	PV CONTACTOR	HYDRO
UTILITY ONLY	X	X		X	
UTILITY + HYDRO	X	X		X	X
GENERATOR ONLY		X	X		
SPLIT BUS GEN & HYDRO			X		X

NOTES:

1. REPROGRAM/REPLACE ATC FOR ADDITIONAL BREAKER CONTROL FOR INCORPORATION OF HYDRO UNIT CONNECTION.

ONE-LINE DIAGRAM-SCENARIO 2A/2B

CITY OF BEND, OREGON
IN-CONDUIT HYDROPOWER FEASIBILITY STUDY
ONE-LINE DIAGRAM - SCENARIO 2A/2B
DESCHUTES COUNTY, OREGON

CITY OF BEND

REVISIONS:
1.
2.
3.

Jacobs
377 SW CENTURY DR STE 201
BEND, OREGON 97702

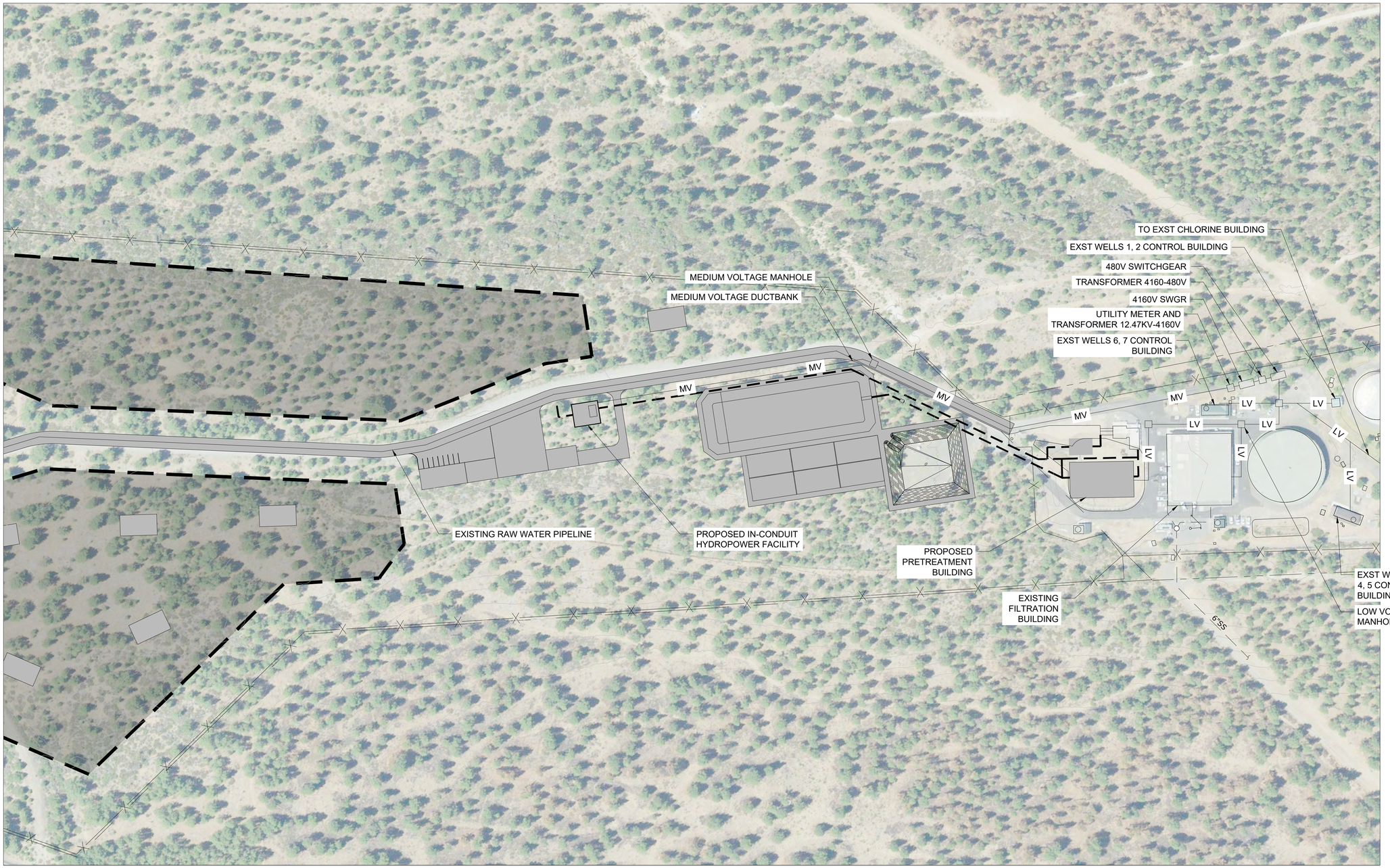
DESIGNED BY: M MACROSTIE
DRAWN BY: C MCCOY
SCALE: 1" = 20'
FILE: E-03
DATE: 06/06/2023

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET: 7/8

COB # 1WHCD

04E-27 Scenario 2A_2B.dwg



SITE PLAN SCENARIO 3

1" = 100'

0 5 10 15

1"=5'

OUTBACK-ELECTRICAL SITE PLAN OPTION 2.dwg

CITY OF BEND, OREGON

IN-CONDUIT HYDROPOWER FEASIBILITY STUDY

CITY OF BEND — OUTBACK SITE - SITE PLAN SCENARIO 3

DESCHUTES COUNTY, OREGON

REVISIONS:
1.
2.
3.

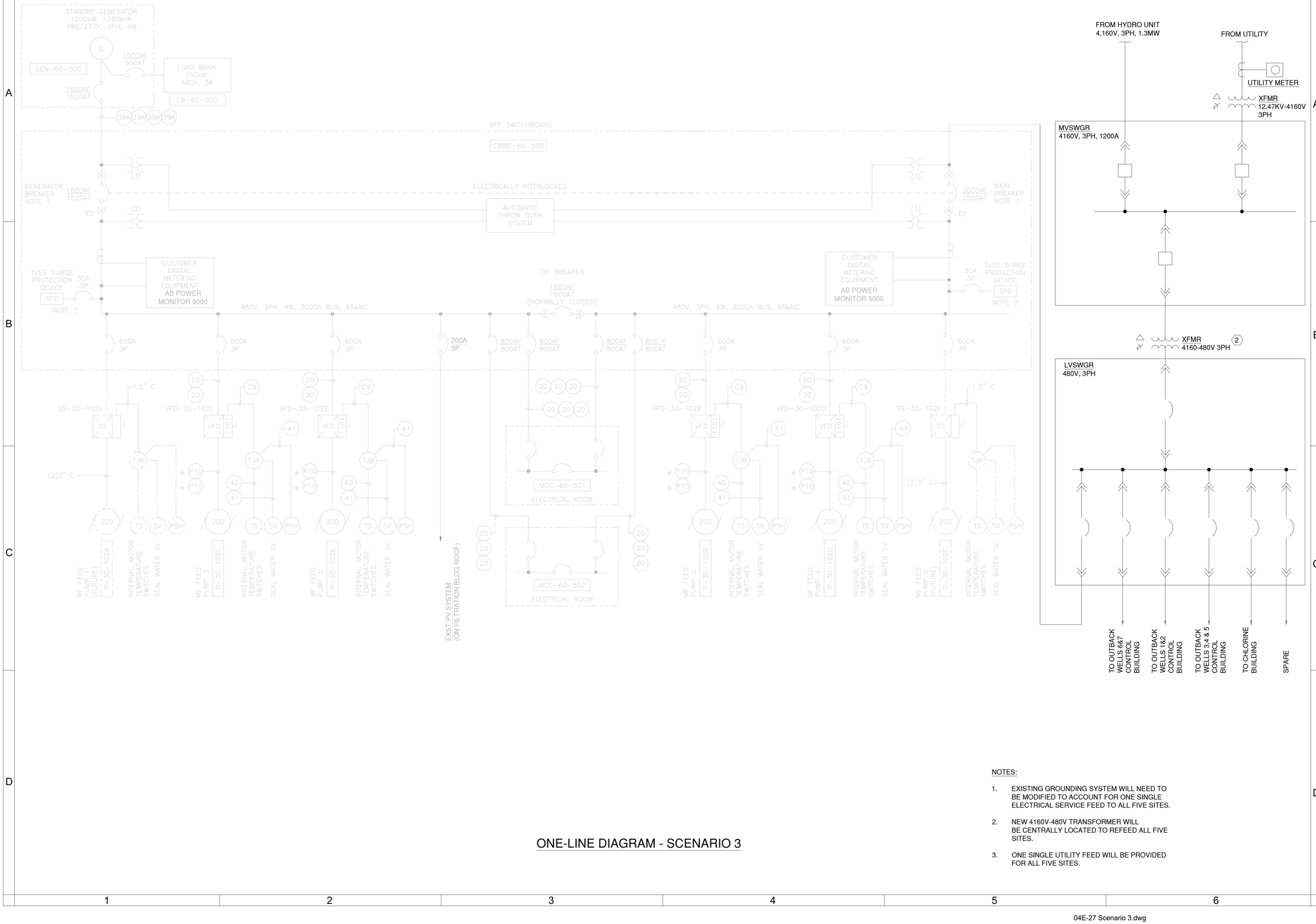
Jacobs
377 SW CENTURY DR STE 201
BEND, OREGON 97702

DESIGNED BY: M MACROSTIE
DRAWN BY: C MCCOY
SCALE: 1" = 100'
FILE: E-02
DATE: 06/06/2023

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING

SHEET:
6/8

COB # 1WHCD



ONE-LINE DIAGRAM - SCENARIO 3

NOTES:

1. EXISTING GROUNDING SYSTEM WILL NEED TO BE MODIFIED TO ACCOUNT FOR ONE SINGLE ELECTRICAL SERVICE FEED TO ALL FIVE SITES.
2. NEW 4160V-480V TRANSFORMER WILL BE CENTRALLY LOCATED TO REFEED ALL FIVE SITES.
3. ONE SINGLE UTILITY FEED WILL BE PROVIDED FOR ALL FIVE SITES.

CITY OF BEND, OREGON

IN-CONDUIT HYDROPOWER FEASIBILITY STUDY

ONE-LINE DIAGRAM - SCENARIO 3

DESCHUTES COUNTY, OREGON

CITY OF BEND

REVISIONS:
1.
2.
3.

Jacobs
377 SW CENTURY DR STE 201
BEND, OREGON 97702

DESIGNED BY: M MACROSTIE
DRAWN BY: C MCCOY
SCALE: 1" = 20'
FILE: E-04
DATE: 06/06/2023

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH
ON ORIGINAL DRAWING

SHEET:
8/8

COB # 1WHCD

04E-27 Scenario 3.dwg

consor

APPENDIX D
2009 DAILY ROUNDS CT FORMULAS

DAILY ROUNDS – CT FORMULAS - Revised 2019

CT BASIN
(Reservoir Level @ Max Flow x 49,725 x .738) / (CT average Peak hourly demand flow)

OUTBACK #1
(Reservoir Level @ Max Flow x 57,230 x .86) / (Outback #1 average Peak hourly demand flow)

(All within peak hourly demand)
Contact Time
Contact Time/ CT = CT Basin + Outback #1

Actual CT = Contact Time x Outback #1 Min. CL2 Residual

Required CT = Variables: First customer high Outlet PH, First customer Min Outlet CL2 Residual, & First customer Min outlet H2O Temp
NOTE: With CT Basin and OB #1 both online Outback # 1 is first customer. This switches to CT Basin when OB # 1 goes offline for maintenance, or level during peak hourly demand drops below **22.3 ft**. CT Basin has a minimum level of **25.5 ft** during peak hourly demand when OB #1 is offline.

Required CT Formula: **Regression Equation**

Temp. < 12.5°C = (0.353*L) (12.006 + e^ (2.46-0.073*T+0.125*C+0.389*pH))

Temp. >12.5°C = (0.361*L) (-2.261 + e^ (2.69-0.065*T+0.111*C+0.361*pH))
Variables:
CT = Product of free chlorine residual and time required
L= Number of log inactivation for Giardia (0.5 Log)
T= Temperature in Celsius (**within the peak hourly demand flow)**
C= Chlorine residual in Mg/L (**within the peak hourly demand flow)**
PH= pH of water **(within the peak hourly demand flow)**
e= 2.7183, base for natural log
F° to C° conversion- 0.555(F°-32) = C°

Reserve CT= Total Actual CT – Required CT

DAILY ROUNDS – CHLORINE FORMULAS Surface water

CL2 LBS USED
Total Filtrate Outlet Flow (CT Basin Inlet Flow) MGD x 8.34 x Use Date Feed Rate x 1.207

NaOCl Gallons Used
CL2 LBS USED / [NaOCl chemical wt. (9.66 lbs./gal) x solution strength % (0.125)]

USE DATE CL2 FEED RATE
CL2 LBS Used / (Total Filtrate Outlet Flow MGD x 8.34)

CL2 DEMAND
Use Date CL2 Feed Rate – Outback #1 Minimum CL2 Residual

consor

APPENDIX E
2023 TRACER STUDY

CITY OF BEND

LOCATION
710 NW Wall Street
Downtown Bend

MAILING ADDRESS
PO Box 431
Bend, OR 97709

PHONE
(541) 388-5505
Relay Users Dial 7-1-1

FAX
(541) 385-6676

WEB
bendoregon.gov

MAYOR
Melanie Kebler

MAYOR PRO TEM
Megan Perkins

CITY COUNCILORS
Anthony Broadman
Barb Campbell
Ariel Méndez
Megan Norris
Mike Riley

CITY MANAGER
Eric King

August 17, 2023, 2023

Chantal Tea Wikstrom, REHS
Drinking Water Specialist & Emergency Preparedness Coordinator
Drinking water Services
Oregon Health Authority

Re: Tracer Study Results for City of Bend (PWSID#OR4100100)

Dear Chantal,

Please find the enclosed Tracer Study Results for the City of Bend. These results are being submitted in accordance with OAR 333-061-0050(6)(a)(R). The Tracer Study plan was submitted to OHA for approval on May 25, 2023, and the tracer study was conducted on August 8, 2023.

The plan was drafted in accordance with the rules and the OHA guidance document "Preparing a Tracer Study Plan" and a copy is enclosed in Appendix A. City staff conducted the sampling and analysis and are available for any questions regarding this report.

Sincerely,

Rod Mingus
Water Operations manager
Utilities Department
City of Bend
rmingus@bendoregon.gov

Accommodation Information for People with Disabilities
To obtain this information in an alternate format such as Braille, large print, electronic formats, etc. Please contact [Project Manager or Document Creator] at [email] or [telephone number]. Relay Users Dial 7-1-1.

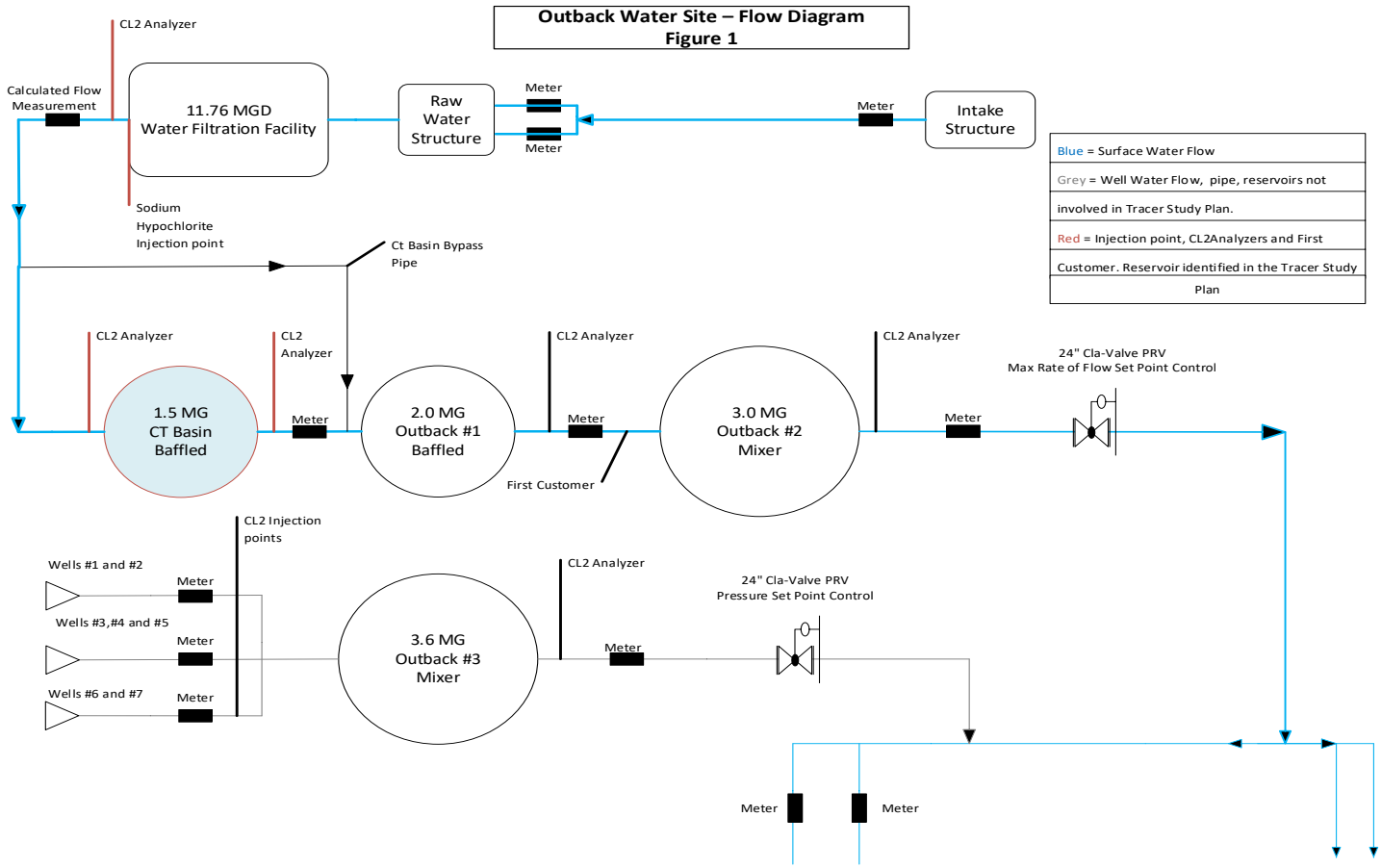
Summary

This Tracer Study Results Report summarizes actions taken by the City to trace chlorine (introduced as sodium hypochlorite) as it traveled through the CT Basin Reservoir. The City conducted this tracer study August 8, 2023.

This Tracer Study Plan (included in Appendix A) was prepared in accordance with OAR 333-061-0050(6)(a)(R). This plan was drafted in accordance with the rules and the OHA guidance document "Preparing a Tracer Study Plan" and was submitted to OHA for Approval May 25, 2023.

Figure 1 illustrates a schematic of the water treatment system, chlorine injection point, chlorine analyzer and flow monitoring locations utilized in the Study. City of Bend staff conducted the monitoring and analysis required the Tracer Study plan and have prepared this summary report.

The Tracer Study test began at 6:07 AM, August 8th,2023. City staff increased chlorine levels from 1.15 mg/L to 1.70 mg/L at the Sodium Hypochlorite injection point labeled on Figure 1. Sodium Hypochlorite was fed at this dose rate until 7:54 AM, At that time chlorine was reduced to 1.15 mg/L. All reservoir set points required by the plan were met, and data from the test is included in Appendix B-D.



Water System Overview

The new City of Bend Water Filtration Facility (WFF) was completed on April 15, 2016, at the Outback Water Facility. The WFF is a Membrane Treatment facility and has a capacity of 18.2 CFS (11.78 MGD). Raw water is conveyed to the Outback site through a ten-mile pipeline from the Bridge Creek intake facility. The WFF is a Pall membrane facility, utilizing 0.01-micron membranes for filtration prior to disinfection with sodium hypochlorite. The Outback Facility has seven groundwater wells and four reservoirs. A flow diagram illustrating the Outback Water site is presented in Figure 1. The four reservoirs and their individual volumes are identified on the flow schematic. Outback #3 is a separate reservoir for well water only.

Sodium hypochlorite is injected after filtration, prior to entering the CT Basin. Inline HACH CLF10 Chlorine residual analyzers are used on the inlet and outlet of each reservoir, monitored real-time by SCADA. Flow is metered and monitored by SCADA on the inlet and outlet of the WFF and each reservoir. All injection and monitoring points are labeled on the flow schematic presented on Figure 1.

For the purposes of this study, the first customer is identified at the outlet of the CT Basin reservoir. This has been identified as a conservative measure, and no transmission line volumes are included in the study.

Tracer Study Sampling

City of Bend Water operations staff conducted this study on August 8, 2023, by agreement with OHA. For the Study, the City utilized Chlorine residual, injected as Sodium Hypochlorite. To study the path of the tracer chemical (Cl2 residual), the City conducted the following study:

- No transmission volume was assumed. The first customer was defined at the outlet of the CT Basin reservoir.
- The City injected 12.5% Sodium Hypochlorite at the outlet of the Water Filtration Facility at a feed rate of 1.70 mg/L for 107 minutes (higher than the standard dose of 1.15 mg/L). Dosing started at 6:07 AM and continued until 7:54 AM. This dosage was determined by flow pacing and measurement at the chlorine analyzer. Chlorine residual was analyzed using inline instruments with data recorded in the SCADA system historian. As identified in Figure 1, chlorine residual was monitored at the outlet of WFF downgradient of the injection point, at the inlet of the CT Basin reservoir and at the outlet of the CT Basin reservoir. Trend charts for chlorine levels at each of these monitoring points are included in Appendix C, and raw data is presented in Appendix D. The CT Basin reservoir does not have mixers present but do have baffles.
- During the study, flow monitoring was conducted and recorded in the SCADA system historian. Flow monitoring locations are identified in Figure 1. Flow monitoring was utilized at the outlet of the WFF and the outlet of the CT Basin reservoir. The Tracer Study Plan identified flow rates and reservoir set points (detailed in Table 1 below) based on historical data during water system peak demand. The flow

rate and reservoir level are trended in Appendix C, raw data is presented in five-minute increments in Appendix D. A summary of the limits of flow rate and reservoir levels during the conducted tracer study are displayed in Table 2. All flow rates and reservoir set points specified in the tracer study plan were targeted for the tracer study.

Table 1: Tracer study plan reservoir set points (level, volumes, and flow rate)

	Reservoir Capacity (gallons)	Reservoir level min. (feet)	Reservoir Volume min. (gallons)	Reservoir level max. (feet)	Reservoir Volume max. (gallons)	Target Peak Hourly Demand during tracer study (gpm) (±10%)
CT Basin Reservoir	1,541,475	25 ft.	1,243,125	26 ft.	1,292,850	9,000

Table 2: Tracer study actual reservoir set point range (level, volumes, and flow rate)

	Reservoir Capacity (gallons)	Actual Reservoir level min. (feet)	Actual Reservoir Volume min. (gallons)	Actual Reservoir level max. (feet)	Actual Reservoir Volume max. (gallons)	Actual Peak Hourly Demand during tracer study (gpm) (±10%)
CT Basin Reservoir	1,541,475	25.14 ft.	1,250,086	25.47 ft.	1,266,495	8,221 gpm

Conclusion

The tracer study conducted by City of Bend staff on August 8, 2023, was conducted in accordance with the submitted and approved Tracer Study Plan with no deviation. Reservoir levels, measured chlorine levels, and flow rates were recorded by the SCADA historian and are included in this report both as trends, summarized data, and raw data recorded in five-minute increments.

Appendix A- Approved Tracer Study

CITY OF BEND

May 25, 2023

LOCATION
710 NW Wall Street
Downtown Bend

MAILING ADDRESS
PO Box 431
Bend, OR 97709

PHONE
(541) 388-5505
Relay Users Dial 7-1-1

FAX
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WEB
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MAYOR
Melanie Kebler

MAYOR PRO TEM
Megan Perkins

CITY COUNCILORS
Anthony Broadman
Barb Campbell
Ariel Méndez
Megan Norris
Mike Riley

CITY MANAGER
Eric King

Michelle Byrd
Oregon Health Authority
800 NE Oregon St. Suite 640
Portland OR 97232-2162

Dear Michelle,

Please find the enclosed Tracer Study Plan for the City of Bend.

The enclosed plan has been drafted in accordance with the OAR333-061-0050 and from the Oregon Health Authority (OHA) guidance document "Preparing a Tracer Study Plan." The City plans to conduct this tracer study upon approval from OHA.

The City staff will be conducting the sampling and analysis. We look forward to your response and are available for any questions regarding the proposed Tracer Study Plan.

Sincerely,

Rod Mingus
Water Operations Manager
City of Bend Utility Department
rmingus@bendoregon.gov

Accommodation Information for People with Disabilities
To obtain this information in an alternate format such as Braille, large print, electronic formats, etc. please contact Rod Mingus at rmingus@bendoregon.gov or 541-693-2180; Relay Users Dial 7-1-1, and 541-317-3046.

Summary

This Tracer Study Plan summarizes actions the City of Bend will take to trace chlorine (introduced as sodium hypochlorite) as it travels from the Water Filtration Facility (WFF) and through the designated water reservoir. The City plans to conduct this tracer study upon approval from OHA.

This Tracer Study Plan has been drafted in accordance with the OAR333-061-0050 and the OHA guidance document "Preparing a Tracer Study Plan."

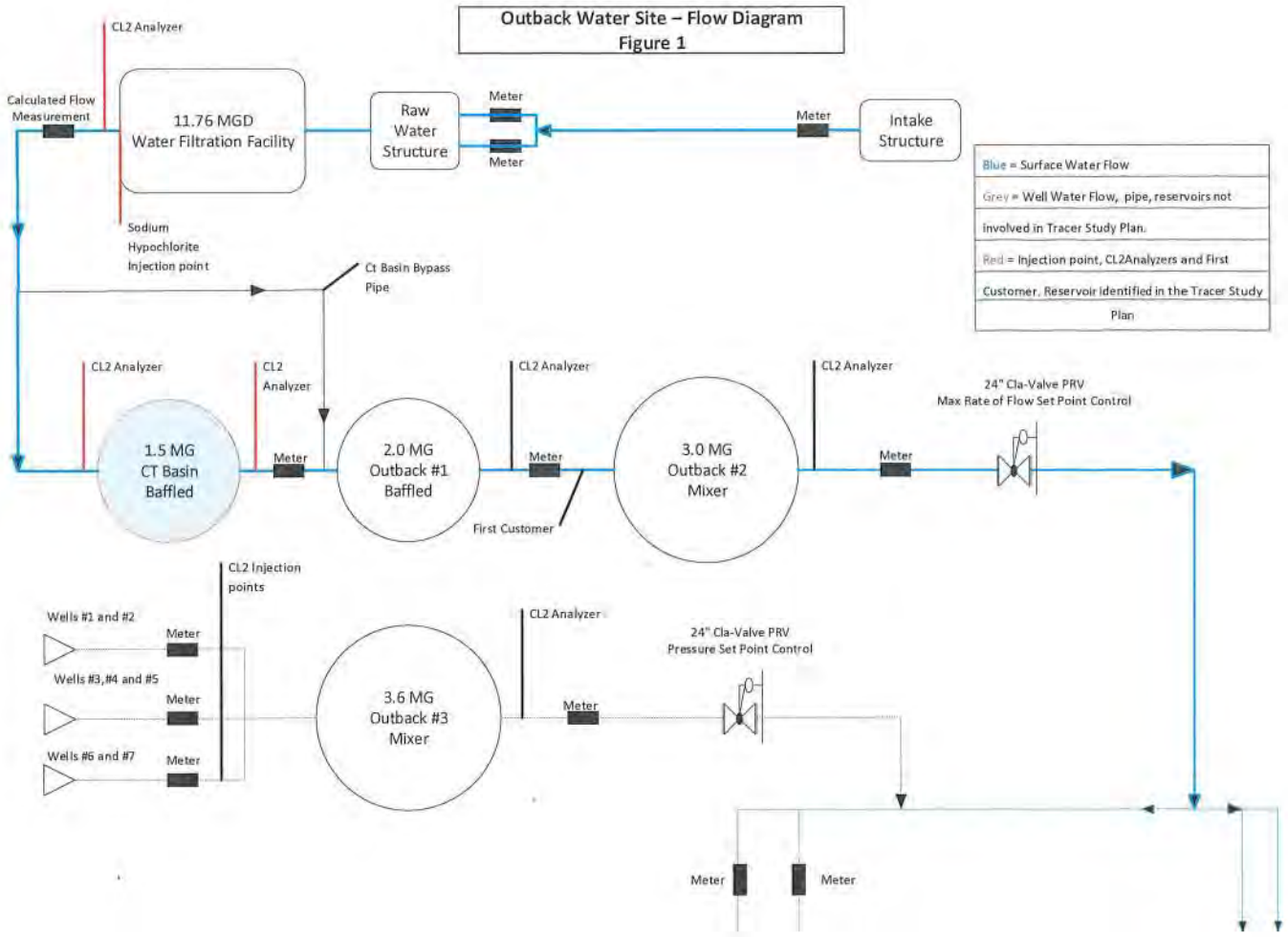
The Tracer Study Plan includes a schematic of the water treatment system, chlorine injection point, chlorine analyzer and flow monitoring locations. This plan also details the reservoir set-point levels and flows that will be maintained during the study. The City of Bend will be conducting the monitoring and analysis required for the study and will submit all information electronically after the completion of analysis.

Water System Overview

The new City of Bend Water Filtration Facility (WFF) was completed on April 15, 2016, at the Outback Water Facility. The WFF is a membrane treatment facility and has a capacity of 18.2 CFS (11.76 MGD). Raw water is conveyed to the Outback site through a ten-mile pipeline from the Bridge Creek intake facility. Pall Corporation supplied the membranes for the facility, utilizing 0.1-micron membranes for filtration prior to disinfection with sodium hypochlorite. The Outback Water Facility has seven groundwater wells and four reservoirs. A flow diagram illustrating the Outback Water facility is presented in Figure 1. The volume of each of the four reservoirs is identified on the operational flow diagram. Outback #3 is a separate reservoir for well water only, as illustrated in the flow diagram.

Sodium hypochlorite is injected after filtration and prior to the CT Basin. Inline HACH CLF10 chlorine residual analyzers are used on the inlet and outlet of each reservoir and monitored in real-time by SCADA. Flow is metered and monitored by SCADA on the inlet and outlet of the WFF and each reservoir. All injection and monitoring points are labeled on the flow diagram presented on Figure 1.

For the purposes of this study sodium hypochlorite is injected after filtration and prior to the CT Basin reservoir. The CT Basin reservoir will be the focus of this Tracer Study Plan. The first customer is identified at the outlet of CT Basin reservoir. This has been identified as a conservative measure and no transmission line volumes are included in the study.



Tracer Study Sampling Plan

The City of Bend proposes to conduct this tracer study upon approval from OHA and will submit the results to OHA after the tracer study has been executed. City of Bend Water Operations and laboratory staff will be conducting the sampling and study.

For the Tracer Study, the City of Bend proposes to utilize chlorine residual, injected as sodium hypochlorite. To study the path of the tracer chemical (Cl2 residual), the City of Bend proposes the following plan:

- For the purposes of this study, no transmission volume is assumed. The first customer is at the outlet of the CT Basin reservoir.
- The City of Bend plans to inject 12.5% sodium hypochlorite at the outlet of the Water Filtration Facility at a feed rate of **1.80 mg/L for the entire duration of the study** (higher than the standard dose of 1.0 mg/L). This dosage will be determined by flow pacing and measurement at the chlorine analyzer. Chlorine residual will be analyzed using inline instruments with data recorded in the SCADA system Historian. As identified in Figure 1, chlorine residual will be monitored at the outlet of the WFF downgradient of the injection point and at the outlet of CT Basin reservoir.
- During the study, flow monitoring will be conducted and recorded in the SCADA system Historian. Flow monitoring locations are identified in Figure 1. Flow monitoring will be utilized at the outlet of the WFF and the outlet of the CT Basin reservoir. It is anticipated that flow can be sustained during this period at flow rates and reservoir set points, as specified below in Table 1 based on historical data during water system peak demand (August).

Table 1: Tracer study reservoir set points (level, volumes, and flow rate)

	Reservoir Capacity (gallons)	Reservoir Level at max Capacity (feet)	Reservoir Level min. (feet)	Reservoir Volume min. (gallons)	Reservoir Level max. (feet)	Reservoir Volume max. (gallons)	Target Peak Hourly Demand during tracer study (gpm) (+ or -10%)
CT Basin	1,541,475	31 ft.	25 ft.	1,243,125	26 ft.	1,292,850	9,000

After the Tracer Study has been completed, the results will be summarized in a report to OHA. This report will include Excel spreadsheets with data and trending charts for reservoir levels, flow and chlorine residual measured during the test period. This report will include data required on the "Tracer Study Parameters and Results" worksheet guidance from OHA.

Appendix B- Tracer Study Parameters and Results Worksheets

Preparing a Tracer Study Plan

OHA Drinking Water Services

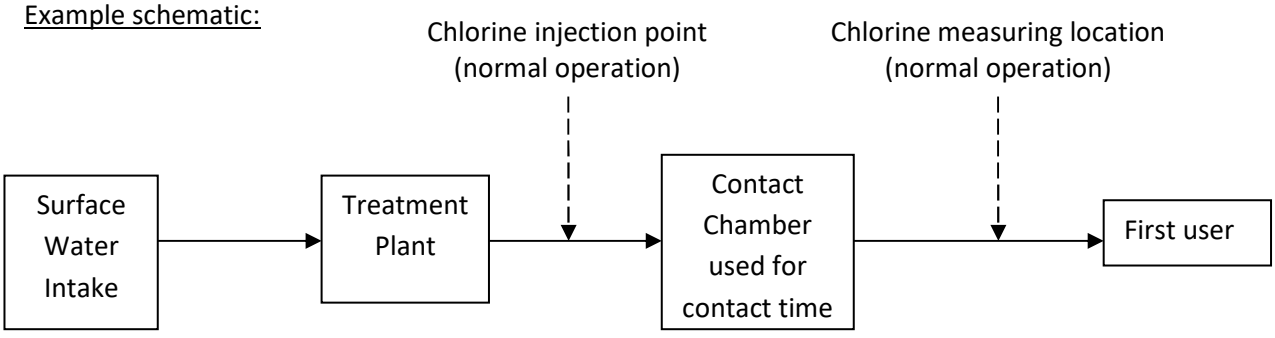
November 2019

A tracer study plan must be submitted for review and approval to Drinking Water Services prior to conducting a tracer study. Failure to receive prior approval may result in the tracer study results not being accepted and it having to be redone.

Be prepared to provide the following information in your tracer study plan:

- Who will be conducting the tracer study? When will the tracer study be conducted?
- What chemical will be used as the tracer? How will the tracer dosage be determined?
  Note: Be sure to keep chlorine residual at levels to ensure disinfection CT (Chlorine residual x contact Time) requirements will be met at all times during the tracer study.
- What is the total volume of the reservoir or clearwell (i.e. contact chamber) being used for the tracer study?
- Is there additional transmission line volume between the contact chamber and the first user that will be included in the tracer study (not preferred)? If yes, explain why this additional volume needs to be included in the tracer study.
- Is there a flow meter at the contact chamber outlet that measures gpm? If no, how will peak hourly flow be determined for the tracer study?
- What is the peak hourly demand leaving the contact chamber?
- At what flow rate(s) will the tracer study be conducted? How will this flow be maintained during the tracer study?
- What is the lowest operating volume of the contact chamber?
- What is the planned contact chamber volume range from beginning to end of tracer study?
- A schematic must be provided that clearly shows:
  - The contact chamber used for contact time
  - All chlorine injection points (including those used during normal operation as well as during the tracer study, if different).
  - All chlorine measuring locations (including those used during normal operation as well as during the tracer study, if different).
  - The first user.

Example schematic:



Tracer Study Parameters & Results

Water System Name: City of Bend ID#: 100
Date of Tracer Study: 8/8/2023

Contact Volume:

Volume of Clearwell when Full: 1,541,475 (a)
Water level height when full: 31 (b)
Minimum water level height: 25 (c)
Minimum Volume of Clearwell (a x c / b): 1,243,125 (d)
Volume or height at time of tracer study*: 25.14 (e)
* Note: Must be within 10% of minimum volume
ume in pipe: 0 (f)
Total volume used for tracer study
(to 1st user): 1250086 (g)

Flow Conditions:

Peak flow at contact chamber effluent: 8221 (h)
determined? _x_ flow meter at effluent
___ pump rates
___ other _____
Flow at time of tracer study: Beginning: 7270
End: 7222
Average*: 7548 (i)
* Note: Flow (i) during tracer study must be at least 90% of peak flow, or 0.9 x h
Note: Tracer study must be repeated when peak flow increases by 10%
Repeat tracer study when peak flow is: 1.1 x (i) = 8302 (j)

Tracer Chemical:

Which chemical is to be used?
__x_ Chlorine compound ___ Fluoride compound
___ Other _____
Initial concentration: 1.15 (k) Dosage conc.: 1.7 (L)
Target concentration at 1st user: k + [0.1 x (L-k)]= 1.205 (m)

Results: **Minimum**

Time for target concentration to be reached: 107 (n) **Contact Time!!**
Baffling factor = (n x i) / g = 0.64 (o)
Note: Baffling factor may be used when volume is greater or flow is less than in study

Name: Rod Mingus

Signature: _____ Date: 8/16/2023

Worksheet for Tracer Study

Addendum to "Tracer Study Parameters and Results" Page

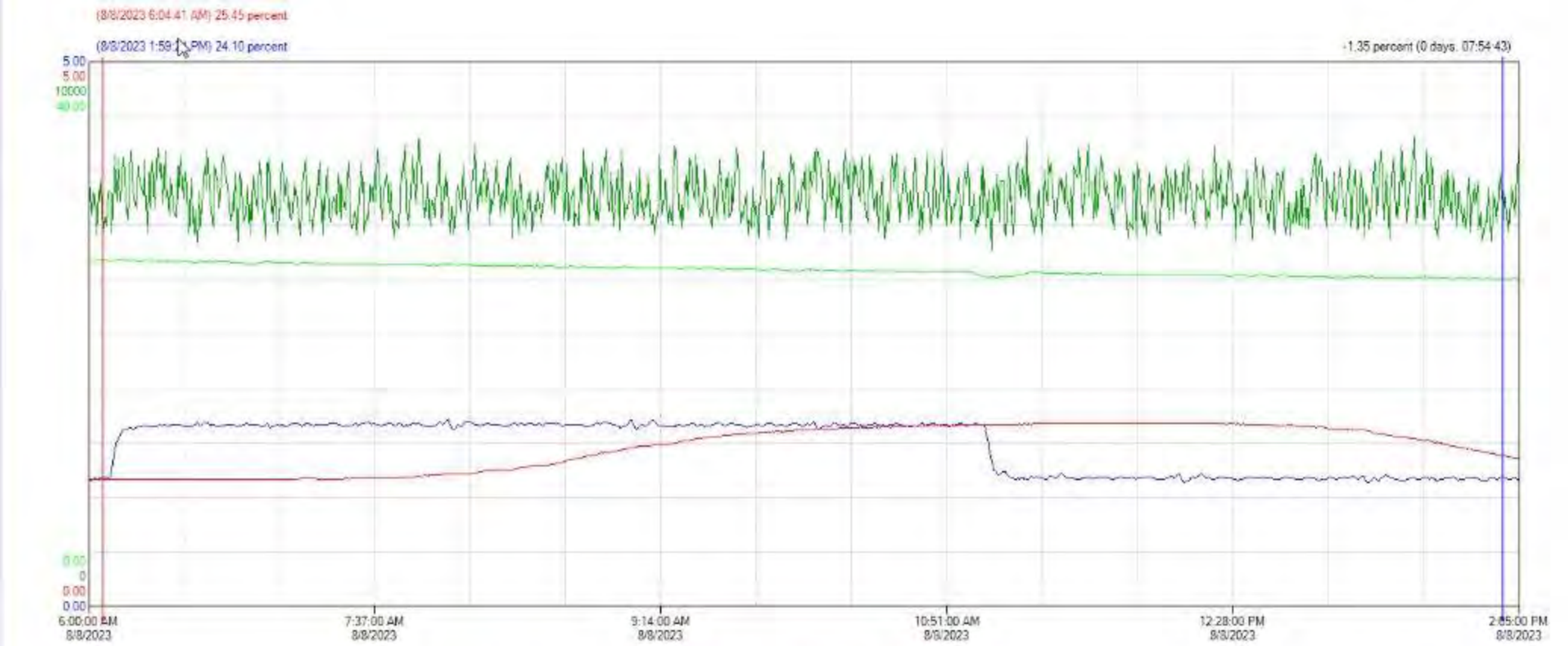
stem: **City of Bend** Date: **8/8/2023**

Time	Concentration (ppm)	Comments
6:07 AM	1.167	Start of test. Initial concentration raised from 1.15 mg/l to 1.70 mg/l
6:08 AM	1.167	
6:09 AM	1.167	
6:10 AM	1.167	
6:11 AM	1.168	
6:12 AM	1.167	
6:13 AM	1.167	
6:14 AM	1.165	
6:15 AM	1.167	
6:16 AM	1.165	
6:17 AM	1.167	
6:18 AM	1.167	
6:19 AM	1.167	
6:20 AM	1.170	
6:21 AM	1.165	
6:22 AM	1.167	
6:23 AM	1.167	
6:24 AM	1.167	
6:25 AM	1.167	
6:26 AM	1.167	
6:27 AM	1.167	
6:28 AM	1.171	
6:29 AM	1.171	
6:30 AM	1.171	
6:31 AM	1.167	
6:32 AM	1.167	
6:33 AM	1.167	
6:34 AM	1.168	
6:35 AM	1.167	
6:36 AM	1.171	
6:37 AM	1.171	
6:38 AM	1.171	
6:39 AM	1.171	
6:40 AM	1.171	
6:41 AM	1.171	
6:42 AM	1.171	
6:43 AM	1.171	
6:44 AM	1.171	
6:45 AM	1.171	
6:46 AM	1.165	
6:47 AM	1.167	

6:48 AM	1.171	
6:49 AM	1.171	
6:50 AM	1.171	
6:51 AM	1.171	
6:52 AM	1.171	
6:53 AM	1.171	
6:54 AM	1.171	
6:55 AM	1.171	
6:56 AM	1.171	
6:57 AM	1.171	
6:58 AM	1.171	
6:59 AM	1.171	
7:00 AM	1.171	
7:01 AM	1.171	
7:02 AM	1.171	
7:03 AM	1.171	
7:04 AM	1.171	
7:05 AM	1.171	
7:06 AM	1.171	
7:07 AM	1.171	
7:08 AM	1.171	
7:09 AM	1.171	
7:10 AM	1.171	
7:11 AM	1.171	
7:12 AM	1.171	
7:13 AM	1.171	
7:14 AM	1.171	
7:15 AM	1.171	
7:16 AM	1.171	
7:17 AM	1.176	
7:18 AM	1.171	
7:19 AM	1.171	
7:20 AM	1.171	
7:21 AM	1.171	
7:22 AM	1.171	
7:23 AM	1.171	
7:24 AM	1.171	
7:25 AM	1.171	
7:26 AM	1.171	
7:27 AM	1.173	CL2 starting to climb
7:28 AM	1.176	
7:29 AM	1.174	
7:30 AM	1.176	
7:31 AM	1.176	

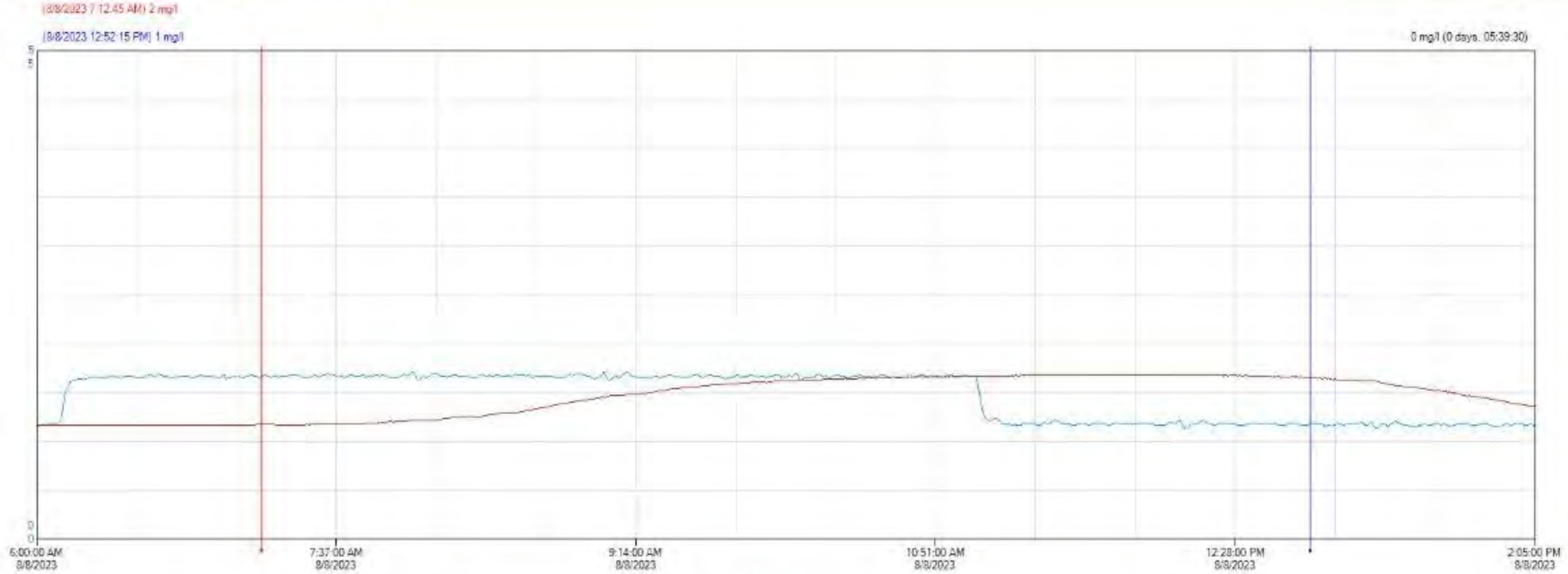
7:32 AM	1.176	
7:33 AM	1.179	
7:34 AM	1.176	
7:35 AM	1.176	
7:36 AM	1.176	
7:37 AM	1.176	
7:38 AM	1.176	
7:39 AM	1.176	
7:40 AM	1.176	
7:41 AM	1.176	
7:42 AM	1.178	
7:43 AM	1.179	
7:44 AM	1.182	
7:45 AM	1.182	
7:46 AM	1.182	
7:47 AM	1.187	
7:48 AM	1.189	
7:49 AM	1.187	
7:50 AM	1.187	
7:51 AM	1.192	
7:52 AM	1.195	
7:53 AM	1.192	
7:54 AM	1.205	End of tracer study
7:55 AM	1.203	
7:56 AM	1.203	
7:57 AM	1.210	
7:58 AM	1.210	
7:59 AM	1.208	
8:00 AM	1.214	

Appendix C- Trend Charts for Tracer Study (Flow, Chlorine, and Levels)



Tag Name	Description	Number	Server	Color	Units	Minimum	Maximum	IO Address	Time Offset	Source Tag	Source Server	Value at X1	Value at X2
1_AIT_001...	CT Basin Chlorine Inlet Residual	1	TELINSQL		mg/l	0.00	5.00	\\TELDA1\abcip\Dutba...	0:00:00.000			1.18	1.19
1_AIT_001...	CT Basin Outlet Chlorine Residual	2	TELINSQL		mg/l	0.00	5.00	\\TELDA1\abcip\Dutba...	0:00:00.000			1.17	1.39
WARS_08...	CT Basin Outlet Flow	3	TELINSQL		GPM	0	10000	\\TELDA1\abcip\Dutba...	0:00:00.000			7825	7966
WARS_08...	CT Basin Level	4	TELINSQL		percent	0.00	40.00	\\TELDA1\abcip\Dutba...	0:00:00.000			25.45	24.10

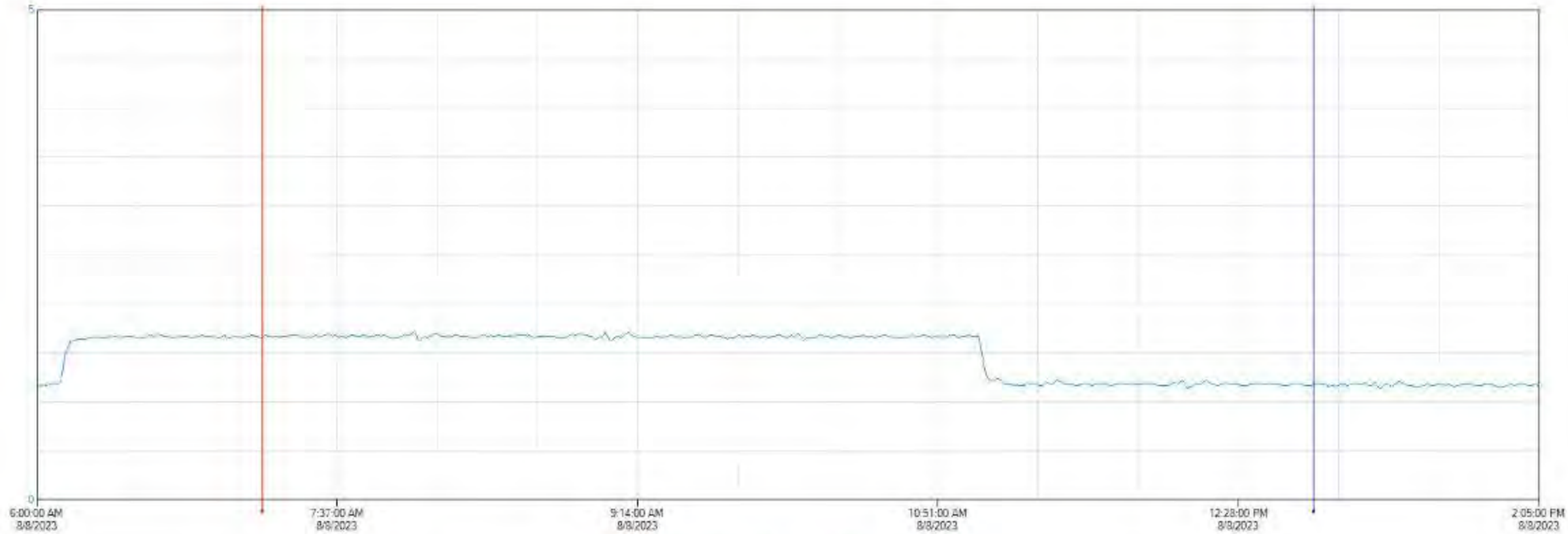
8/ 8/2023 6:00:00 AM | [00] 08:05:00.000 | 8/ 8/2023 2:05:00 PM



TELINSQL\WARS_OB_AIT_0007_PV [BestFit - 00:00:01:33.333]

Tag Name	Description	Number	Server	Color	Units	Minimum	Maximum	IO Address	Time Offset	Source Tag	Source Server	Value at X1	Value at X2
☐ WARS_OB...	CT Basin Level	2	TELINSQL		percent	0	40	\\TELDA1\abcp\Outba...	0:00:00.000			25	24
☐ WARS_OB...	CT Basin Outlet Flow	3	TELINSQL		GPM	0	10000	\\TELDA1\abcp\Outba...	0:00:00.000			8171	7732
☑ WARS_OB...	CT Basin Chlorine Inlet Residual	4	TELINSQL		mg/l	0	5	\\TELDA1\abcp\Outba...	0:00:00.000			2	1
☑ WARS_OB...	CT Basin Outlet Chlorine Residual	5	TELINSQL		mg/l	0	5	\\TELDA1\abcp\Outba...	0:00:00.000			1	2

8/ 8/2023 6:00:00 AM | [00] 08:05:00.000 | 8/ 8/2023 2:05:00 PM



[HIDDEN] TELINSQL\WARS_OB_FT_0012_PV (BestFit - 00:08:01.333)

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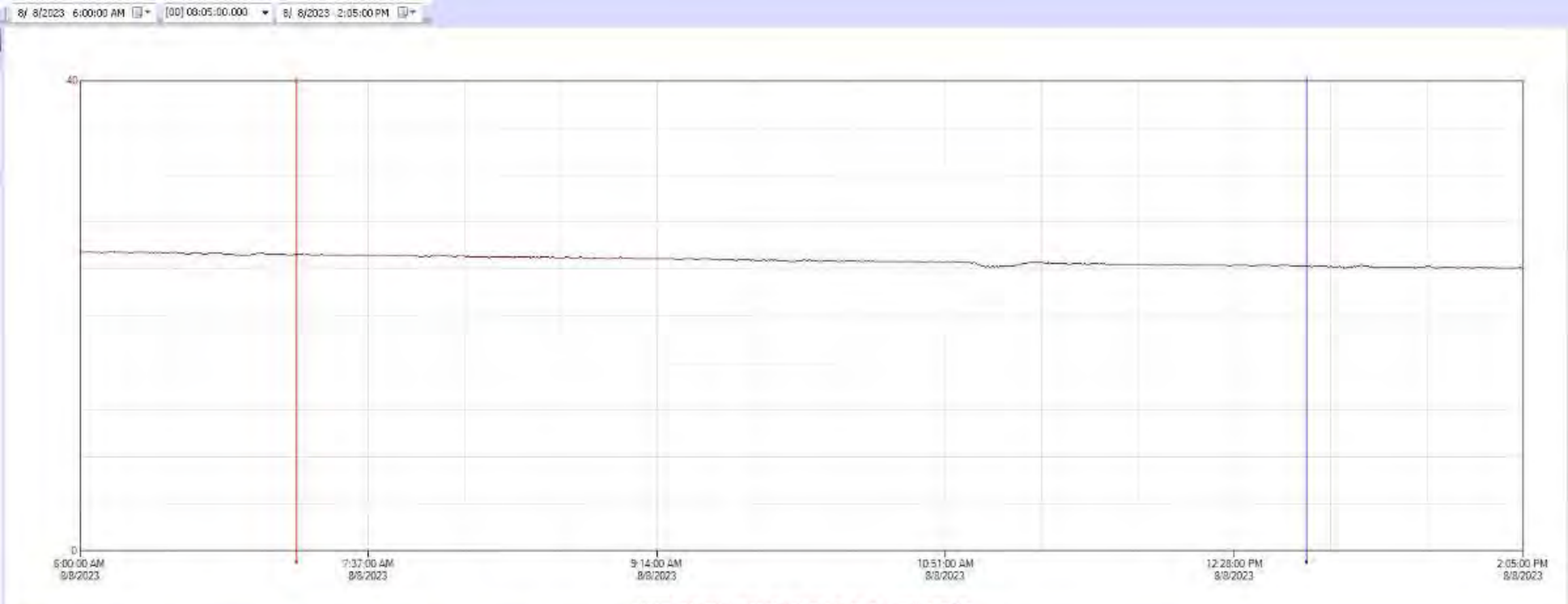
☐ WARS_OB...	CT Basin Outlet Flow	3	TELINSQL		GPM	0	10000	\\TELDA1\abcp\Outba..	0:00:00.000			8171	7732
☑ WARS_OB...	CT Basin Chlorine Inlet Residual	4	TELINSQL		mg/l	0	5	\\TELDA1\abcp\Outba..	0:00:00.000			2	1
☐ WARS_OB...	CT Basin Outlet Chlorine Residual	5	TELINSQL		mg/l	0	5	\\TELDA1\abcp\Outba..	0:00:00.000			1	2

8/ 8/2023 6:00:00 AM | [00] 08:05:00.000 | 8/ 8/2023 2:05:00 PM



[HIDDEN] TELINSQL\WARS_OB_AIT_0013_PV (Best-fit - 00:00:01:33.333)

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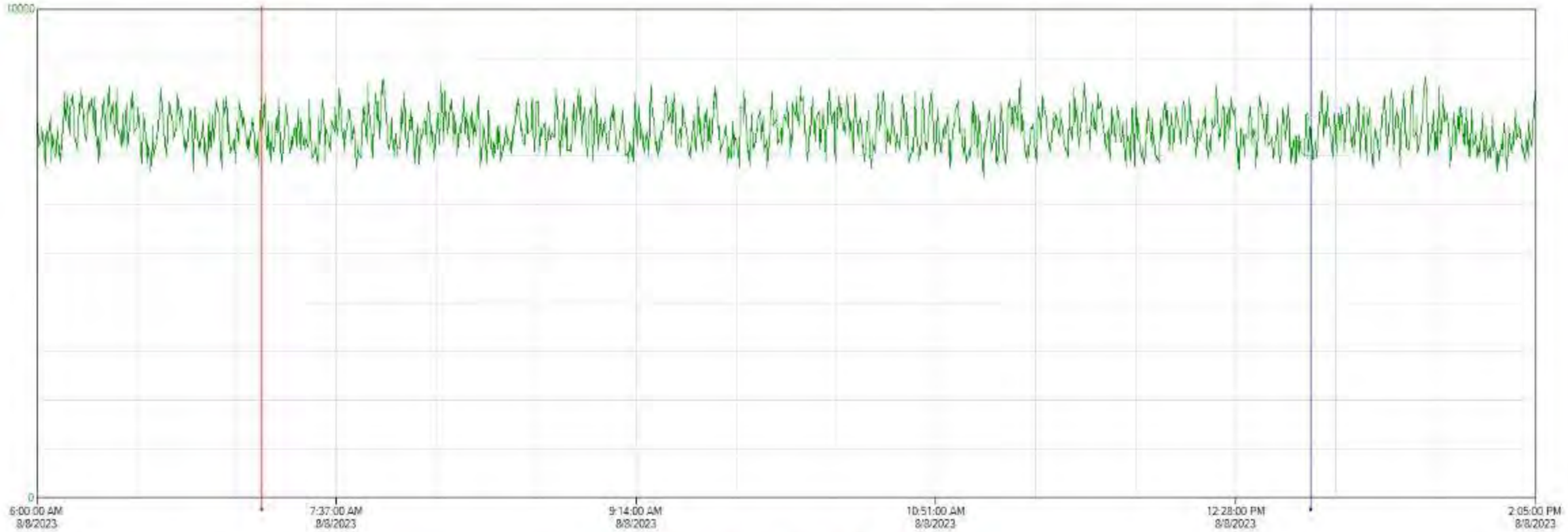
☑ WARS_OB...	CT Basin Level	2	TELINSQL		percent	0	40	\\TELDA1\abcipl0utba...	0:00:00.000			25	24
☐ WARS_OB...	CT Basin Outlet Flow	3	TELINSQL		GPM	0	10000	\\TELDA1\abcipl0utba...	0:00:00.000			8171	7732
☐ WARS_OB...	CT Basin Chlorine Inlet Residual	4	TELINSQL		mg/l	0	5	\\TELDA1\abcipl0utba...	0:00:00.000			2	1
☐ WARS_OB...	CT Basin Outlet Chlorine Residual	5	TELINSQL		mg/l	0	5	\\TELDA1\abcipl0utba...	0:00:00.000			1	2

8/ 8/2023 6:00:00 AM | [00] 08:05:00.000 | 8/ 8/2023 2:05:00 PM



[HIDDEN] TELINSQL\WARS_OB_LT_0001_PV [BestFit - 00 00:01:33.333]

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☐ WARS_OB...	CT Basin Level	2	TELINSQL		percent	0	40	\\TELDA1\abcpl0utba...	0 00:00.000			25	24
☑ WARS_OB...	CT Basin Outlet Flow	3	TELINSQL		GPM	0	10000	\\TELDA1\abcpl0utba...	0 00:00.000			8171	7732
☐ WARS_OB...	CT Basin Chlorine Inlet Residual	4	TELINSQL		mg/l	0	5	\\TELDA1\abcpl0utba...	0 00:00.000			2	1
☐ WARS_OB...	CT Basin Outlet Chlorine Residual	5	TELINSQL		mg/l	0	5	\\TELDA1\abcpl0utba...	0 00:00.000			1	2

Appendix D- Tracer Study Excel database with raw test data

WARS_OB_AIT_0013_PV

DateTime	WARS_OB_AIT_0013_PV
6:07:00 AM	1.167
1/0/00 6:08:00 AM	1.167
1/0/00 6:09:00 AM	1.167
8/8/23 6:10:00 AM	1.167
8/8/23 6:11:00 AM	1.168
8/8/23 6:12:00 AM	1.167
8/8/23 6:13:00 AM	1.167
8/8/23 6:14:00 AM	1.165
8/8/23 6:15:00 AM	1.167
8/8/23 6:16:00 AM	1.165
8/8/23 6:17:00 AM	1.167
8/8/23 6:18:00 AM	1.167
8/8/23 6:19:00 AM	1.167
8/8/23 6:20:00 AM	1.170
8/8/23 6:21:00 AM	1.165
8/8/23 6:22:00 AM	1.167
8/8/23 6:23:00 AM	1.167
8/8/23 6:24:00 AM	1.167
8/8/23 6:25:00 AM	1.167
8/8/23 6:26:00 AM	1.167
8/8/23 6:27:00 AM	1.167
8/8/23 6:28:00 AM	1.171
8/8/23 6:29:00 AM	1.171
8/8/23 6:30:00 AM	1.171
8/8/23 6:31:00 AM	1.167
8/8/23 6:32:00 AM	1.167
8/8/23 6:33:00 AM	1.167
8/8/23 6:34:00 AM	1.168
8/8/23 6:35:00 AM	1.167
8/8/23 6:36:00 AM	1.171
8/8/23 6:37:00 AM	1.171
8/8/23 6:38:00 AM	1.171
8/8/23 6:39:00 AM	1.171
8/8/23 6:40:00 AM	1.171
8/8/23 6:41:00 AM	1.171
8/8/23 6:42:00 AM	1.171
8/8/23 6:43:00 AM	1.171
8/8/23 6:44:00 AM	1.171
8/8/23 6:45:00 AM	1.171
8/8/23 6:46:00 AM	1.165
8/8/23 6:47:00 AM	1.167
8/8/23 6:48:00 AM	1.171
8/8/23 6:49:00 AM	1.171

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8/8/23 6:51:00 AM	1.171
8/8/23 6:52:00 AM	1.171
8/8/23 6:53:00 AM	1.171
8/8/23 6:54:00 AM	1.171
8/8/23 6:55:00 AM	1.171
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8/8/23 6:57:00 AM	1.171
8/8/23 6:58:00 AM	1.171
8/8/23 6:59:00 AM	1.171
8/8/23 7:00:00 AM	1.171
8/8/23 7:01:00 AM	1.171
8/8/23 7:02:00 AM	1.171
8/8/23 7:03:00 AM	1.171
8/8/23 7:04:00 AM	1.171
8/8/23 7:05:00 AM	1.171
8/8/23 7:06:00 AM	1.171
8/8/23 7:07:00 AM	1.171
8/8/23 7:08:00 AM	1.171
8/8/23 7:09:00 AM	1.171
8/8/23 7:10:00 AM	1.171
8/8/23 7:11:00 AM	1.171
8/8/23 7:12:00 AM	1.171
8/8/23 7:13:00 AM	1.171
8/8/23 7:14:00 AM	1.171
8/8/23 7:15:00 AM	1.171
8/8/23 7:16:00 AM	1.171
8/8/23 7:17:00 AM	1.176
8/8/23 7:18:00 AM	1.171
8/8/23 7:19:00 AM	1.171
8/8/23 7:20:00 AM	1.171
8/8/23 7:21:00 AM	1.171
8/8/23 7:22:00 AM	1.171
8/8/23 7:23:00 AM	1.171
8/8/23 7:24:00 AM	1.171
8/8/23 7:25:00 AM	1.171
8/8/23 7:26:00 AM	1.171
8/8/23 7:27:00 AM	1.173
8/8/23 7:28:00 AM	1.176
8/8/23 7:29:00 AM	1.174
8/8/23 7:30:00 AM	1.176
8/8/23 7:31:00 AM	1.176
8/8/23 7:32:00 AM	1.176
8/8/23 7:33:00 AM	1.179
8/8/23 7:34:00 AM	1.176
8/8/23 7:35:00 AM	1.176

8/8/23 7:36:00 AM	1.176
8/8/23 7:37:00 AM	1.176
8/8/23 7:38:00 AM	1.176
8/8/23 7:39:00 AM	1.176
8/8/23 7:40:00 AM	1.176
8/8/23 7:41:00 AM	1.176
8/8/23 7:42:00 AM	1.178
8/8/23 7:43:00 AM	1.179
8/8/23 7:44:00 AM	1.182
8/8/23 7:45:00 AM	1.182
8/8/23 7:46:00 AM	1.182
8/8/23 7:47:00 AM	1.187
8/8/23 7:48:00 AM	1.189
8/8/23 7:49:00 AM	1.187
8/8/23 7:50:00 AM	1.187
8/8/23 7:51:00 AM	1.192
8/8/23 7:52:00 AM	1.195
8/8/23 7:53:00 AM	1.192
8/8/23 7:54:00 AM	1.205
8/8/23 7:55:00 AM	1.203
8/8/23 7:56:00 AM	1.203
8/8/23 7:57:00 AM	1.210
8/8/23 7:58:00 AM	1.210
8/8/23 7:59:00 AM	1.208
8/8/23 8:00:00 AM	1.214
8/8/23 8:01:00 AM	1.214
8/8/23 8:02:00 AM	1.214
8/8/23 8:03:00 AM	1.214
8/8/23 8:04:00 AM	1.221
8/8/23 8:05:00 AM	1.219
8/8/23 8:06:00 AM	1.214
8/8/23 8:07:00 AM	1.214
8/8/23 8:08:00 AM	1.214
8/8/23 8:09:00 AM	1.219
8/8/23 8:10:00 AM	1.226
8/8/23 8:11:00 AM	1.226
8/8/23 8:12:00 AM	1.231
8/8/23 8:13:00 AM	1.237
8/8/23 8:14:00 AM	1.242
8/8/23 8:15:00 AM	1.243
8/8/23 8:16:00 AM	1.253
8/8/23 8:17:00 AM	1.253
8/8/23 8:18:00 AM	1.253
8/8/23 8:19:00 AM	1.253
8/8/23 8:20:00 AM	1.255
8/8/23 8:21:00 AM	1.253

8/8/23 8:22:00 AM	1.253
8/8/23 8:23:00 AM	1.253
8/8/23 8:24:00 AM	1.256
8/8/23 8:25:00 AM	1.264
8/8/23 8:26:00 AM	1.269
8/8/23 8:27:00 AM	1.275
8/8/23 8:28:00 AM	1.280
8/8/23 8:29:00 AM	1.285
8/8/23 8:30:00 AM	1.291
8/8/23 8:31:00 AM	1.296
8/8/23 8:32:00 AM	1.296
8/8/23 8:33:00 AM	1.301
8/8/23 8:34:00 AM	1.296
8/8/23 8:35:00 AM	1.296
8/8/23 8:36:00 AM	1.303
8/8/23 8:37:00 AM	1.307
8/8/23 8:38:00 AM	1.312
8/8/23 8:39:00 AM	1.317
8/8/23 8:40:00 AM	1.322
8/8/23 8:41:00 AM	1.328
8/8/23 8:42:00 AM	1.335
8/8/23 8:43:00 AM	1.344
8/8/23 8:44:00 AM	1.347
8/8/23 8:45:00 AM	1.351
8/8/23 8:46:00 AM	1.356
8/8/23 8:47:00 AM	1.365
8/8/23 8:48:00 AM	1.373
8/8/23 8:49:00 AM	1.381
8/8/23 8:50:00 AM	1.387
8/8/23 8:51:00 AM	1.392
8/8/23 8:52:00 AM	1.394
8/8/23 8:53:00 AM	1.404
8/8/23 8:54:00 AM	1.410
8/8/23 8:55:00 AM	1.415
8/8/23 8:56:00 AM	1.416
8/8/23 8:57:00 AM	1.421
8/8/23 8:58:00 AM	1.426
8/8/23 8:59:00 AM	1.431
8/8/23 9:00:00 AM	1.437
8/8/23 9:01:00 AM	1.439
8/8/23 9:02:00 AM	1.444
8/8/23 9:03:00 AM	1.452
8/8/23 9:04:00 AM	1.455
8/8/23 9:05:00 AM	1.463
8/8/23 9:06:00 AM	1.471
8/8/23 9:07:00 AM	1.471

8/8/23 9:08:00 AM	1.471
8/8/23 9:09:00 AM	1.471
8/8/23 9:10:00 AM	1.477
8/8/23 9:11:00 AM	1.482
8/8/23 9:12:00 AM	1.488
8/8/23 9:13:00 AM	1.488
8/8/23 9:14:00 AM	1.488
8/8/23 9:15:00 AM	1.487
8/8/23 9:16:00 AM	1.488
8/8/23 9:17:00 AM	1.493
8/8/23 9:18:00 AM	1.496
8/8/23 9:19:00 AM	1.505
8/8/23 9:20:00 AM	1.506
8/8/23 9:21:00 AM	1.516
8/8/23 9:22:00 AM	1.520
8/8/23 9:23:00 AM	1.525
8/8/23 9:24:00 AM	1.530
8/8/23 9:25:00 AM	1.536
8/8/23 9:26:00 AM	1.541
8/8/23 9:27:00 AM	1.548
8/8/23 9:28:00 AM	1.548
8/8/23 9:29:00 AM	1.553
8/8/23 9:30:00 AM	1.554
8/8/23 9:31:00 AM	1.554
8/8/23 9:32:00 AM	1.559
8/8/23 9:33:00 AM	1.559
8/8/23 9:34:00 AM	1.559
8/8/23 9:35:00 AM	1.564
8/8/23 9:36:00 AM	1.570
8/8/23 9:37:00 AM	1.575
8/8/23 9:38:00 AM	1.575
8/8/23 9:39:00 AM	1.575
8/8/23 9:40:00 AM	1.580
8/8/23 9:41:00 AM	1.581
8/8/23 9:42:00 AM	1.585
8/8/23 9:43:00 AM	1.586
8/8/23 9:44:00 AM	1.591
8/8/23 9:45:00 AM	1.591
8/8/23 9:46:00 AM	1.591
8/8/23 9:47:00 AM	1.596
8/8/23 9:48:00 AM	1.602
8/8/23 9:49:00 AM	1.602
8/8/23 9:50:00 AM	1.602
8/8/23 9:51:00 AM	1.602
8/8/23 9:52:00 AM	1.609
8/8/23 9:53:00 AM	1.609

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8/8/23 9:55:00 AM	1.609
8/8/23 9:56:00 AM	1.609
8/8/23 9:57:00 AM	1.610
8/8/23 9:58:00 AM	1.609
8/8/23 9:59:00 AM	1.617
8/8/23 10:00:00 AM	1.618
8/8/23 10:01:00 AM	1.623
8/8/23 10:02:00 AM	1.623
8/8/23 10:03:00 AM	1.625
8/8/23 10:04:00 AM	1.623
8/8/23 10:05:00 AM	1.623
8/8/23 10:06:00 AM	1.623
8/8/23 10:07:00 AM	1.628
8/8/23 10:08:00 AM	1.629
8/8/23 10:09:00 AM	1.629
8/8/23 10:10:00 AM	1.626
8/8/23 10:11:00 AM	1.629
8/8/23 10:12:00 AM	1.633
8/8/23 10:13:00 AM	1.629
8/8/23 10:14:00 AM	1.629
8/8/23 10:15:00 AM	1.641
8/8/23 10:16:00 AM	1.641
8/8/23 10:17:00 AM	1.641
8/8/23 10:18:00 AM	1.644
8/8/23 10:19:00 AM	1.645
8/8/23 10:20:00 AM	1.645
8/8/23 10:21:00 AM	1.645
8/8/23 10:22:00 AM	1.645
8/8/23 10:23:00 AM	1.645
8/8/23 10:24:00 AM	1.645
8/8/23 10:25:00 AM	1.641
8/8/23 10:26:00 AM	1.645
8/8/23 10:27:00 AM	1.650
8/8/23 10:28:00 AM	1.652
8/8/23 10:29:00 AM	1.647
8/8/23 10:30:00 AM	1.650
8/8/23 10:31:00 AM	1.652
8/8/23 10:32:00 AM	1.645
8/8/23 10:33:00 AM	1.650
8/8/23 10:34:00 AM	1.650
8/8/23 10:35:00 AM	1.652
8/8/23 10:36:00 AM	1.655
8/8/23 10:37:00 AM	1.657
8/8/23 10:38:00 AM	1.661
8/8/23 10:39:00 AM	1.661

8/8/23 10:40:00 AM	1.661
8/8/23 10:41:00 AM	1.661
8/8/23 10:42:00 AM	1.661
8/8/23 10:43:00 AM	1.661
8/8/23 10:44:00 AM	1.661
8/8/23 10:45:00 AM	1.661
8/8/23 10:46:00 AM	1.666
8/8/23 10:47:00 AM	1.665
8/8/23 10:48:00 AM	1.668
8/8/23 10:49:00 AM	1.668
8/8/23 10:50:00 AM	1.668
8/8/23 10:51:00 AM	1.668
8/8/23 10:52:00 AM	1.668
8/8/23 10:53:00 AM	1.668
8/8/23 10:54:00 AM	1.666
8/8/23 10:55:00 AM	1.668
8/8/23 10:56:00 AM	1.668
8/8/23 10:57:00 AM	1.673
8/8/23 10:58:00 AM	1.673
8/8/23 10:59:00 AM	1.673
8/8/23 11:00:00 AM	1.673
8/8/23 11:01:00 AM	1.673
8/8/23 11:02:00 AM	1.673
8/8/23 11:03:00 AM	1.668
8/8/23 11:04:00 AM	1.673
8/8/23 11:05:00 AM	1.673
8/8/23 11:06:00 AM	1.673
8/8/23 11:07:00 AM	1.673
8/8/23 11:08:00 AM	1.673
8/8/23 11:09:00 AM	1.673
8/8/23 11:10:00 AM	1.673
8/8/23 11:11:00 AM	1.673
8/8/23 11:12:00 AM	1.673
8/8/23 11:13:00 AM	1.673
8/8/23 11:14:00 AM	1.673
8/8/23 11:15:00 AM	1.673
8/8/23 11:16:00 AM	1.674

DateTime	CT Basin Outlet Flow - Feet. WARS_OB_FT_0012_PV	CT Basin Level - Gallons. WARS_OB_LT_0001_PV	CT Basin Inlet CL2 - Mg/L WARS_OB_AIT_0007_PV	CT basin Outlet CL2 - Mg/L WARS_OB_AIT_0013_PV
8/8/23 12:00:00 AM	7712.39	26.53	1.18	1.16
8/8/23 12:05:00 AM	8215.63	26.53	1.17	1.16
8/8/23 12:10:00 AM	7645.27	26.57	1.19	1.16
8/8/23 12:15:00 AM	7526.59	26.53	1.17	1.16
8/8/23 12:20:00 AM	7305.45	26.49	1.19	1.16
8/8/23 12:25:00 AM	7135.86	26.49	1.19	1.16
8/8/23 12:30:00 AM	7654.67	26.47	1.17	1.16
8/8/23 12:35:00 AM	7468.87	26.39	1.18	1.16
8/8/23 12:40:00 AM	7472.11	26.36	1.17	1.16
8/8/23 12:45:00 AM	7626.13	26.43	1.17	1.16
8/8/23 12:50:00 AM	7296.04	26.39	1.16	1.16
8/8/23 12:55:00 AM	7363.16	26.39	1.20	1.16
8/8/23 1:00:00 AM	7311.93	26.39	1.17	1.16
8/8/23 1:05:00 AM	6956.23	26.34	1.18	1.16
8/8/23 1:10:00 AM	7571.66	26.39	1.16	1.16
8/8/23 1:15:00 AM	7754.22	26.34	1.17	1.16
8/8/23 1:20:00 AM	7523.35	26.34	1.17	1.16
8/8/23 1:25:00 AM	8289.23	26.30	1.17	1.16
8/8/23 1:30:00 AM	7334.31	26.28	1.21	1.16
8/8/23 1:35:00 AM	7424.12	26.30	1.17	1.16
8/8/23 1:40:00 AM	7539.56	26.30	1.14	1.16
8/8/23 1:45:00 AM	7363.16	26.22	1.18	1.16
8/8/23 1:50:00 AM	7936.77	26.26	1.16	1.16
8/8/23 1:55:00 AM	8087.22	26.16	1.17	1.16
8/8/23 2:00:00 AM	7084.63	26.14	1.18	1.16
8/8/23 2:05:00 AM	7744.49	26.16	1.16	1.16
8/8/23 2:10:00 AM	7879.05	26.14	1.17	1.16
8/8/23 2:15:00 AM	7510.70	26.06	1.17	1.16
8/8/23 2:20:00 AM	8170.56	26.18	1.18	1.16
8/8/23 2:25:00 AM	7667.64	26.10	1.16	1.16
8/8/23 2:30:00 AM	7308.69	26.10	1.17	1.16
8/8/23 2:35:00 AM	7248.05	26.10	1.17	1.16
8/8/23 2:40:00 AM	7148.51	26.06	1.17	1.16
8/8/23 2:45:00 AM	7311.93	25.96	1.15	1.16
8/8/23 2:50:00 AM	7917.64	26.00	1.16	1.16
8/8/23 2:55:00 AM	8010.38	26.04	1.19	1.16
8/8/23 3:00:00 AM	7440.01	26.02	1.18	1.16
8/8/23 3:05:00 AM	8129.05	26.00	1.16	1.16
8/8/23 3:10:00 AM	7148.51	26.00	1.17	1.17

8/8/23 3:15:00 AM	7209.47	26.00	1.16	1.16
8/8/23 3:20:00 AM	7907.91	25.92	1.17	1.17
8/8/23 3:25:00 AM	7603.44	25.94	1.17	1.17
8/8/23 3:30:00 AM	8077.82	25.92	1.16	1.16
8/8/23 3:35:00 AM	7433.85	25.92	1.16	1.17
8/8/23 3:40:00 AM	7414.40	25.79	1.17	1.16
8/8/23 3:45:00 AM	7725.36	25.83	1.18	1.16
8/8/23 3:50:00 AM	7151.75	25.79	1.17	1.16
8/8/23 3:55:00 AM	7584.31	25.87	1.17	1.16
8/8/23 4:00:00 AM	6991.57	25.83	1.19	1.16
8/8/23 4:05:00 AM	7164.72	25.83	1.17	1.16
8/8/23 4:10:00 AM	7949.74	25.79	1.17	1.16
8/8/23 4:15:00 AM	7334.31	25.83	1.17	1.16
8/8/23 4:20:00 AM	7494.49	25.75	1.17	1.16
8/8/23 4:25:00 AM	7924.12	25.75	1.17	1.16
8/8/23 4:30:00 AM	7760.70	25.79	1.18	1.17
8/8/23 4:35:00 AM	7859.92	25.75	1.17	1.16
8/8/23 4:40:00 AM	7706.23	25.75	1.18	1.16
8/8/23 4:45:00 AM	7773.35	25.67	1.18	1.17
8/8/23 4:50:00 AM	7587.55	25.61	1.20	1.16
8/8/23 4:55:00 AM	7296.04	25.71	1.18	1.17
8/8/23 5:00:00 AM	7539.56	25.65	1.18	1.16
8/8/23 5:05:00 AM	8234.76	25.67	1.19	1.17
8/8/23 5:10:00 AM	8109.92	25.63	1.17	1.17
8/8/23 5:15:00 AM	7651.75	25.59	1.18	1.17
8/8/23 5:20:00 AM	7533.07	25.57	1.18	1.16
8/8/23 5:25:00 AM	7382.62	25.61	1.19	1.17
8/8/23 5:30:00 AM	7279.83	25.57	1.18	1.17
8/8/23 5:35:00 AM	7683.53	25.57	1.17	1.17
8/8/23 5:40:00 AM	7139.10	25.55	1.19	1.17
8/8/23 5:45:00 AM	7001.30	25.53	1.18	1.17
8/8/23 5:50:00 AM	7491.57	25.45	1.17	1.17
8/8/23 5:55:00 AM	7750.97	25.47	1.19	1.17
8/8/23 6:00:00 AM	7478.60	25.45	1.15	1.17
8/8/23 6:05:00 AM	7270.43	25.45	1.19	1.17
8/8/23 6:10:00 AM	8221.79	25.47	1.56	1.17
8/8/23 6:15:00 AM	7795.72	25.43	1.63	1.17
8/8/23 6:20:00 AM	7424.12	25.45	1.66	1.17
8/8/23 6:25:00 AM	7978.60	25.41	1.66	1.17
8/8/23 6:30:00 AM	7914.40	25.34	1.68	1.17
8/8/23 6:35:00 AM	7741.25	25.34	1.65	1.17
8/8/23 6:40:00 AM	7674.12	25.38	1.69	1.17
8/8/23 6:45:00 AM	7376.13	25.36	1.66	1.17
8/8/23 6:50:00 AM	7379.38	25.30	1.65	1.17
8/8/23 6:55:00 AM	7430.61	25.18	1.67	1.17
8/8/23 7:00:00 AM	6911.48	25.36	1.66	1.17

8/8/23 7:05:00 AM	7174.12	25.26	1.66	1.17
8/8/23 7:10:00 AM	7651.75	25.24	1.68	1.17
8/8/23 7:15:00 AM	7699.74	25.26	1.67	1.17
8/8/23 7:20:00 AM	7260.70	25.22	1.67	1.17
8/8/23 7:25:00 AM	7949.74	25.22	1.67	1.17
8/8/23 7:30:00 AM	7087.55	25.18	1.67	1.18
8/8/23 7:35:00 AM	7193.58	25.22	1.69	1.18
8/8/23 7:40:00 AM	7651.75	25.18	1.67	1.18
8/8/23 7:45:00 AM	7257.46	25.14	1.67	1.18
8/8/23 7:50:00 AM	8109.92	25.18	1.68	1.19
8/8/23 7:55:00 AM	7795.72	25.04	1.65	1.20
8/8/23 8:00:00 AM	7222.44	25.18	1.67	1.21
8/8/23 8:05:00 AM	7417.64	25.10	1.66	1.22
8/8/23 8:10:00 AM	7478.60	25.10	1.69	1.23
8/8/23 8:15:00 AM	7520.10	25.08	1.68	1.24
8/8/23 8:20:00 AM	7174.12	25.04	1.66	1.25
8/8/23 8:25:00 AM	7475.36	25.02	1.68	1.26
8/8/23 8:30:00 AM	7475.36	25.04	1.68	1.29
8/8/23 8:35:00 AM	7917.64	25.04	1.69	1.30
8/8/23 8:40:00 AM	7754.22	24.96	1.67	1.32
8/8/23 8:45:00 AM	7010.70	24.96	1.68	1.35
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8/8/23 8:55:00 AM	8119.33	24.96	1.70	1.41
8/8/23 9:00:00 AM	7369.65	24.94	1.65	1.44
8/8/23 9:05:00 AM	7472.11	24.97	1.64	1.46
8/8/23 9:10:00 AM	7786.32	24.87	1.68	1.48
8/8/23 9:15:00 AM	7869.65	24.87	1.66	1.49
8/8/23 9:20:00 AM	7555.45	24.85	1.67	1.51
8/8/23 9:25:00 AM	7827.82	24.87	1.68	1.54
8/8/23 9:30:00 AM	7613.16	24.87	1.66	1.55
8/8/23 9:35:00 AM	7437.09	24.79	1.67	1.56
8/8/23 9:40:00 AM	8257.13	24.77	1.67	1.58
8/8/23 9:45:00 AM	7170.88	24.79	1.65	1.59
8/8/23 9:50:00 AM	7059.01	24.77	1.67	1.60
8/8/23 9:55:00 AM	7574.58	24.73	1.67	1.61
8/8/23 10:00:00 AM	7420.88	24.67	1.68	1.62
8/8/23 10:05:00 AM	7824.58	24.79	1.67	1.62
8/8/23 10:10:00 AM	7347.28	24.73	1.66	1.63
8/8/23 10:15:00 AM	7270.43	24.65	1.67	1.64
8/8/23 10:20:00 AM	7722.11	24.75	1.68	1.65
8/8/23 10:25:00 AM	8282.75	24.71	1.68	1.64
8/8/23 10:30:00 AM	6757.78	24.65	1.67	1.65
8/8/23 10:35:00 AM	7446.50	24.65	1.67	1.65
8/8/23 10:40:00 AM	8029.83	24.67	1.65	1.66
8/8/23 10:45:00 AM	7347.28	24.61	1.67	1.66
8/8/23 10:50:00 AM	7808.69	24.57	1.67	1.67

8/8/23 10:55:00 AM	7885.54	24.63	1.68	1.67
8/8/23 11:00:00 AM	7068.42	24.53	1.67	1.67
8/8/23 11:05:00 AM	7709.14	24.22	1.55	1.67
8/8/23 11:10:00 AM	7603.44	24.24	1.24	1.67
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8/8/23 11:20:00 AM	7017.19	24.55	1.19	1.68
8/8/23 11:25:00 AM	7398.51	24.53	1.17	1.68
8/8/23 11:30:00 AM	7661.15	24.48	1.23	1.68
8/8/23 11:35:00 AM	7568.42	24.48	1.17	1.68
8/8/23 11:40:00 AM	7674.12	24.44	1.18	1.68
8/8/23 11:45:00 AM	7568.42	24.44	1.19	1.68
8/8/23 11:50:00 AM	7872.57	24.44	1.19	1.68
8/8/23 11:55:00 AM	7411.48	24.40	1.17	1.68
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8/8/23 12:55:00 PM	7795.72	24.22	1.18	1.65
8/8/23 1:00:00 PM	7850.19	24.22	1.17	1.64
8/8/23 1:05:00 PM	7654.67	24.14	1.18	1.63
8/8/23 1:10:00 PM	7872.57	24.24	1.17	1.62
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8/8/23 10:25:00 PM	7437.09	25.00	1.18	1.16
8/8/23 10:30:00 PM	8164.40	25.10	1.21	1.15
8/8/23 10:35:00 PM	6732.17	25.10	1.17	1.15
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8/8/23 10:45:00 PM	7600.52	25.12	1.17	1.15
8/8/23 10:50:00 PM	7145.27	25.14	1.17	1.15
8/8/23 10:55:00 PM	6847.28	25.12	1.17	1.15
8/8/23 11:00:00 PM	7049.29	25.16	1.18	1.15
8/8/23 11:05:00 PM	7452.98	25.16	1.16	1.15
8/8/23 11:10:00 PM	7520.10	25.22	1.19	1.15
8/8/23 11:15:00 PM	7446.50	25.22	1.17	1.15
8/8/23 11:20:00 PM	7238.33	25.22	1.17	1.15
8/8/23 11:25:00 PM	6956.23	25.14	1.18	1.15
8/8/23 11:30:00 PM	7113.49	25.22	1.16	1.15
8/8/23 11:35:00 PM	7600.52	25.26	1.16	1.15
8/8/23 11:40:00 PM	7959.14	25.30	1.18	1.15
8/8/23 11:45:00 PM	7517.19	25.34	1.18	1.15
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8/8/23 11:55:00 PM	7984.76	25.34	1.18	1.15
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APPENDIX F
FOREST SERVICE WATER TRANKER FILL STATION STANDARD DRAWINGS

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Facilities
Tech Tips

USDA United States Department of Agriculture
Forest Service
Technology & Development Program
August 2011
7300 1173–2308P–MTDC

Water Tanker Fill Station Standard Drawings Include Options

Kathleen Snodgrass, Project Leader

Many locations across the Forest Service fill fire tankers and engines using equipment, such as fire hydrants, that could contaminate drinking water. This practice exists because practical, code-compliant plans have not been easily accessible when a water tanker fill station was needed. In addition, an air gap mechanism that would handle the required flow without splashing and drenching the employees responsible for filling the tanker has not been available commercially and had to be developed (figure 1).

Water tanker fill station standard drawings are now available on the Forest Service internal Web network. These drawings should meet the needs of any water tanker fill location and eliminate the possibility of contaminating drinking water.

The standard drawings include pressure- and air gap-type fill stations (figures 2 and 3) that prevent backflow and potential contamination of the potable water supply. Both fill stations can be used with either a steel or wood support structure and either a camlock quick disconnect or a pipe clamp connection between the tower and the fill hose. The steel structure has an optional swivel that allows the fill arm to swing away from the fill location when not in use. The air gap-type fill station can be constructed with either a self-draining blowoff or a gravity drain for winter shutdown. The standard drawings include keyed notes and details that support all fill station types and options. An engineer must assemble the kit of drawing parts and ensure the tower and foundation meet local structural requirements. The standard drawings for the fill stations, as well as sample operations and maintenance

Figure 1—Testing the air gap prototype. The prototype, built by mechanical engineering technicians at the Missoula Technology and Development Center (MTDC), produces no splash while operating.

Highlights...

- Forest Service fire engines and tankers are often filled by using fire hydrants and other devices that don't protect drinking water supplies from contamination.
- Standard drawings for water tanker fill stations are now available.
- The drawings include pressure and air gap-type fill stations and options to suit almost any location.

For additional information, contact: *Kathleen Snodgrass, project leader; USDA Forest Service, MTDC; 5785 Hwy. 10 West; Missoula, MT 59808–9361. Phone: 406–329–3922; fax: 406–329–3719; email: ksnodgrass@fs.fed.us*

plans, are available to Forest Service and Bureau of Land Management employees in Acrobat PDF and AutoCAD compatible formats at <http://fsweb.wo.fs.fed.us/eng/programs/water/tankerfill.htm>.

Equipment, such as fire hydrants or other devices, that does not prevent backflow should no longer be used to fill tankers. Use of the standard drawings will eliminate unnecessary costs for each National forest to independently develop a design. The uniformity and consistency resulting from using the standard drawings will make training and operation easier for crews that work on more than one unit.

Many thanks to these Forest Service employees:

- Chuck Coleman, Lou Janke, Jennifer Knutson, Jason Peterson, and Shanisha Reese for their development work.
- Wayne Harpel, Satgur Klar, and Donna Wians for their suggestions for improving the fill station designs.
- Scott Gilmore and Doug Lausch for building and testing the air gap prototype.

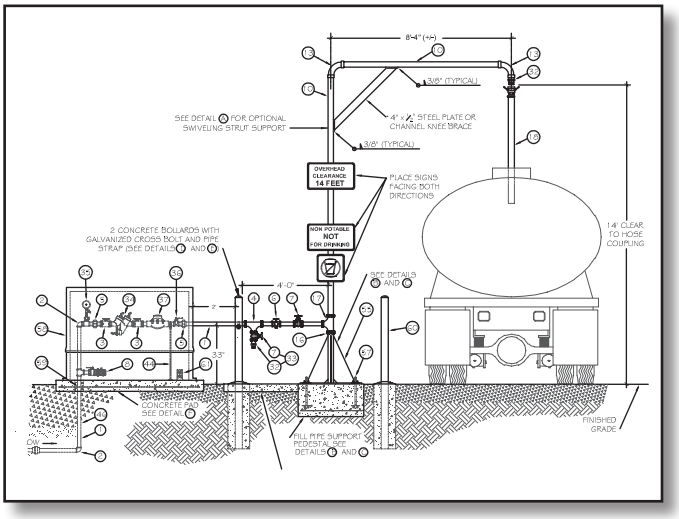

Figure 1—Part of the elevation view of the pressure-type fill station with a steel tower from the water tanker fill station plans.

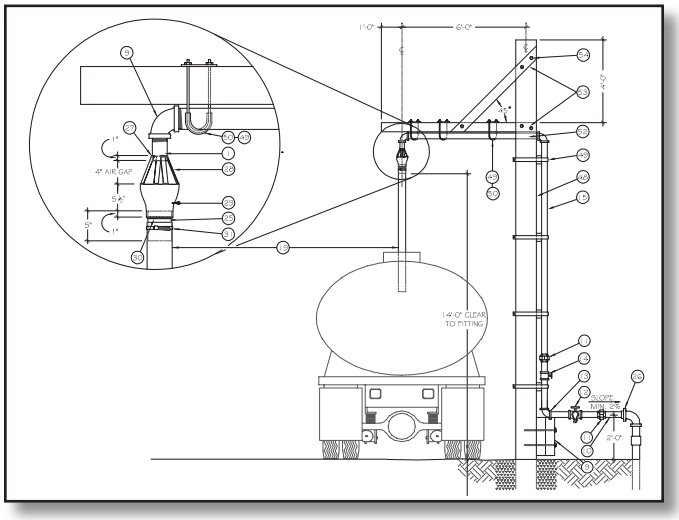

Figure 2—Part of the elevation view of the air gap-type fill station with a wooden tower from the water tanker fill station plans.

Library Card

Snodgrass, Kathleen. 2011. Water tanker fill station standard drawings include options. Tech Tip 1173–2308P–MTDC. Missoula, MT: U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center. 2 p.

Many locations across the Forest Service use equipment and methods to fill fire tankers and engines that could contaminate drinking water. Fire hydrants or other devices that do not prevent backflow should no longer be used. Water tanker fill station standard drawings now available include options for pressure- and air gap-type fill stations. Using the standard drawings throughout the Forest Service will make training and operation easier for crews that work on more than one unit.

Keywords: air gap, AutoCAD, backflow, code, drawings, engines, fill, fire, hydrant, potable, pressure, splash, tankers, tower, water

For additional information about fill station standard drawings and options, contact Kathleen Snodgrass:

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APPENDIX G
OPINIONS OF PROBABLE CONSTRUCTION COST

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City of Bend - Outback Facility Plan
Pretreatment Cost Estimate: Site Civil Breakout
Concept Level (Class 5)
Apr-2026

Item No.	Item Description	Unit	Quantity	Unit Price	Amount
1	**Mobilization & Demobilization:** Assumed 10% of Project Cost	LS	1	$844,000	$844,000
2	**Temporary Erosion & Sediment Control Measures (TESC):** TESC to support site improvements, including BMPs, temporary slope stabilization and drainage control.	LS	1	$380,000	$380,000
3	**Demolition & Surface Restoration:** Includes selective demolition of the existing concrete process structure at the current site piping facility, including removal of above-grade building components and interior process piping (approx. 8-inch to 18-inch), valves, controls, and associated electrical conduits. Includes excavation and removal of buried site piping surrounding the facility and abandonment of the existing 36-inch pipeline, including cutting, capping, and removal or slurry-fill in place as required. The existing concrete wet well is to remain and be protected in place. Includes removal of trees within the limits of disturbance, clearing, removal of miscellaneous abandoned utilities or concrete surfaces, and backfilling and grading to achieve construction subgrade. Temporary surface stabilization is included; permanent paving is not included and is covered under separate bid items.	LS	1	$140,000	$140,000
4	**Sitework, Earthwork, & Site Utilities:** This component includes earthwork and site preparation required for the pre-sedimentation pond and access road improvements, consisting of excavation, embankment, grading, and subgrade preparation. Includes clearing and removal of trees and vegetation within the limits of disturbance; roadway and parking subgrade preparation; placement of aggregate base; and localized surface restoration where site civil construction modifies existing ground. Includes site drainage improvements such as ditches, culverts, or surface conveyance features necessary to manage stormwater around the pond and access road. Scope is limited to work supporting site civil improvements outside the in-conduit hydropower and treatment plant building pads. Includes cost for realigning the fire service line and assumes connection at new in-conduit hydropower facility.	LS	1	$1,740,000	$1,740,000
5	**Pre-Sedimentation Pond:** Includes excavation and embankment required to construct the earthen pre-sedimentation pond, including shaping of the pond basin, berms, and side slopes. Includes subgrade preparation and installation of the concrete pond liner. Work includes grading for the 10-ft perimeter access road around the pond, placement of aggregate surfacing, localized riprap or erosion protection, and final surface restoration within the pond limits. Scope is limited to construction of the pond and associated access improvements and does not include in-conduit hydropower or pretreatment facility grading. Piping and appurtenances are included under separate bid items.	LS	1	$3,050,000	$3,050,000
6	**Large Diameter Site Piping, Valves & Fittings:** Includes installation of new 30-inch transmission piping extending from the in-conduit hydropower facility through the pretreatment facilities and connecting to existing site systems. Work includes trench excavation, bedding, backfill, and compaction. Includes 30-inch fittings (tees, bends, reducers, dismantling joints), isolation valves, and appurtenances required for the site piping alignment. Includes connection to the existing control structure basin wall flange, and installation of the downstream 30-inch meter. Includes surface restoration along the trench alignment, consisting of asphalt replacement in paved areas (minor) and native surface restoration in unpaved areas. Does not include piping internal to the in-conduit hydropower facility, pretreatment building, or presedimentation pond. Final landscaping or paving in new construction areas is provided under separate bid items.	LS	1	$1,780,000	$1,780,000
7	**Solids Pump Station & Forcemain to Existing Sewer:** Includes construction of the solids pump station serving the pretreatment process, assumed adjacent to the pretreatment building, consisting of a below-grade wet well equipped with submersible solids-handling pumps, guide rails, discharge piping, valves, and appurtenances. Work includes furnishing and installing all mechanical equipment, access hatches, internal piping, mud valves, extension stems, and associated floor drain piping within the process area. Scope also includes electrical connections, controls, and integration provisions for the future solids recirculation system. Scope includes force main from solids pump station to existing sewer line. This item excludes solids drying bed infrastructure and associated forcemain piping to beds.	LS	1	$380,000	$380,000
8	**Landscaping:** Includes permanent site restoration in disturbed areas outside of paved surfaces, buildings, and gravel access roads. Work includes import and placement of topsoil, permanent hydroseeding or seeding with native mixes, installation of trees and shrubs in designated landscape zones, and placement of bark mulch or native restoration materials around planting beds and facility perimeters. Landscaping provides final surface restoration following construction and supplements temporary stabilization performed under TESC measures.	LS	1	$150,000	$150,000
9	**FS Road Realignment:** Includes modifications to existing Forest Service access roads required to accommodate Outback Site facility expansion and maintain safe and continuous access. Work includes clearing and grubbing, earthwork, roadway excavation and embankment, aggregate base placement, localized paving, drainage improvements (including culverts), traffic control, installation or relocation of gates and signage, and restoration of disturbed areas. Road realignment provides permanent access improvements consistent with Forest Service standards and includes final surface restoration following construction, supplemented by temporary erosion and sediment control measures implemented during construction.	LS	1	$170,000	$170,000
10	**Site Security:** Includes planning-level security measures for new and expanded facilities, consisting of security fencing, vehicle access gates, and signage within the expansion property. Scope includes allowances for wildlife corridor fencing requirements, installation of Knox Box 3200 units at new and existing gates, and placement of access control and security notification signage. Surveillance infrastructure includes provision and installation of ten (10) security cameras with associated mounting hardware, local power connections, and short conduit runs. Cameras are assumed to integrate with existing site systems; upgrades to network, communications backbone, storage, or alarm/SCADA systems are excluded.	LS	1	$650,000	$650,000
				Construction Subtotal	**$9,284,000**
				Engineering, Legal, and Admin (25%)	$2,321,000
				Construction Contingency (30%)	$ 2,785,200
				PROJECT SUBTOTAL (Rounded)	**$ 14,391,000**
				AACE Class 5 Low Estimate Range (-30%):	*$ 10,073,700*
				AACE Class 5 High Estimate Range (+40%):	*$ 20,147,400*

Additive Line Items

			Price Before additives
Solids Drying Beds: Includes construction of two concrete-lined solids drying beds, each approximately 250 feet by 100 feet. Work includes excavation and embankment to form the bed basins, subgrade preparation, placement of the gravel base layer, installation of the concrete liner slab and perimeter concrete curbs, and grading of a gravel access road around the beds. Includes piping from the solids process pump station. Pump station included under separate bid items.	LS	1	$1,060,000

All costs related to Tariffs are excluded from the estimate

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City of Bend - Outback Facility Plan
Pretreatment Cost Estimate: Pretreatment Building Breakout
Concept Level (Class 5)
Apr-2026

Item No.	Item Description	Unit	Quantity	Unit Price	Amount
1	**Mobilization & Demobilization:** Assumed 10% of Project Cost	LS	1	$1,977,000	$1,977,000
2	**Sitework & Earthwork:** Includes all earthwork required to establish subgrade conditions for the pretreatment facility. Work includes common excavation across the shallow building footprint to reach design elevations; deep excavation for the plate settler, flocculation, and rapid-mix basin areas; rock excavation where competent material is encountered in the 17-ft-deep process area; and the hauling, placement, and compaction of structural fill and backfill around foundations, utility trenches, and non-basin building areas. Earthwork assumes no dewatering is required due to low groundwater levels.	LS	1	$820,000	$820,000
3	**Structural Concrete (Basins, Slabs, Channels & CIP Walls):** Construction of all reinforced concrete structures for the pretreatment facility, including the plate settler basins, flocculation basins, rapid-mix basins, and the associated influent and effluent channels. Scope includes all cast-in-place structural concrete such as floor slabs, basin walls, interior dividing walls, baffle walls, equipment pads, and walkways.	LS	1	$4,700,000	$4,700,000
4	**Building Architectural & Structural Framing:** Includes construction of the building superstructure and architectural elements such as CMU exterior walls around the tank area; CMU and metal-stud interior partitions; exterior and interior doors, including eight roll-up doors; windows; roofing; coatings; finishes; and all associated architectural components. Work includes structural building framing, roof systems, grating, flooring, fixtures, and interior build-out for administrative, laboratory, and support spaces.	LS	1	$7,810,000	$7,810,000
5	**Building HVAC, Plumbing, & Electrical:** Includes furnishing and installation of complete building HVAC, plumbing, and electrical systems. HVAC scope includes systems serving all occupied and process spaces, chemical-room ventilation, exhaust and makeup air systems, ductwork, controls, testing, balancing, and commissioning. Plumbing scope includes domestic water distribution, sanitary sewer, venting, floor and trench drains, plumbing fixtures, piping, valves, supports, insulation, and required testing. Electrical scope includes normal and emergency power distribution, interior and exterior lighting, grounding and bonding, raceways, wiring, panels, transformers, controls, and power connections for all mechanical and process equipment necessary to support building operations and code compliance.	LS	1	$1,440,000	$1,440,000
6	**Rapid Mixing System:** Includes furnishing and installing the complete rapid-mix system for the pretreatment facility. Scope includes two-stage high-speed vertical mixers with drives, motors, supports, and all associated mechanical components. Work also includes basin inlet slide gates with manual operators, influent piping and valves for flow control and isolation, and all embedded items and hardware required for installation into the cast-in-place rapid-mix basins. Includes all appurtenances necessary to provide a fully functional rapid-mix system integrated with the pretreatment process.	LS	1	$500,000	$500,000
7	**Flocculation System & Plate Settler System:** Includes furnishing and installing the complete flocculation and plate settler equipment package for the pretreatment facility. Scope includes all mechanical equipment for three (3) three-stage flocculation basins, including drives, motors, shafts, mixers, and structural mounting hardware. Work also includes stainless-steel baffle walls, inclined plate settler modules for three (3) sedimentation basins, sludge collection and removal systems with VFD control panel, and all associated appurtenances. Includes floor drains and mud valves. Includes 6-ton bridge crane.	LS	1	$4,000,000	$4,000,000
8	**Chemical Systems & Storage:** Includes furnishing and installing the chemical feed and storage systems required for pretreatment, including the coagulant system with metering pumps, dual storage tanks, tank fill piping, secondary containment, flow measurement, and suction/discharge piping. Work also includes chemical-room appurtenances, safety equipment, spill containment components, and integration of chemical systems with the process electrical and control systems.	LS	1	$500,000	$500,000
				Construction Subtotal	**$21,747,000**
				Engineering, Legal, and Admin (25%)	$5,436,750
				Construction Contingency (30%)	$ 6,524,100
				PROJECT SUBTOTA (Rounded)	**$ 33,708,000**
				AACE Class 5 Low Estimate Range (-30%):	*$ 23,595,600*
				AACE Class 5 High Estimate Range (+40%):	*$ 47,191,200*

Additive Line Items

			Price Before additives
On-Site Sodium Hypochlorite Generation System: Provide and install a complete on-site hypochlorite generation system, including generation skid(s), brine tank, metering pumps, electrical connections, ventilation provisions, secondary containment, and SCADA integration. Includes concrete pad, piping tie-ins, and startup/commissioning support. Assumption is that system will be located inside new pretreatment building so cost does not include building cost.	LS	1	$1,000,000

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City of Bend - Outback Facility Plan
In-Conduit Hydropower Cost Estimate: Scenario 1A/1B
Concept Level (Class 5)
Apr-2026

Item No.	Item Description	Unit	Quantity	Unit Price	Amount
1	**In-Conduit Hydropower & Energy Dissipation Facility**: The hydro facility structure consists of a purpose-built building approximately 51 feet and 4-inches by 44 feet and 8-inches that also incorporates the drop box structure as part of the overall footprint, and includes all major structural elements required to house the turbine-generator and electrical systems. The structure comprises reinforced concrete foundations and slabs (including 12-inch and 18-inch slab-on-grade areas), an elevated concrete deck, and equipment pads for mounting mechanical and electrical systems, as well as cast-in-place concrete walls that form the building envelope and support the roof system. The building is topped with open-web steel joists and metal roof decking with an adhered EPDM roofing system, and includes typical includes typical building openings such as hollow-metal doors and a large overhead door for equipment access; it also incorporates a ventilation/HVAC allowance to support indoor environmental needs for the turbine-generator equipment.	LS	1	$1,800,000	$1,800,000
2	**Turbine-Generator Equipment Package**: This component includes the complete Pelton turbine and generator assembly, associated control cabinet, and all vendor-supplied accessories required for hydroelectric power generation, along with the isochronous mode adder, freight, and startup/commissioning/training support. It also includes the labor and materials associated with installing the hydro generator, integrating the turbine controls with the facility's electrical and SCADA systems, and any equipment necessary to bring the generating unit online as a fully functional power-producing asset.	LS	1	$2,470,000	$2,470,000
3	**Electrical & Controls System:** This component includes all electrical and controls work required to power, protect, and integrate the hydro facility, beginning with the 4160V to 124,700V step-up transformer configuration used in both 1A and 1B scenarios, along with the conduit, cable, manholes, trenching, and terminations needed to connect the hydro generator to the utility system and the Water Filtration Facility. It includes switchgear, breaker equipment, control panels, and the extensive process electrical work required for the turbine, generator, and auxiliary systems. The scope also includes integration of generator controls with the existing PLC and SCADA systems, installation of metering and protection equipment, and all site power upgrades necessary to support the new hydro building. The difference between the two options lies in utility metering: Option 1A connects through the new step-up transformer. Cost includes a transformer 5kv primary 3 phase, 1500 kVA, pad mounted.	LS	1	$50,000	$50,000
4	**Bridge Crane:** Includes a 6-ton bridge crane and associated rails, supports, and installation required for lifting, maintaining, and servicing the Pelton turbine-generator equipment inside the hydro building. The crane allows for removal and handling of major components during maintenance and is considered a standalone equipment item separate from the building structure.	LS	1	$120,000	$120,000
5	**Process Piping & Valves:** This component includes the new process conveyance system serving the hydro facility, consisting of 18- to 36-inch steel pressure piping that delivers flow to and from the turbine, along with all associated valves, including 36-inch slide gate, 18-inch sleeve valves, butterfly valves, flow meters, and specialty fittings required for turbine control and hydraulic operation. The scope covers pipe fabrication, coatings and linings, welded joints, bends, tees, flanges, and pipe supports, as well as the mechanical appurtenances needed to regulate, meter, and isolate flow within the hydro process train.	LS	1	$1,300,000	$1,300,000
6	**Yard Piping & Site Utilities:** This component includes the new large-diameter steel yard piping, primarily 36-inch carbon-steel conveyance pipe, required to bring raw water from the designated tie-in location to the hydro facility, along with the associated trenching, bedding, backfill, and installation of bends, tees, flanges, and appurtenant pipe components. It also includes pipe coatings and linings, pipe supports, and the excavation and restoration necessary to install the upstream conveyance system. The scope covers only the raw-water piping upstream of the hydro building, and excludes any downstream discharge piping, which will be addressed separately under pretreatment improvements. Note, site piping from the hydro facility to the pretreatment components are covered under the pretreatment project element.	LS	1	$200,000	$200,000
7	**Sitework & Earthwork:** This component includes the earthwork and site preparation necessary to construct the hydro facility, consisting of grading, excavation, and backfill for the building pad and surrounding area, and localized surface restoration where construction activities disturb existing ground. It also includes cast-in-place retaining wall with railing required for site stabilization, along with general earthmoving operations associated with shaping the site to accommodate the hydro building footprint and its appurtenances. The scope is limited to work directly supporting the hydro facility site and does not include broader site or pretreatment improvements.	LS	1	$110,000	$110,000
				Construction Subtotal	**$6,050,000**
				Engineering, Legal, and Admin (25%)	$1,512,500
				Construction Contingency (30%)	$ -
				PROJECT SUBTOTAL	**$ 7,563,000**
				AACE Class 5 Low Estimate Range (-30%):	*$ 5,294,100*
				AACE Class 5 High Estimate Range (+40%):	*$ 10,588,200*

Table Note: Costs for the in-conduit hydropower facility were developed independently by a subconsultant and do not follow the OPCC line-item structure used elsewhere in this chapter. Contingency and mobilization/demobilization are included within the total estimated cost and are not shown separately

Additive Line Items

Scenario 2A and Scenario 2B share identical scope for all cost components except the Electrical & Controls Systems (Summary Item 4). Because the detailed Jacobs breakout is not being included in this report, it is important to note that the full difference in cost between the two options comes solely from additional electrical equipment and utility-metering integration work required in Scenario 2B. This includes the added WFF bus connection work and ATS reprogramming needed to support a combined utility-meter configuration. No other structural, mechanical, turbine, process piping, yard piping, or sitework elements differ between the scenarios. Accordingly, this cost estimate presents Scenario 2A as the base configuration, and Scenario 2B would be represented by an additive to Summary Item 4 only.Construction subtotal increases to $165,000 under this scenario.

Scenario 3 includes the same structural, mechanical, turbine-generator, piping, yard piping, and sitework scope as the base hydropower configuration. The only difference occurs within the Electrical & Controls Systems (Summary Item 4), where Scenario 3 requires a substantially larger electrical integration effort to support a physically combined-meter configuration, as reflected in Jacobs' estimate. Accordingly, this cost estimate uses the base configuration as the foundation, with the Scenario 3 cost difference attributed solely to Summary Item 4.Construction subtotal increases to $5.28M under this scenario.

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City of Bend - Outback Facility Plan
Concept 1: New Groundwater Reservoir:
Concept Level (Class 5)
Apr-2026

Item No.	Reservoir Siting and Integration (Ch. 5) - Item Description	Unit	Quantity	Unit Price	Amount
1	**Mobilization & Demobilization:** Assumed 10% of project cost.	LS	1	$1,186,000	$1,186,000
2	**Modified Mixing System at Outback Reservoir 2:** Replace existing floating mixer with a new electric submersible water-circulation mixer system. Work includes removal and disposal of the existing surface-mounted mixer assembly and associated cabling. Provide and install a GridBee GS-12 (or approved equal) submersible mixer, including weighted power cable, support chain to the access hatch, and required mounting hardware. Includes new electrical feed and conduit routing to the tank (as needed), connection to the SCADA control panel at the WFF, and basic SCADA integration for mixer run/stop and status indication.	LS	1	$60,000	$60,000
3	**New Groundwater Reservoir:** Construction of a new 5 MG welded steel water storage tank, including site grading and foundation preparation with the assumption of potential for rock excavation and hauling material offsite, structural steel tank fabrication and erection, interior and exterior coatings, cathodic protection, interior ladders, exterior spiral ladder, safety railing and fall protection systems, tank appurtenances and interior piping, access hatches and vents, and related site improvements. Cost includes 24-ft wide gravel access road around the reservoir and includes placeholder for potential new stormwater pond for overflow piping.	LS	1	$7,100,000	$7,100,000
4	**Groundwater System Piping (for new tank):** Installation of approximately 1,600 LF of 30-inch and 1,500 LF of 24-inch steel pipeline connecting the new 5MG tank to the existing groundwater header and return pipeline to distribution. Includes all associated valves and fittings, a new pressure-sustaining valve vault with appurtenances, tie-ins, and related site piping, trenching, and surface restoration.	LS	1	$3,100,000	$3,100,000
5	**Outback Reservoir 3 Conversion to Surface Water:** Installation of a new 24-inch tank inlet, including a new welded wall penetration, double-plate and flexible coupling assembly, localized interior and exterior coating repairs. The project further includes approximately 200 feet of new 24-inch transmission piping with valves, fittings, and tie-ins to integrate the reservoir with existing on-site surface water piping.	LS	1	$850,000	$850,000
6	**Decommissioning CT Basin:** Includes demolition and removal of the bolted steel CT Basin, removal and disposal of concrete ringwall foundation and associated appurtenances, and backfill, grading and surface restoration of the former tank site. Work also includes removal or abandonment of existing 24-inch and 10-inch site piping associated with the facility.	LS	1	$250,000	$250,000
7	**Decommissioning Outback Reservoir 1:** Includes demolition and removal of the bolted steel Outback Reservoir 1, removal and disposal of concrete ringwall foundation and associated appurtenances, and backfill, grading and surface restoration of the former tank site. Work also includes removal or abandonment of existing 24-inch and 10-inch site piping associated with the facility	LS	1	$300,000	$300,000
8	**Appurtenances & Sitework:** Allowance for minor, miscellaneous adjustments to site utilities, including electrical, fiber/SCADA, and limited drainage elements, needed to support final layout and integration of the new groundwater and reservoir improvements. Also includes removal of trees at new reservoir location.	LS	1	$200,000	$200,000
				Construction Subtotal	**$13,046,000**
				Engineering, Legal, and Admin (25%)	$3,261,500
				Construction Contingency (30%)	$ 3,913,800
				PROJECT SUBTOTAL	**$ 20,222,000**
				AACE Class 5 Low Estimate Range (-50%):	*$ 10,111,000*
				AACE Class 5 High Estimate Range (+100%):	*$ 40,444,000*

	Existing Reservoir Modifications - Increased Mixing			*Price Before additives*
	Hydrodynamic Mixing System in Reservoir 2: Enhanced Mixing System: Includes draining and cleaning of reservoir, installation of pipe, concrete anchors, and duckbill valves, filling and chlorination of reservoir, testing, and installation labor.	LS	1	$250,000
	Hydrodynamic Mixing System in Reservoir 3: Enhanced Mixing System: Includes draining and cleaning of reservoir, installation of pipe, concrete anchors, and duckbill valves, filling and chlorination of reservoir, testing, and installation labor.	LS	1	$250,000

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City of Bend - Outback Facility Plan
Concept 2a: New Dedicated Clearwells - Hydraulically Floats - 62ft x 38ft (ea.)
Concept Level (Class 5)
Apr-2026

Item No.	Reservoir Siting and Integration (Ch. 5) - Item Description	Unit	Quantity	Unit Price	Amount
1	**Mobilization & Demobilization:** Assumed 10% of project cost.	LS	1	$420,000	$420,000
2	**Decommissioning CT Basin:** Includes demolition and removal of the bolted steel CT Basin, removal and disposal of concrete ringwall foundations and associated appurtenances, and backfill, grading and surface restoration of the former tank sites. Work also includes removal or abandonment of existing 24-inch and 10-inch site piping associated with the facilities.	LS	1	$250,000	$250,000
3	**New Reinforced Concrete CT Clearwell Basins:** Construction of two enclosed 62-ft by 38-ft cast-in-place reinforced concrete CT clearwell basins, including permanent multi-pass baffling, internal and external walkways, interior piping and appurtenances, and access hatches. Work includes installation of level instrumentation, valve actuators and position indicators, local electrical panels, and associated electrical and SCADA wiring required to integrate the clearwells into the new treatment and storage system.	LS	1	$2,300,000	$2,300,000
4	**Clearwell Site Piping and Fittings:** Installation of new 24-inch steel site piping required to connect the two new CT clearwell basins to the existing WFF finished water pipeline and to the Outback Reservoir 2 header. Work includes buried 24-inch transmission piping, isolation valves, fittings, a tie-in to the existing WFF pipeline and Reservoir 2 yard piping, and all associated trench excavation, bedding, backfill, and surface restoration. Scope includes necessary valve vault(s), appurtenances, and yard piping modifications required to integrate the clearwells with the existing site hydraulics.	LS	1	$1,250,000	$1,250,000
5	**Decommissioning Reservoir 1:** Includes demolition and removal of the bolted steel Outback Reservoir 1, removal and disposal of concrete ringwall foundations and associated appurtenances, and backfill, grading and surface restoration of the former tank sites. Work also includes removal or abandonment of existing 24-inch and 10-inch site piping associated with the facility.	LS	1	$300,000	$300,000
6	**Appurtanaces & Sitework:** Allowance for minor, miscellaneous modifications to site utilities—including electrical, fiber/SCADA, and limited drainage elements—needed to support final layout integration of the new clearwells and reservoir improvements. Scope is preliminary and will be refined during design.	LS	1	$100,000	$100,000
				Construction Subtotal	**$4,620,000**
				Engineering, Legal, and Admin (25%)	$1,155,000
				Construction Contingency (30%)	$ 1,386,000
				PROJECT SUBTOTAL	**$ 7,161,000**
				AACE Class 5 Low Estimate Range (-50%):	*$ 3,580,500*
				AACE Class 5 High Estimate Range (+100%):	*$ 14,322,000*

	Existing Reservoir Modifications - Increased Mixing			*Price Before additives*
Option 1	**Modified Mixing System at Outback Reservoir 2:** Replace existing floating mixer with a new electric submersible water-circulation mixer system. Work includes removal and disposal of the existing surface-mounted mixer assembly and associated cabling. Provide and install a GridBee GS-12 (or approved equal) submersible mixer, including weighted power cable, support chain to the access hatch, and required mounting hardware. Includes new electrical feed and conduit routing to the tank (as needed), connection to the SCADA control panel at the WFF, and basic SCADA integration for mixer run/stop and status indication.	LS	1	$60,000
Option 2	**Hydrodynamic Mixing System in Reservoir 2**: Enhanced Mixing System: Includes draining and cleaning of reservoir, installation of pipe, concrete anchors, and duckbill valves, filling and chlorination of reservoir, testing, and installation labor.	LS	1	$250,000
	Hydrodynamic Mixing System in Reservoir 3: Enhanced Mixing System: Includes draining and cleaning of reservoir, installation of pipe, concrete anchors, and duckbill valves, filling and chlorination of reservoir, testing, and installation labor.	LS	1	$250,000

Alternative 2C - Additional Groundwater Storage			
Would include the following items from Concept 1: Item #3 New Groundwater Reservoir, #4 Groundwater System Piping (for new tank), and #5 (Outback Reservoir 3 Conversion to Surface Water.	LS	1	$11,050,000

All costs related to Tariffs are excluded from the estimate

AACE Class 5 Estimate. This estimate is prepared based on limited information, where little more than proposed plant type, its location, and the capacity are known, where preliminary engineering is from 0% to 2% complete. Strategic planning purposes include but are not limited to, market studies, assessment of viability, evaluation of alternate schemes, project screening, location and evaluation of resource needs and budgeting, and long-range capital planning. Examples of estimating methods used would include cost/capacity curves and factors, scale-up factors, and parametric and modeling techniques. Typically, little time is expended in the development of this estimate. The expected accuracy ranges for this class of estimate are –20% to –50% for the low range side and +30% to +100% on the high range side.

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City of Bend - Outback Facility Plan
Concept 2b: New Dedicated Clearwells - Level Controlled - 44ft x 24ft (ea.)
Concept Level (Class 5)
Apr-2026

Item No.	Reservoir Siting and Integration (Ch. 5) - Item Description	Unit	Quantity	Unit Price	Amount
1	**Mobilization & Demobilization:** Assumed 10% of project cost.	LS	1	$360,000	$360,000
2	**Decommissioning CT Basin:** Includes demolition and removal of the bolted steel CT Basin and Outback Reservoir 1, removal and disposal of concrete ringwall foundations and associated appurtenances, and backfill, grading and surface restoration of the former tank sites. Work also includes removal or abandonment of existing 24-inch and 10-inch site piping associated with the facilities.	LS	1	$250,000	$250,000
3	**New Reinforced Concrete CT Clearwell Basins:** Construction of two enclosed 44-ft by 24-ft cast-in-place reinforced concrete CT clearwell basins, including permanent multi-pass baffling, internal and external walkways, interior piping and appurtenances, and access hatches. Work includes installation of level instrumentation, valve actuators and position indicators, local electrical panels, and associated electrical and SCADA wiring required to integrate the clearwells into the new treatment and storage system.	LS	1	$1,600,000	$1,600,000
4	**Clearwell Site Piping and Fittings:** Installation of new 24-inch steel site piping required to connect the two new CT clearwell basins to the existing WFF finished water pipeline and to the Outback Reservoir 2 header. Work includes buried 24-inch transmission piping, isolation valves, fittings, a tie-in to the existing WFF pipeline and Reservoir 2 yard piping, and all associated trench excavation, bedding, backfill, and surface restoration. Scope includes necessary valve vault(s), appurtenances, and yard piping modifications required to integrate the clearwells with the existing site hydraulics.	LS	1	$1,350,000	$1,350,000
5	**Decommissioning Reservoir 1:** Includes demolition and removal of the bolted steel Outback Reservoir 1, removal and disposal of concrete ringwall foundations and associated appurtenances, and backfill, grading and surface restoration of the former tank sites. Work also includes removal or abandonment of existing 24-inch and 10-inch site piping associated with the facilities.	LS	1	$300,000	$300,000
6	**Appurtanaces & Sitework:** Allowance for minor, miscellaneous modifications to site utilities—including electrical, fiber/SCADA, and limited drainage elements—needed to support final layout integration of the new clearwells and reservoir improvements. Scope is preliminary and will be refined during design.	LS	1	$100,000	$100,000
				Construction Subtotal	**$3,960,000**
				Engineering, Legal, and Admin (25%)	$990,000
				Construction Contingency (30%)	$ 1,188,000
				PROJECT SUBTOTAL	**$ 6,138,000**
				AACE Class 5 Low Estimate Range (-50%):	*$ 3,069,000*
				AACE Class 5 High Estimate Range (+100%):	*$ 12,276,000*

Existing Reservoir Modifications - Increased Mixing *Price Before additives*

Option 1	**Modified Mixing System at Outback Reservoir 2:** Replace existing floating mixer with a new electric submersible water-circulation mixer system. Work includes removal and disposal of the existing surface-mounted mixer assembly and associated cabling. Provide and install a GridBee GS-12 (or approved equal) submersible mixer, including weighted power cable, support chain to the access hatch, and required mounting hardware. Includes new electrical feed and conduit routing to the tank (as needed), connection to the SCADA control panel at the WFF, and basic SCADA integration for mixer run/stop and status indication.	LS	1	$60,000
Option 2	**Hydrodynamic Mixing System in Reservoir 2**: Enhanced Mixing System: Includes draining and cleaning of reservoir, installation of pipe, concrete anchors, and duckbill valves, filling and chlorination of reservoir, testing, and installation labor.	LS	1	$250,000
	Hydrodynamic Mixing System in Reservoir 3: Enhanced Mixing System: Includes draining and cleaning of reservoir, installation of pipe, concrete anchors, and duckbill valves, filling and chlorination of reservoir, testing, and installation labor.	LS	1	$250,000

Alternative 2C - Additional Groundwater Storage

Would include the following items from Concept 1: Item #3 New Groundwater Reservoir, #4 Groundwater System Piping (for new tank), and #5 (Outback Reservoir 3 Conversion to Surface Water.	LS	1	$11,050,000

All costs related to Tariffs are excluded from the estimate

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City of Bend - Outback Facility Plan
New Well(s)
Concept Level (Class 5)
Apr-2026

Item No.	Item Description	Unit	Quantity	Unit Price	Amount
1	**Mobilization & Demobilization:** Assumed 10% of Project Cost	LS	1	$255,000	$255,000
2	**Drill & Construct New Well:** Includes contractor drilling, construction, testing, and initial completion of a new groundwater production well. Scope includes drilling through overburden and bedrock, installation of temporary and permanent well casings, annular sealing and grouting, and well development to establish yield and performance. Completion activities include well disinfection, regulatory video logging, temporary well cap installation, surface protection measures, and allowances for standby time and subsurface uncertainties. Cost is based on River Well 1 planning level costs from 2025 planning work which assumed a new well constructed to a total depth of 900 feet and with capacity of ~2,000 gpm.	LS	1	$1,000,000	$1,000,000
3	**Construct Wellhouse Building:** Includes site preparation and earthwork, structural excavation, placement and compaction of structural fill, and construction of cast-in-place concrete foundations, slab-on-grade, and concrete perimeter walls, along with a timber-framed roof structure, roof decking, metal roofing system, and a roof access hatch to provide a fully enclosed, weather-tight facility. Work also includes exterior doors, louvers, coatings, sealants, and basic architectural elements necessary for durability and building enclosure.	LS	1	$350,000	$350,000
4	**Building Mechanical (Wellhouse Pumping Equipment and Piping):** Includes furnishing and installation of the well pump and motor, pump pedestal, and all associated building mechanical components required for pumping and discharge within the wellhouse. Includes discharge piping from the pump to the building wall or connection point, including all pipe, fittings, supports, thrust restraint as required, and appurtenances such as isolation valves, check valves, pump-to-waste piping and valve, and related accessories.	LS	1	$550,000	$550,000
5	**Electrical and HVAC:** Includes furnishing and installation of all electrical power, controls, and building HVAC systems necessary to support wellhouse operation. Includes new motor control center (MCC), variable frequency drive (VFD), and control panels; new conduit, feeders, and wiring; control wiring and terminations; and testing, startup, and commissioning of all electrical systems and equipment. Also includes installation of a manual transfer switch with plug-in connection for standby power supplied by a portable or trailer-mounted generator (no permanent on-site generator included), along with associated feeder, conduit, wiring, and a concrete pad for trailer generator placement. Includes louvers, exhaust ventilation, and unit heaters required to maintain acceptable operating conditions within the wellhouse.	LS	1	$350,000	$350,000
6	**Site Piping and Site Improvements Allowance:** Includes furnishing and installation of all site piping and appurtenances required to convey water from the wellhouse to existing site facilities, along with a general allowance for site restoration and minor improvements. Includes installation of approximately 10-inch diameter discharge piping from the wellhouse to the existing reservoir, including fittings, joints, supports, and connection to the existing system, as well as installation of pump-to-waste piping routed to the existing pond, including pipe, fittings, and termination improvements. This bid item also includes a site improvements allowance covering access road repairs or modifications, grading, surface restoration, landscaping, erosion control, and other minor civil work disturbed by construction.	LS	1	$300,000	$300,000
				Construction Subtotal	**$2,805,000**
				Engineering, Legal, and Admin (25%)	$701,250
				Construction Contingency (30%)	$ 841,500
				PROJECT SUBTOTAL	**$ 4,348,000**
				AACE Class 5 Low Estimate Range (-50%):	*$ 2,174,000*
				AACE Class 5 High Estimate Range (+100%):	*$ 8,696,000*

All costs related to Tariffs are excluded from the estimate

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City of Bend - Outback Facility Plan

Outback Site Transmission Main Project P-1

Concept Level (Class 5)

Apr-2026

Item No.	Item Description	Unit	Quantity	Unit Price	Amount
1	**Mobilization & Demobilization:** Assumed 10% of Project Cost	LS	1	$110,000	$110,000
2	**P-1 Outback Site Transmission Project:** Install approximately 530 feet of 16-inch transmission main and 540 feet of 30-inch transmission main to provide an additional hydraulic connection between the North and South Outback Transmission Mains. Includes excavation, pipe installation, fittings, backfill, surface restoration, erosion control, and tie-ins to existing mains. Alignment corresponds to the purple/white and brown/white dashed segments on the planning figure.	LS	1	$1,100,000	$1,100,000
				Construction Subtotal	**$1,210,000**
				Engineering, Legal, and Admin (25%)	$302,500
				Construction Contingency (30%)	$ 363,000
				PROJECT SUBTOTAL	**$ 1,876,000**
				AACE Class 5 Low Estimate Range (-50%):	*$ 938,000*
				AACE Class 5 High Estimate Range (+100%):	*$ 3,752,000*

All costs related to Tariffs are excluded from the estimate

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City of Bend - Outback Facility Plan

Outback Site Transmission Main Projects

Concept Level (Class 5)

Apr-2026

Item No.	Item Description	Unit	Quantity	Unit Price	Amount
1	**Mobilization & Demobilization:** Assumed 10% of Project Cost	LS	1	$350,000	$350,000
2	**P-2 Outback Site Transmission Project:** Replace approximately 3,320 liner feet of existing 14-inch and 16-inch parallel pipe with new 30-inch transmission main to address condition issues and improve long-term hydraulic performance. Work includes trenching, pipe removal/abandonment, new pipe installation, fittings, appurtenances, backfill, pavement and surface restoration, erosion control, and tie-ins. Assumption that developer will be responsible installation of remaindar of pipeline.	LS	1	$3,500,000	$3,500,000
				Construction Subtotal	**$3,850,000**
				Engineering, Legal, and Admin (25%)	$962,500
				Construction Contingency (30%)	$ 1,155,000
				PROJECT SUBTOTAL	**$ 5,968,000**
				AACE Class 5 Low Estimate Range (-50%):	*$ 2,984,000*
				AACE Class 5 High Estimate Range (+100%):	*$ 11,936,000*

All costs related to Tariffs are excluded from the estimate

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City of Bend - Outback Facility Plan
PFAS Scenario A
Concept Level (Class 5)
Apr-2026

Item No.	Item Description	Unit	Quantity	Unit Price	Amount
1	**Mobilization & Demobilization:** Assumed 10% of Project Cost	LS	1	$489,000	$489,000
2	**PFAS Scenario Groundwater A:** Groundwater Scenario A represents the minimum planning-level PFAS treatment condition for the Outback Facility and provides an order-of-magnitude cost for limited groundwater PFAS treatment if required in the future. Under this scenario, PFAS treatment is assumed to apply only to groundwater, with treatment sized for two wells (Wells 6 and 7) using pressure-vessel-based systems consistent with technologies previously evaluated by the City. The OPCC reflects PFAS treatment equipment, interconnections between treatment units, and supporting onsite features but does not include site piping to convey flow to or from the PFAS treatment area, which would be defined as part of future system integration and design.	LS	1	$4,888,000	$4,888,000
				Construction Subtotal	**$5,377,000**
				Engineering, Legal, and Admin (25%)	$1,344,250
				Construction Contingency (30%)	$ 1,613,100
				PROJECT SUBTOTAL	**$ 8,335,000**
				AACE Class 5 Low Estimate Range (-50%):	*$ 4,167,500*
				AACE Class 5 High Estimate Range (+100%):	*$ 16,670,000*

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City of Bend - Outback Facility Plan
PFAS Scenario B
Concept Level (Class 5)
Apr-2026

Item No.	Item Description	Unit	Quantity	Unit Price	Amount
1	**Mobilization & Demobilization:** Assumed 10% of Project Cost	LS	1	$1,560,000	$1,560,000
2	**PFAS Scenario B:** Scenario B represents an intermediate planning-level PFAS treatment condition for the Outback Facility in which PFAS treatment is assumed for the full surface water flow in combination with limited groundwater PFAS treatment. Under this scenario, surface water PFAS treatment is sized for the full design surface water capacity, while groundwater PFAS treatment remains sized for one well at a time using separate pressure-vessel-based treatment trains. The OPCC reflects PFAS treatment equipment, interconnections between treatment units, and supporting onsite features for both surface water and groundwater treatment but does not include site piping to convey flow to or from the PFAS treatment areas, which would be defined as part of future system integration and design.	LS	1	$15,600,000	$15,600,000
				Construction Subtotal	**$17,160,000**
				Engineering, Legal, and Admin (25%)	$4,290,000
				Construction Contingency (30%)	$ 5,148,000
				PROJECT SUBTOTAL	**$ 26,598,000**
				AACE Class 5 Low Estimate Range (-50%):	*$ 13,299,000*
				AACE Class 5 High Estimate Range (+100%):	*$ 53,196,000*

All costs related to Tariffs are excluded from the estimate

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City of Bend - Outback Facility Plan
PFAS Scenario C
Concept Level (Class 5)
Apr-2026

Item No.	Item Description	Unit	Quantity	Unit Price	Amount
1	**Mobilization & Demobilization:** Assumed 10% of Project Cost	LS	1	$1,560,000	$1,560,000
2	**PFAS Scenario C:** Scenario C represents the most conservative planning-level PFAS treatment condition for the Outback Facility and provides an order-of-magnitude cost for full PFAS treatment of both surface water and groundwater sources. Under this scenario, PFAS treatment is assumed for the full design surface water flow and for all existing Outback groundwater wells operating concurrently, resulting in the largest treatment footprint and highest infrastructure demand. The OPCC reflects PFAS treatment equipment, interconnections between treatment units, and supporting onsite features but does not include site piping to convey flow to or from the PFAS treatment areas, which would be defined as part of future system integration and design.	LS	1	$15,600,000	$15,600,000
				Construction Subtotal	**$17,160,000**
				Engineering, Legal, and Admin (25%)	$4,290,000
				Construction Contingency (30%)	$ 5,148,000
				PROJECT SUBTOTAL	**$ 26,598,000**
				AACE Class 5 Low Estimate Range (-50%):	*$ 13,299,000*
				AACE Class 5 High Estimate Range (+100%):	*$ 53,196,000*

All costs related to Tariffs are excluded from the estimate

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City of Bend - Outback Facility Plan

Wildland Firefighting Infrastructure Cost Estimate

Concept Level (Class 5)

Apr-2026

Item No.	Item Description	Unit	Quantity	Unit Price	Amount
1	**Mobilization/Demobilization:** Assumed 10% of Project Cost	LS	1	$70,000	$70,000
2	**Truck-Accessible Water Fill Station:** Construct a Forest Service water tender compatible water fill station alongside the existing Outback Facility access road. Work includes grading and compaction of rock for a 200 feet long by 50 feet wide bump-out along the access road; constructing one Forest Service standard pressure-type fill station, including standpipe, DCVA vault, foundation, and associated appurtenances; installing approximately 700 linear feet of buried 6-inch ductile iron piping with associated fittings; minor site restoration, striping, and signage as required.	LS	1	$290,000	$290,000
3	**Helicopter Dip Tank:** Construct a prefabricated temporary helicopter dip tank, approximately 16 feet in diameter and 12 feet in height. Work includes grading, compacting, and stabilizing tank area; installing prefabricated 16 feet diameter, 12 feet tall dip tank; installing a dedicated raw water supply connection with associated isolation valves, fittings, flow control devices and backflow; incorporating overflow and drainage piping; site clearing of 110 feet in all directions of the tank site.	LS	1	$170,000	$170,000
4	**Helipad:** Construct a square helipad on the Outback property. Work includes clearing and grading of a 400 feet by 400 feet area; compacting and leveling of the immediate helipad area; casting a 6 inch thick, 132 foot by 132 foot level concrete slab; implementing drainage and erosion control; minor site restoration, painting, striping, and signage as required.	LS	1	$240,000	$240,000
				Construction Subtotal	**$770,000**
				Engineering, Legal, and Admin (25%)	$192,500
				Construction Contingency (30%)	$ 231,000
				PROJECT SUBTOTAL	**$ 1,194,000**
				AACE Class 5 Low Estimate Range (-50%):	*$ 597,000*
				AACE Class 5 High Estimate Range (+100%):	*$ 2,388,000*

All costs related to Tariffs are excluded from the estimate

AACE Class 5 Estimate. This estimate is prepared based on limited information, where little more than proposed plant type, its location, and the capacity are known, where preliminary engineering is from 0% to 2% complete. Strategic planning purposes include but are not limited to, market studies, assessment of viability, evaluation of alternate schemes, project screening, location and evaluation of resource needs and budgeting, and long-range capital planning. Examples of estimating methods used would include cost/capacity curves and factors, scale-up factors, and parametric and modeling techniques. Typically, little time is expended in the development of this estimate. The expected accuracy ranges for this class of estimate are –20% to –50% for the low range side and +30% to +100% on the high range side.

CONSOR's construction cost estimate ("estimate") is in dollars valued as of the date of this estimate. This estimate is an opinion of probable cost based on information available at the time of its development. Final costs will depend on; actual field conditions, actual material and labor costs, market conditions for construction, regulatory factors, final project scope, method of implementation, schedule (time to completion, time of commencement, Speed of execution), and other variables. This estimate is based on our perception, which is based on experience and research, yet nevertheless, an assessment, of current conditions at the project location. This estimate reflects our professional opinion of current costs and is subject to change as the project design evolves. CONSOR has no control over, nor can it forecast variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means, and methods of executing the work, or of determining prices, of the impact of competitive bidding or market conditions, practices, or bidding strategies. CONSOR neither warrants nor guarantees that proposals, bids, or actual construction costs will reflect the costs presented, which are for illustrative purposes only.