Memorandum

Date: September 20, 2021

Project: Integrated Water System Master Plan, City of Bend, Oregon

To: Brittany Barker, PE
City of Bend

From: Tom Perry, PE
Brian Rowbotham, PE
Murraysmith

Kevin Crew, PE
Black Rock Consulting

Reviewed By: David Stangel, PE

Re: Outback Siting Study

RENEWS 12/31/2022

Introduction

The City of Bend (City) authorized Murraysmith, Inc. (Murraysmith) to complete an Integrated Water System Master Plan (iWSMP) to evaluate and quantify short and long-term needs in their potable water distribution system based on hydraulic, supply, and condition deficiencies. The Outback Facility (Outback) is a critical piece of the City's water system infrastructure and is the location of the terminus of the surface water transmission pipeline, the Water Filtration Facility (WFF), a key wellfield location with multiple wells, multiple above ground reservoirs, and storage of essential equipment and related supplies

As part of iWSMP, future infrastructure needs and existing condition issues at Outback have been identified. Future needs at Outback include potential replacement of portions or all of the existing above ground reservoirs, upgrades to existing wells, additional groundwater wells, additional water storage reservoirs, pretreatment facilities ahead of the existing Water Filtration Facility (WFF) and determining the best hydraulic location for any potential hydro power generation.

The addition of pretreatment to be constructed upstream of the existing filtration facility has been discussed as a means to help sustain the current influent water quality during normal operations and in case of a turbidity event or fire in the watershed that may degrade water quality. Pretreatment will also improve finished water quality and extend the life of the existing membrane elements.

Purpose

The purpose of this amendment to the iWSMP is to conduct high level site planning to accommodate water system infrastructure needs on the relatively constrained existing City-owned Outback site and determine the need for additional property to support near and long-term goals. In addition, this work will evaluate and identify a pretreatment solution and develop implementation options and cost estimates.

This work will address the feasibility of accommodating system improvements on the existing site and its potential expansion and will be the first step in the development of a Facility Plan for the existing Outback Site. The Outback Facility Plan, included as a project in the iWSMP Capital Improvement Plan, will build on this study and the iWSMP to further develop and evaluate a comprehensive plan for the facilities and processes at the Outback site. The Facility Plan will define the necessary land use and environmental reviews, permitting, agency approvals and processes and prioritize facility improvements, and will define projects that can be advanced to the design and construction phases.

Project Scope

The Scope of Work for the Outback Siting Study (Study) includes the following elements:

- Develop a concept for pretreatment that can be incorporated in the Facility Plan or implemented separately.
    - Establish pretreatment design criteria
    - Identify and evaluate feasible alternatives
    - Collaborate with City staff to select a preferred alternative
- Inventory improvements identified in the Integrated Water System Master Plan (iWSMP) for the Outback site; well sources, contact time basins and finished water storage.
- Identify potential long-term needs at Outback, beyond the current iWSMP planning horizon, that focuses on resiliency, security, and sustainability of the water system infrastructure.
- Identify a concept for location of a hydro power generation facility along the existing raw water transmission line given the existing head conditions and operating parameters of the WFF.
- Develop a site plan layout that incorporates the water infrastructure elements; pretreatment, location of a potential hydro power facility, iWSMP improvements and potential long-term needs.
    - Develop alternatives and evaluate site plan layouts.
    - Define potential property needs.

- Collaborate with staff to develop a preferred site plan layout.

- Define next steps associated with the further development of Outback and project implementation.

Background

The Outback site is the most critical piece of the City's water system with respect to both water source/supply and distribution.

Water Source/Supply

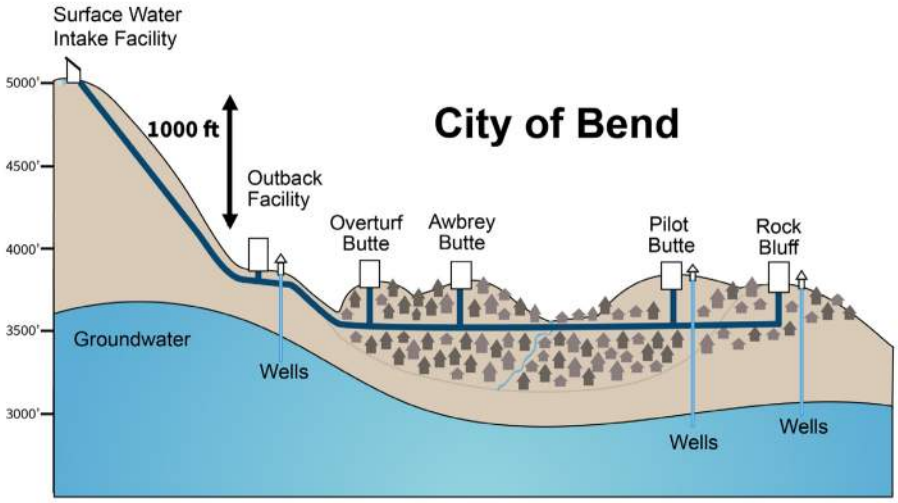
Prior to 1926 the water system was centered around downtown Bend, and owned and operated by Bend Water, Light and Power Company with the Deschutes River as the water source. Due to degrading water quality in the mid-1920's, attributed to the construction of upstream reservoirs at Crane Prairie and Crescent Lake, alternative water sources were explored. Upon review of the alternatives, the upper portion of Tumalo Creek was recommended based on its exceptional water quality, protected nature of the watershed, gravity flow and low operating cost. In 1926 the City of Bend purchased the water system and constructed the Bridge Creek intake in the Tumalo Creek watershed and transmission line. In parallel with construction of the intake, the City established the Bend Municipal Watershed by agreement with the USFS. The surface water source from the Bend Municipal Watershed was expanded over the years, to increase capacity and provide required levels of treatment dictated by the EPA Initially treatment was disinfection with chlorine, reservoirs were constructed at Outback to provide sufficient contact time, and in 2016 the City constructed the WFF.

To supplement surface water from the Bend Municipal Watershed, Well #1 was constructed in 1972 and since then a total of seven wells have been constructed at the Outback site. Groundwater flow in the Upper Deschutes Basin is generally to the northeast. Upgradient from the Outback wells, in the wellhead protection areas, is National Forest land, with no development and very low potential for groundwater contamination.

Water Distribution

A key attribute of the Tumalo Creek water source, and why it was initially selected as the City's water supply, is its ability to gravity feed the City's distribution system. The Outback site is located at a unique elevation that takes maximum advantage of the gravity flow. Initially an overflow tower at Outback (constructed in 1926) established the hydraulic gradient for the City's distribution system. The overflow tower has been replaced by storage reservoirs, but the hydraulic gradient remains essentially the same, allowing the City to efficiently serve the majority of residents by gravity, without the need for pumping and the associated high energy costs. Figure 1 illustrates gravity flow of the surface water supply and the hydraulic connection between the raw water intake, filtration facility, and storage reservoirs located throughout the City.

Figure 1|Water System Hydraulics



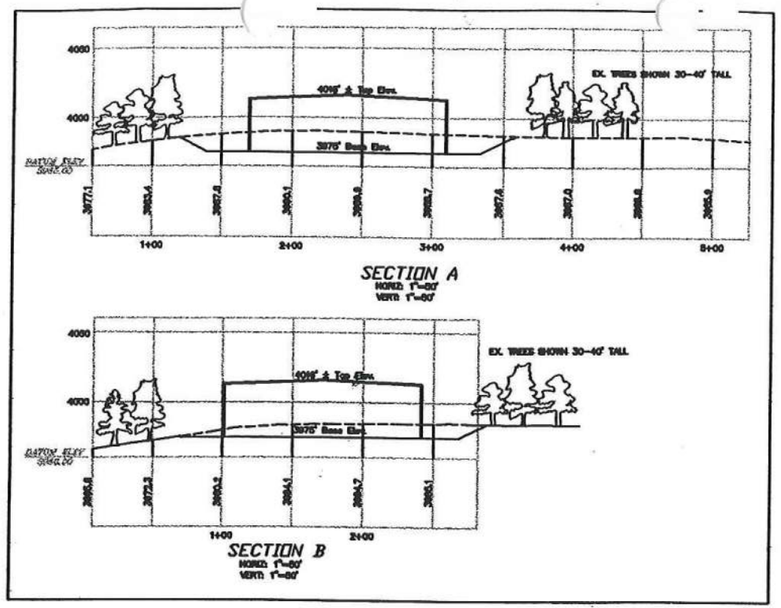
Site Development

The existing 15-acre Outback site is owned outright by the City of Bend. The site was deeded by the Miller family in the 1950's. 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.

In anticipation of further needs at the site, the City obtained a Special Use Permit (SUP) from the National Forest Service in 2002 for 14.14 acres located adjacent to the existing Outback site. A copy of the permit can be found in Appendix D. The permit allows for the construction, operation, and maintenance of the following:

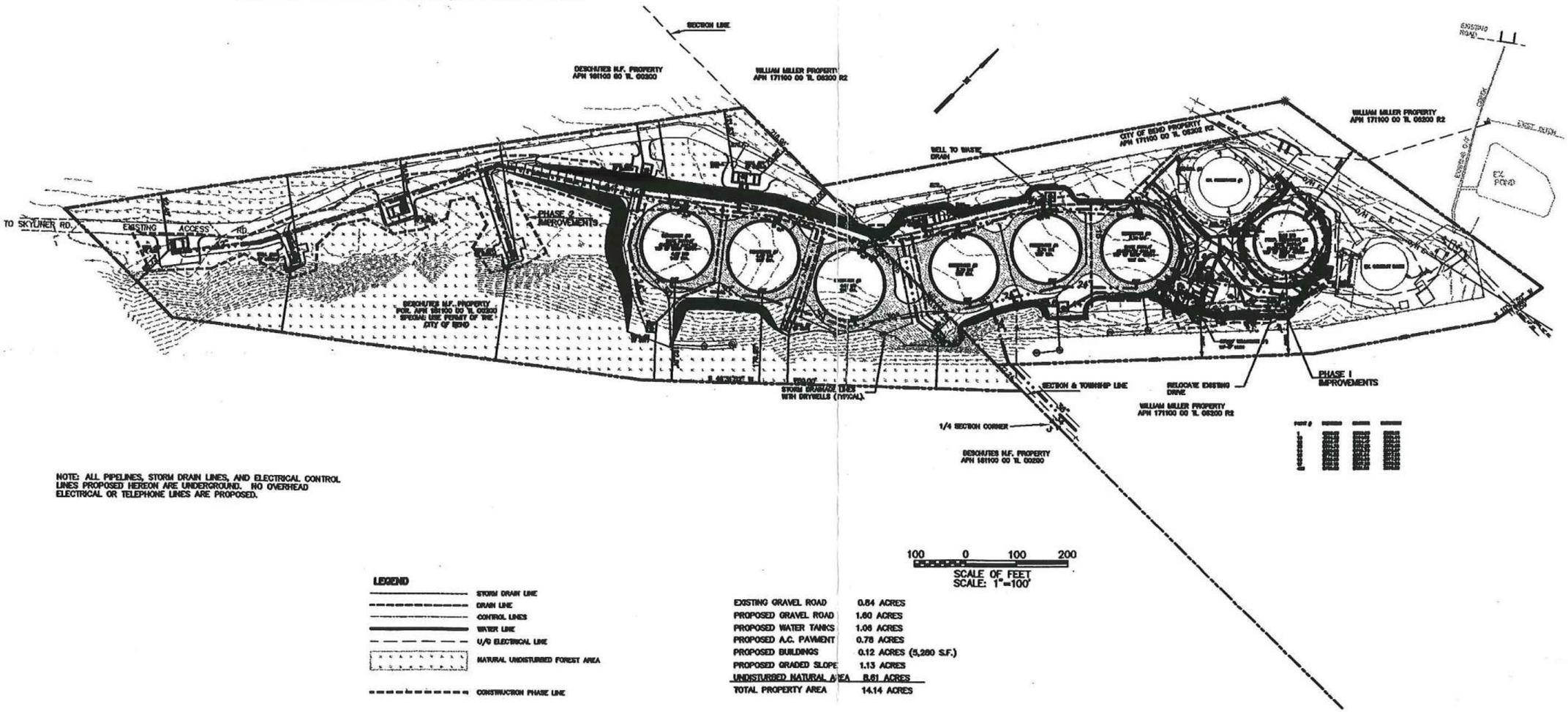
- Three water storage tanks,
- Nine water wells,
- Several dry wells,
- Three 16 x 50-foot wellhead control buildings which will house disinfecting equipment
- Six 12 x 20-foot buildings to be constructed over the remaining well heads
- Water pipes
- Access roads
- Site security fencing

A site plan was developed as part of the permitting effort incorporating the listed elements above which can be found in Figure 2. The SUP expires in December of 2022.



SECTION A
HORIZ: 1"=50'
VERT: 1"=50'

SECTION B
HORIZ: 1"=50'
VERT: 1"=50'



NOTE: ALL PIPELINES, STORM DRAIN LINES, AND ELECTRICAL CONTROL LINES PROPOSED HEREON ARE UNDERGROUND. NO OVERHEAD ELECTRICAL OR TELEPHONE LINES ARE PROPOSED.

LEGEND

- STORM DRAIN LINE
- DRAIN LINE
- CONTROL LINES
- WATER LINE
- U/G ELECTRICAL LINE
- NATURAL UNDISTURBED FOREST AREA
- CONSTRUCTION PHASE LINE

EXISTING GRAVEL ROAD	0.84 ACRES
PROPOSED GRAVEL ROAD	1.60 ACRES
PROPOSED WATER TANKS	1.06 ACRES
PROPOSED A.C. PAVMENT	0.78 ACRES
PROPOSED BUILDINGS	0.12 ACRES (5,260 S.F.)
PROPOSED GRADED SLOPE	1.13 ACRES
UNDISTURBED NATURAL AREA	8.61 ACRES
TOTAL PROPERTY AREA	14.14 ACRES

DESIGNED BY: SAL
DRAWN BY: JJB
CHECKED BY: TLA
SCALE: 1"=100'
12/11/00

REGISTERED PROFESSIONAL ENGINEER 16,893 OREGON July 25, 1997 Stephen M. Hasker
EXPIRES: 12/31/02

CENTURY WEST
ENGINEERING CORPORATION
549 SW Mill View Way, Bend, OR 97702
541-388-3500 ph, 541-388-3062 fax
e-mail: bend@centurywest.com

PROJECT NO. 10051.083.01

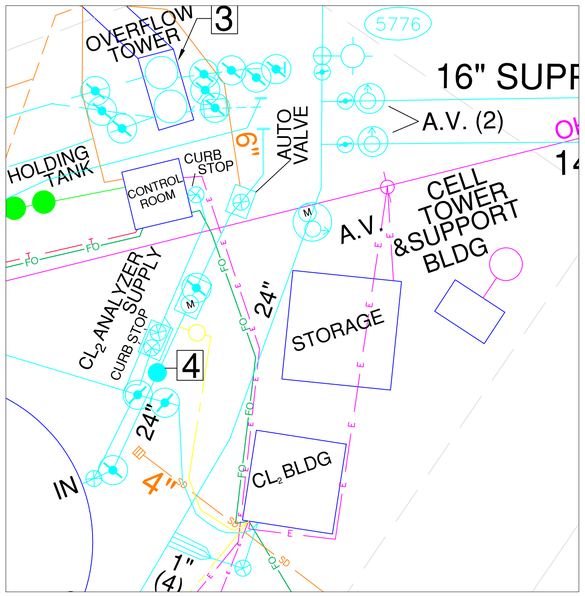
MASTER SITE PLAN
OUTBACK RESERVOIR AND WELLS
CITY OF BEND
BEND, OREGON

NO.	DATE	BY	APP'R	REVISIONS

DRAWING NO.
1/1

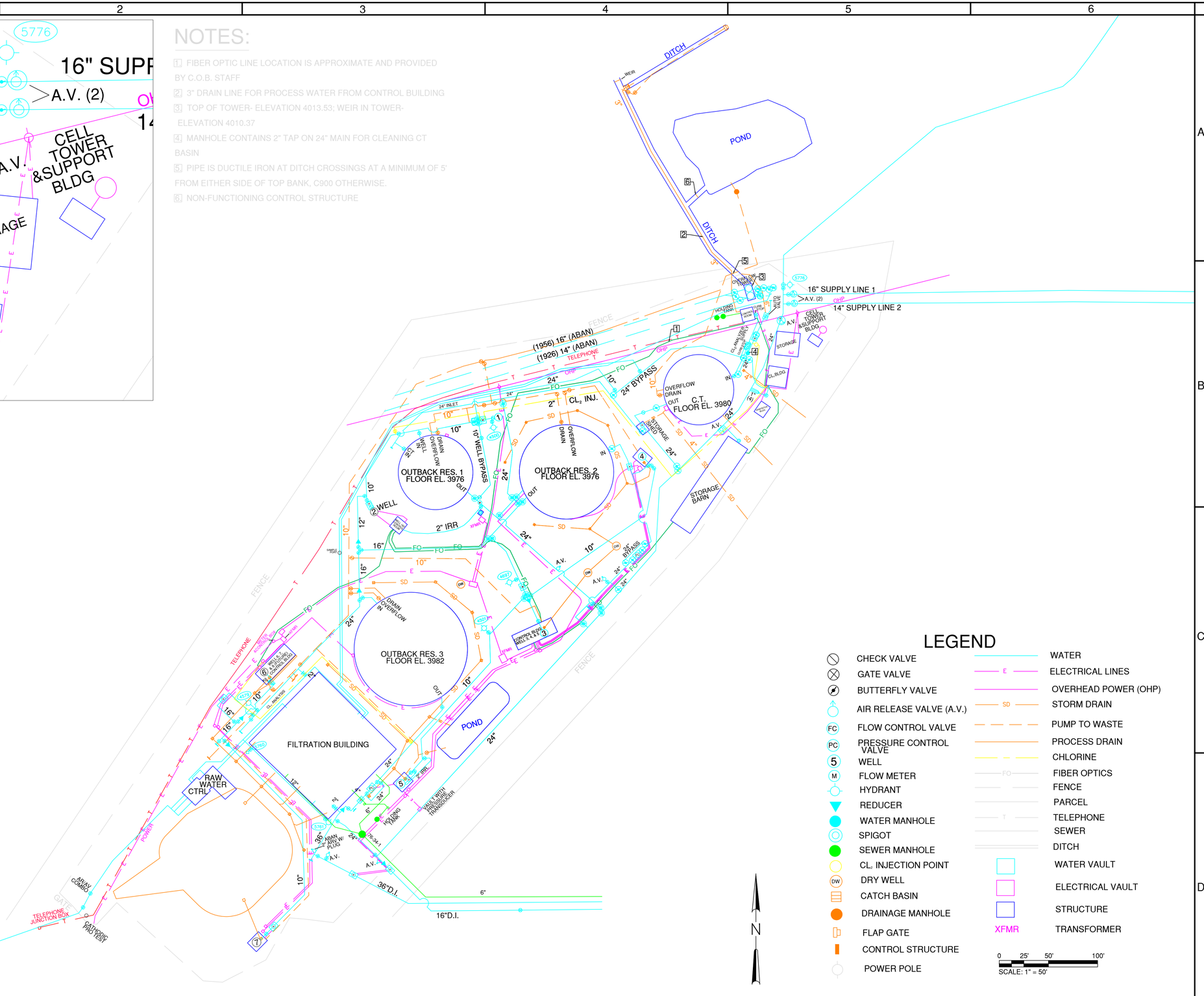
Currently, none of the facilities have been constructed and the SUP expires in December of 2022.

As federal regulation on potable water systems has grown, additional infrastructure has been constructed at the Outback site to the point of capacity. In 2006, the Long Term 2 Enhanced Surface Water Treatment Rule (LT2) was passed by congress to address health effects associated with *Cryptosporidium* in surface waters used for drink water supply. One of the chief requirements of the rule was that water systems using surface water as a raw water source employ a filtration process prior to disinfection. The existing WFF was constructed in response to the LT2 rule. With the addition of the WFF, the existing site is almost fully utilized with both above and below ground infrastructure adding complexity and limiting options for replacement or addition of facilities on the site without the addition of more land. Figure 3 below illustrates the current site plan illustrating how much growth has occurred.



NOTES:

1. FIBER OPTIC LINE LOCATION IS APPROXIMATE AND PROVIDED BY C.O.B. STAFF
2. 3" DRAIN LINE FOR PROCESS WATER FROM CONTROL BUILDING
3. TOP OF TOWER- ELEVATION 4013.53; WEIR IN TOWER- ELEVATION 4010.37
4. MANHOLE CONTAINS 2" TAP ON 24" MAIN FOR CLEANING CT BASIN
5. PIPE IS DUCTILE IRON AT DITCH CROSSINGS AT A MINIMUM OF 5' FROM EITHER SIDE OF TOP BANK, C900 OTHERWISE.
6. NON-FUNCTIONING CONTROL STRUCTURE



LEGEND

- CHECK VALVE
- GATE VALVE
- BUTTERFLY VALVE
- AIR RELEASE VALVE (A.V.)
- FC FLOW CONTROL VALVE
- PC PRESSURE CONTROL VALVE
- 5 WELL
- M FLOW METER
- HYDRANT
- REDUCER
- WATER MANHOLE
- SPIGOT
- SEWER MANHOLE
- CL_2 INJECTION POINT
- DW DRY WELL
- CATCH BASIN
- DRAINAGE MANHOLE
- FLAP GATE
- CONTROL STRUCTURE
- POWER POLE
- WATER
- E ELECTRICAL LINES
- OVERHEAD POWER (OHP)
- SD STORM DRAIN
- PUMP TO WASTE
- PROCESS DRAIN
- CHLORINE
- FO FIBER OPTICS
- FENCE
- PARCEL
- T TELEPHONE
- SEWER
- DITCH
- WATER VAULT
- ELECTRICAL VAULT
- STRUCTURE
- XFMR TRANSFORMER

OUTBACK RESERVOIR & WELL SITE

SITE PLAN

DESCHUTES COUNTY, OREGON

REVISIONS:
1.
2.
3.

DESIGNED BY: KW
DRAWN BY: KW
SCALE: AS SHOWN
FILE: OUTBACK.dwg
DATE: 7/31/2019

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

SHEET: 1/1

COB #

Pretreatment

Pretreatment is generally defined as any unit process located upstream of a filtration step at a water treatment facility. Pretreatment serves as a first step in removal of contaminants to reduce the load on the filters and also act as a buffer against large contaminant loads that a filtration facility may experience during a water quality event. Pretreatment upstream of the filtration process can increase and extend membrane life, decrease cleaning frequencies, and reduce the formation of disinfection byproducts (DBPs). Some filtration processes, such as low-pressure membranes, do not directly remove dissolved organic carbon without a coagulation process. A coagulation process is included in the majority of pretreatment alternatives and aids in the removal of organic carbon which leads to DBPs formed during disinfection.

Water quality at the existing Outback WFF is generally high quality due to the nature of the high mountain source from the Bend Municipal Watershed at Bridge Creek. However, during rain events turbidity levels in the raw water can reach upwards of 100 Nephelometric Turbidity Unit (NTU) and overload the membrane filters, consequently forcing the plant to shut down until turbidity levels reduce. A photo of the raw water at the intake during a rain event on August 5th of 2020 can be found below in **Figure 4.** Pretreatment processes can reduce these raw water turbidity spikes at the WFF and greatly reduce the number of shutdowns the plant experiences.

Figure 4|Post-storm Raw Water Turbidity

The Bend Municipal Watershed within the Deschutes National Forest where both the Outback Facility and its raw water intake are located have experienced numerous forest fires, including the 1979 Bridge Creek Fire which directly affected a portion of the watershed and subsequent impacts on water quality. The Bridge Creek fire also has led to watershed soil instability which can further increase turbidity after storm events. Additionally, the state of Oregon experienced devastating

wildfires during the summers of 2020 and 2021, several of which directly impacted the watersheds of several water sources. Concerns of wildfire risk in the watershed have been raised by USFS and City staff. The City of Bend produced a report on fire impacts in the water shed during the initial design of the WFF identifying these concerns. The original design of the WFF also included a pretreatment step but was eliminated during the design due to budgetary concerns.

Raw water quality in an impacted watershed can be affected for many years after a forest fire and pretreatment processes are a highly recommended step that can mitigate their impacts. In the short term, wildfires have detrimental effects such as significantly higher turbidity, color, and suspended particles along with an increase of dissolved organic carbon and nitrogen. Long term changes to dissolved organic matter (DOM) and nitrate can also be expected (H. Uzun et al, 2020). Changes in the nature of the DOM can also prove difficult for water treatment facilities to treat and highlights the need for a treatment process that can be adaptable and resilient. Effective coagulation and clarification processes have been proven to be an effective strategy in treating post-wildfire runoff at treatment plants (Hohner et all 2016).

Along with the direct impacts of wildfire, changing conditions in the watershed as a result of wildfire can often lead to erosion and mudslides during rainfall events and snow melt. Tree roots hold vegetation and soil in place. Without them, the loose soil erodes and can lead to massive landslides like those recently seen in California. These events can increase both the sediment loading and the amount of organic material in the raw water.

Other potential events that could hamper the WFF's ability to produce quality drinking water in the future are algal blooms and changes to regulation. Algal blooms in source water can cause both taste and odor issues for treatment facilities but also release harmful toxins that are dangerous to public health. Issues associated with algal blooms are often difficult to treat and require a robust process train for thorough treatment.

Lastly, the Environmental Protection Agency (EPA) continuously monitors upcoming contaminants and issues for public health and consequent requirements of treatment facilities. Possible future regulations might address but are not limited to emerging contaminants, further reduction in DBPs, and lead levels in distribution systems. Any regulation passed down from the EPA concerning these topics would directly impact treatment plants and their treatment requirements. A pretreatment system greatly increases the ability of a plant to respond to these emerging possible regulations.

A summary of possible events and their consequent impacts on water quality can be found in Table 1.

Table 1|Water Quality Impacts

Event	Water Quality Impacts
Forest Fire	Turbidity, TOC[1], Color, Taste and Odor
Landslide	Turbidity, Iron and Manganese
Algal Bloom	Taste and Odor (algal toxins)
Future Regulations	
Contaminants of Emerging Concerns	TOC Removal
Disinfection By Products	TOC Removal
Lower Lead Levels	TOC Removals

Note:
1. TOC = Total Organic Carbon

Pretreatment Overview

The three primary goals of a pretreatment process are as follows:

- Destabilize suspended particles in the water
- Removal of dissolved organic material
- Removal of contaminants through clarification

Typically pretreatment consists of the following steps:

- Coagulation
- Flocculation
- Clarification/Settling

Coagulation is defined as the destabilization of the charge on colloids and suspended solids, including bacteria and viruses. A coagulant chemical is added to the water such as alum or ferric chloride and mixed with a very high intensity to disperse the chemical as effectively as possible. Hydrolysis of the chemical occurs rapidly and adsorption of the coagulant to the suspended solids takes place almost immediately. Colloids with similar surface charges stay in solution and are not easily removed from water primarily due to colloidal materials having similar surface charges which repel them from each other. Adsorption of a coagulant to the colloidal surface reduces or removes the charges and allows the particles to collide and create larger removable particles.

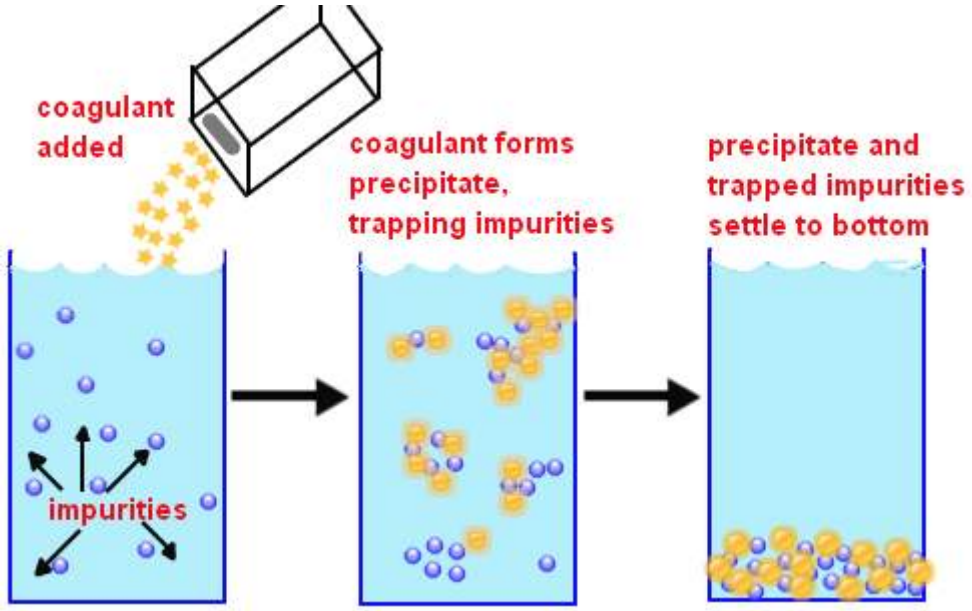
Flocculation is the gentle mixing phase following coagulation that serves to accelerate the rate of particle collisions. These particle collisions cause the agglomeration of electrolytically destabilized colloidal particles into large settleable and filterable sizes. This step is achieved by passing the coagulated water through a series of large basins where gentle mixing is induced. Mixing can be achieved by either hydraulic or mechanical means.

Clarification, also known as sedimentation or settling, is broadly defined as the removal of suspended solids (mineral and organic) from a liquid. This process is designed to remove a majority of the settleable solids by gravitational settling, thereby maximizing the downstream processes

such as filtration. An alternative to gravitational settling is flotation of solids, however, efficiency is dominated by particle buoyance and size. Settling is defined by Stokes Law which dictates the process is highly influenced by water temperature and particle size, which can be directly affected by the efficiency of the coagulation and flocculation processes.

An overview of the pretreatment process on a conceptual level can be found in **Figure 5**.

Figure 5|Pretreatment Process Schematic



Numerous methods of the pretreatment process have been implemented throughout water treatment facilities over the last century. Each alternative has unique characteristics yielding distinct advantages and disadvantages. It is crucial the right process is chosen for both the operations staff and to address the potential water quality issues expected.

Planning Criteria

An initial set of criteria was generated to review possible pretreatment alternatives at the WFF. These criteria were developed based on input from City staff along with municipal industry standards for pretreatment. The criteria were used to reduce the initial list of pretreatment alternatives to three that would be evaluated in greater detail. The initial criteria can be found in **Table 2**.

Table 2|Project Planning Criteria

Parameter	Goal
TOC Removal	Remove dissolved organic carbon
Turbidity Removal	< 1 NTU 95% of time, treat raw water events up to 500 NTU
Color Removal	< 5 color units
Fire Resiliency	Maximize ability to treat runoff after fire in watershed (elevated DOC[1], turbidity, T&O[2] issues, change in water chemistry)
Operational Intensity	Minimize operator time
Energy Requirements/Sustainability	Meet City requirements/standards
Hydro Electric Power	Compatibility

Notes:
1. DOC = Dissolved Organic Carbon
2. T&O = Taste and Odor

Initial Screening of Alternatives

Initially six pretreatment alternatives were considered for the Outback facility. These alternatives included:

- Upflow Clarification
- Pulsed Sludge Blanket Clarification
- Dissolved Air Flotation (DAF)
- Pre-sedimentation Ponds
- Ballasted Sedimentation (Actiflo®)
- Enhanced Settling (Plate Settlers)

The alternatives were compared to the project parameters and the following three alternatives were eliminated for further evaluation:

Upflow Clarification

Upflow clarification combines flocculation and sedimentation into a single unit process. It is preceded by rapid mixing where a coagulant chemical is added. Eliminating the separate flocculation process reduces facility footprint. Upflow clarification maintains a large, set volume of flocculated solids within the unit, which further enhances flocculation by forcing inter-particle collision and agglomeration. The flocculated solids form what is referred to as a "solids blanket." Cohesion of the blanket is achieved through the use of coagulant and polymer addition – additional to the rapid mixing process.

Upflow clarification was eliminated from further evaluation for the following reasons:

- Requires a high degree of operator input and supervision
- Process does not respond well to rapid changes in raw water quality conditions

- Additional polymer is required which can also increase solids disposal requirements
- More advantageous to raw water challenges such as frequent extreme high turbidity and/or algae events, which is not expected at the WFF

Pulsed Sludge Blanket

Pulsed Sludge Blanket clarification is a process where water is pulsed through a sludge blanket by vacuum pumps in a clarification basin. Clarification is preceded by coagulation and flocculation steps. Clarified water exits the top of the solids contact chamber and sludge is drawn off the bottom.

Pulsed sludge blanket clarification was eliminated for further evaluation for the following reasons:

- Requires a high degree of operator input and supervision to maintain a sludge blanket for effective treatment
- Mechanically intensive due to vacuum pumps
- More advantageous to raw water challenges such as frequent extreme high turbidity and/or algae events, which is not expected at the WFF

Dissolved Air Flotation (DAF)

DAF is a pretreatment process that is relatively common in the United States as an alternative to conventional sedimentation, and often used where removal of algae is a key consideration. In the DAF process, the solids are separated out by floating the floc to the water surface, as opposed to settling the floc to the bottom of the basin. After the flocculation process, DAF introduces air bubbles at the bottom of a contactor to float the floc. The air bubbles are produced by reducing the pressure in the recycle water stream to ambient conditions.

The “float” is scraped or floated from the top of the reactor, and the clarified water is removed via underflow channels at the bottom of the reactor

DAF was eliminated from further evaluation for the following reasons:

- DAF is less compatible with the addition of powdered activated carbon (PAC) than other clarification processes because PAC tends to settle, and DAF is a flotation process. This reduces the Outback facilities resilience to mitigate taste and odor, algal toxins, and other contaminants that could potentially impact the City’s supply.
- More advantageous to raw water quality challenges not expected at the Outback facility
- High energy requirements/low sustainability compared to other options

- More mechanically intensive than other alternatives considered which requires a higher degree of operator supervision.

Evaluation of Alternatives

After the initial process of eliminating upflow clarification, pulsed sludge blanket clarification, and DAF, the remaining three alternatives were evaluated in greater detail. This evaluation included initial process sizing, site layouts and high-level cost estimates. This information was presented to the City during the pretreatment alternatives workshop. Slides from the workshop prepared by Murraysmith can be found in Appendix A.

Pre-sedimentation Ponds

A pre-sedimentation pond is a large pond or basin located at the head of a plant that removes high turbidity levels from the water through gravity settling. Coagulants are not typically added in this process and solids are removed manually when a basin is drained and taken offline. Typical detention times for these ponds are 3 or more hours to provide adequate settling time for particles and basin depth is limited to ensure settling. Due to the lack of coagulation or chemical addition, the efficiency of the process is dominated by raw water temperature and the size of the incoming suspended solids. Pre-sedimentation ponds can be effective at removing solids during very high turbidity events but may require additional pretreatment and do not have a high degree of optimization. These facilities are often used in conjuncture with other pretreatment processes and have been effective in removing sediment after wildfire events. These facilities are also easily bypassed during times of the year where they are not needed to avoid complications from outdoor operations in adverse weather and are easily put back into service during water quality events.

A summary of the relative advantages/disadvantages can be found in Table 3.

Table 3|Advantages and Disadvantages of Pre-sedimentation Ponds

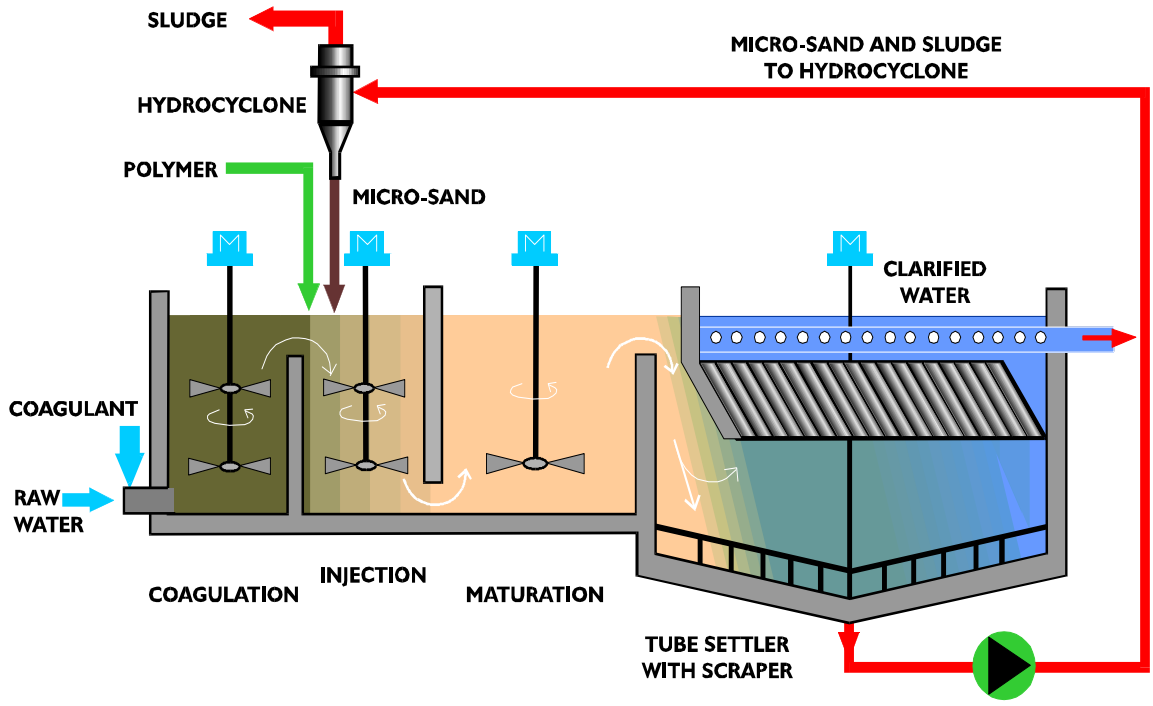
Advantages	Disadvantages
Simplicity	No DOC removal
Provides flow attenuation	No particle destabilization
Can help after storm and fire events	Particle removal efficiency dependent on particle size and water temperature and cannot be optimized by operations staff
	Large footprint
	Manual sludge removal

Ballasted Sedimentation (Actiflo)

Ballasted sedimentation is a proprietary process of high-rate clarification that uses microsand-enhanced flocculation and plate settling to produce a clarified effluent. Ballasted sedimentation is produced by several manufacturers, the most common of which is Actiflo® produced by Veolia. The process consists of a rapid mix chamber where a coagulant is added, followed by an injection

chamber where microsand and a polymer are added (high-energy mixing environment), and then a maturation chamber (lower-energy mixing to build floc and attach to sand). Typical detention time for these three steps is about 6 minutes. Following these chambers, water enters the settling tank where the microsand-floc settles quickly. The process water is further clarified by flowing upward through settling tubes and into effluent channels. Total retention time is between 10 and 15 minutes. The microsand sludge at the bottom of the settling tank is pumped to a hydrocyclone, where it is separated from the sludge by centrifugal force. The sand is then returned to the head of the process for reintroduction in the injection chamber.

Figure 6|Schematic of the Ballasted Sedimentation Process



A summary of the advantages and disadvantages of ballasted sedimentation relative to the project goals can be found in Table 4.

Table 4|Advantages and Disadvantages of Ballasted Sedimentation

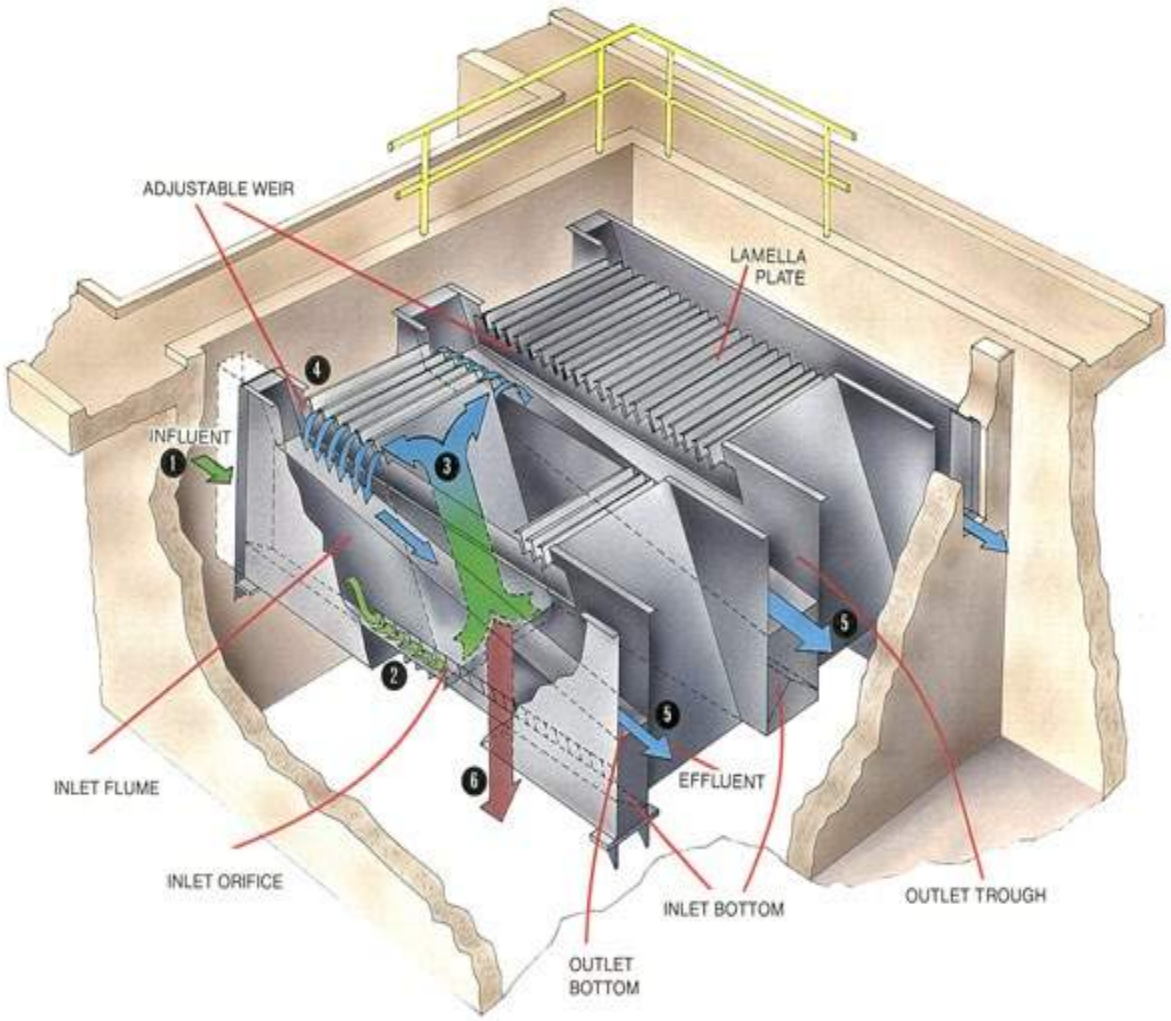
Advantages	Disadvantages
Rapid start-up (30 to 60 minutes)	Mechanically intensive
Handles rapid water quality changes	Requires operator expertise/experience: Recycle stream Prompt operator response to changing conditions
Highly effective treatment for: ▪ High turbidity ▪ Rapidly changing conditions ▪ Low turbidity, high color	Highly dependent on coagulant dose and polymer type
	pH dependent

Enhanced Settling (Plate Settling)

Inclined parallel plates or tubes are an enhancement of the traditional conventional sedimentation process that enables a substantial reduction in facility footprint from what conventional sedimentation requires. Enhanced settling refers to the clarification process, however, it is always used in combination with a chemical injection, coagulation, and flocculation process. Coagulation and flocculation upstream of the enhanced settling basin can be achieved through either mechanical or hydraulic means. Coagulant injection occurs ahead of coagulation and the chemical can be chosen depending on raw water. Loading rates for inclined plate settling can typically range from 2 to 4 gallons per minute per square foot (gpm/sf) based on facility footprint as opposed to 0.5 gpm/sf for conventional sedimentation. Both plates and tubes are used in the municipal water treatment industry. Plates tend to be more efficient, while tubes tend to be less expensive. For the purpose of this study, and because of the greater removal efficiency, this alternative is assumed to be comprised of inclined plates.

Inclined plate settling is accomplished in an open basin where water flow is conveyed in either of the following ways though the plates: (1) from top to bottom downward between the plates (co-current), (2) from bottom to top upward between the plates (counter-current), or horizontally from one side of the plates to the other (cross-current). Most new plate settling processes use a combination of cross- and counter-current flow by introducing the process water near the bottom of one side of the plates and withdrawing it at the top of the other side of the plates. A schematic diagram of a counter-current inclined plate settling process is presented in Figure 7.

Figure 7|Schematic Diagram of a Counter-Current Inclined Plate Settling Process



The material costs for the plates or tubes can vary depending on the materials required for the installation. Solids loading on surfaces and removal of solids can be a problem in some configurations. Similar to conventional sedimentation, 30 minutes or more of detention time in the flocculation process is necessary. Plate and tube settlers have been in use for many years in water treatment and are a widely accepted technology for settling of flocculated solids.

A summary of the advantages and disadvantages of enhanced settling relative to the project goals can be found below in Table 5.

Table 5|Advantages and Disadvantages of Enhanced Settling

Advantages	Disadvantages
Increased surface loading (relative to standard settling basin)	Sludge removal maintenance
Variety of raw water treatment	Not as efficient at removing extreme turbidity relative to ballasted sedimentation
Low maintenance	
Mechanically simple	
Proven performance producing settled water < 5 NTU	
Handles a variety of flow rates	
Simple construction	

Evaluation of Alternatives

Preliminary layouts, sizing, and costs were created for the selected alternatives for further evaluation. A list of criteria was developed to evaluate the best possible pretreatment alternative for the Outback facility and can be found below:

- Capital costs
- Life cycle costs
- Redundancy/Failure Resiliency
- TOC removal efficiency
- Turbidity removal efficiency
- Color removal efficiency
- T&O removal efficiency
- Disinfection byproduct reduction
- Future regulatory compliance
- Flow attenuation capability
- Complexity of operation
- Power use
- Process footprint
- Proprietary parts/spare parts availability
- Ease of implementation
- Compatibility with hydroelectric power generation

Alternatives were evaluated and give a raw score of 1 through 5 for each criterion. Scoring was performed by Murraysmith staff based on industry experience and recent projects. The scoring was reviewed with City staff during a workshop held on January 27th of 2021.

Each criterion was also given a weighting of 1 through 3 with:

- 3 - Greatest importance
- 2 - Moderate importance
- 1 - Least importance

An initial weighting was given to each evaluation criteria and reviewed with City staff during the January 27th workshop. Raw scores were multiplied by the weighting and a weighted score generated for each evaluation criteria and alternative. Based on the criteria and weighting, a higher total score correlates to a pretreatment alternative being a more favorable option. The scoring was summarized in the scoring matrix in **Table 6**.

Table 6|Pretreatment Alternatives Evaluation Matrix

Criteria	Weighting Factor	Alternative 1 - Pre-Sed Ponds		Alternative 2 - Actiflo		Alternative 3 - Plate Settlers	
		Raw Score	Weighted Score	Raw Score	Weighted Score	Raw Score	Weighted Score
Capital Costs	3	5	15	3	9	2	6
Life Cycle Costs	3	5	15	2	6	3	9
Redundancy/Resiliency	3	2	6	4	12	5	15
TOC Removal Efficiency	3	2	6	4	12	4	12
Turbidity Removal Efficiency	3	2	6	5	15	4	12
Color Removal Efficiency	3	1	3	4	12	4	12
T&O Removal Efficiency	2	1	2	3	6	3	6
DBP Reduction	2	2	4	4	8	4	8
Future Regulatory Compliance	3	1	3	4	12	4	12
Flow Attenuation	2	5	10	1	2	3	6
Complexity of Operations	3	5	15	2	6	4	12
Power Use	3	5	15	2	6	3	9
Process Footprint	1	1	1	5	5	3	3
Proprietary parts/spare parts	3	5	15	2	6	4	12
Ease of Implementation	2	1	2	3	6	5	10
Hydropower Compatibility	3	5	15	5	15	5	15
Total Weighted Scores:		**48**	**133**	**53**	**138**	**60**	**159**
Weighting Factors:		*3 = Greatest Importance* *2 = Moderate Importance* *1 = Least Importance*		*High Score =Favorable* *Low Score = Less Favorable*			

Preferred Alternative

Based on the weighted scores, existing site and needs at the Outback facility, City staff chose a combination of the pre-sedimentation pond and plate settler options to carry forward to conceptual design and siting layouts.

A process flow schematic was generated to examine how the new pretreatment processes would be integrated with the existing facilities at Outback and can be found in **Figure 8**. Raw water will

be routed from the existing 30-inch raw water pipe at a point upstream of the existing raw water control structure. Water will then pass through a flow meter at the head of the new facilities and through a new energy dissipation structure and into the pre-sedimentation pond. Decanted water from the pond will pass through another flow meter into a control valve found in the pretreatment facility. Water will then be injected with a coagulant and enter a 2-stage rapid mix basin. Coagulated water will enter one of two flocculation and sedimentation basins consisting of three stages of flocculation followed by clarification achieved by stainless steel plate settlers. Treated water from the plate settler units will discharge into a wet well located inside the building. This wet well will be tied into the wet well in the existing raw water control structure such that operations of the existing membrane feed pumps will not be altered. Solids will be removed from the pretreatment process by hoseless sludge collectors and flow by gravity into a solids equalization basin. Decant from that basin will be returned to the front of the process train and the remaining solids underflow will be pumped to the existing sanitary sewer connection onsite. Lastly, bypasses are located around each of the new processes in case of failure or if the process is not needed due to water quality.

FIRE

EXISTING RAW WATER CONTROL STRUCTURE

FROM INTAKE

EXISTING RAW WATER

TO WFF

M

M

POTENTIAL HYDROPOWER FACILITY

M

METER

PROPOSED ENERGY DISSIPATION STRUCTURE

PRE-SEDIMENTATION POND

M

M

2-STAGE RAPID MIXING

3-STAGE FLOCCULATION

PLATE SETTLERS AND SLUDGE COLLECTION

EFFLUENT CHANNEL

SOLIDS

PROCESS RECIRCULATION

RECIRCULATION PUMP STATION

PRETREATMENT BUILDING

SANITARY SEWER

OVERFLOW POND

FIGURE 8

Outback Siting Study

Outback WFF Pretreatment Flow Schematic

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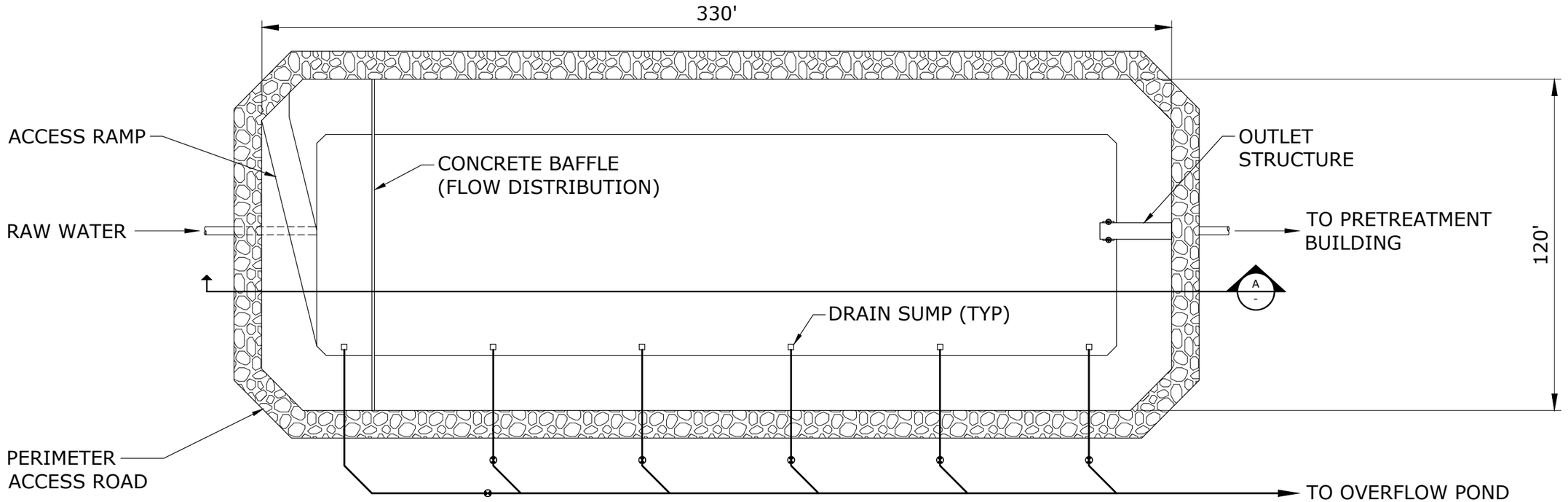
Each of the individual unit processes was sized using typical industry standards. Design criteria used for the unit process sizing can be found in **Table 7.**

Table 7| Design Criteria Used for the Unit Process Sizing

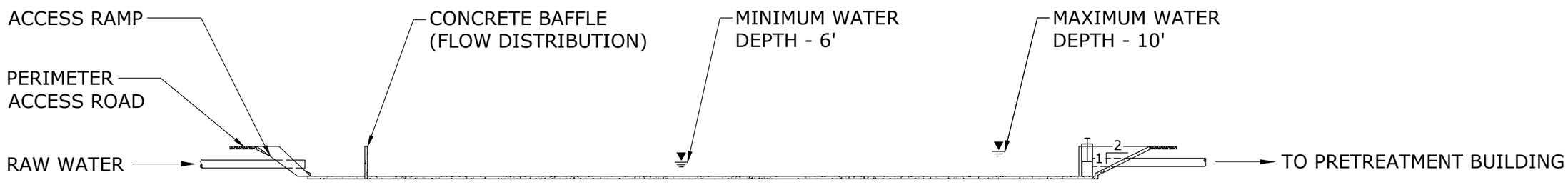
Criteria	Value
Design Flow (MGD)	**11.8**
Pre-sedimentation Pond	
Detention Time (hours)	3 (at minimum depth)
Volume (million gallon)	1.5
Depth (ft)	6 (min) 10 (max)
Plate Settler Building – Rapid Mix	
No. Stages	2
Detention Time (sec)	30 (per stage)
Plate Settler Building - Flocculation	
No. Basins	2
Detention Time (sec)	30
No. Stages	3
Plate Settler Building – Plate Settlers	
Clarification type	Plate settlers
Material	Stainless steel
Loading rate (gpm/ft^2)	0.35
Sludge Removal	Hoseless vacuum
Solids Holding Tank Volume (gal)	19,800

Pre-Sedimentation Pond

The pre-sedimentation pond was designed around a minimum depth of 6 feet (ft) to achieve the desired detention time and a maximum depth of 10 ft. The variable flow depth provides a degree of flow attenuation so the 18.2 cubic feet per second (cfs) water right can be maintained while individual unit processes can be reduced or briefly taken offline. The pond is designed around a 3 to 1 length to width ratio to minimize hydraulic dead zones. Concrete baffling will be installed immediately after the inlet to the structure to prevent short circuiting and encourage distribution of raw water across the entire width of the pond. The bottom slab of the pond will have a slight slope for routine cleaning and washdown if needed. Walls will consist of concrete poured at a 2 to 1 slope. A concrete drive will provide access to the pond when offline for excavation and other equipment for cleaning. The outlet of the pond will consist of a concrete structure housing two manually controlled slide gates for basin isolation. A conceptual layout of the pre-sedimentation pond can be found in **Figure 9**.



PRE-SEDIMENTATION POND PLAN VIEW
SCALE: 1"=20'



PRE-SEDIMENTATION POND SECTION VIEW A -
SCALE: 1"=20'

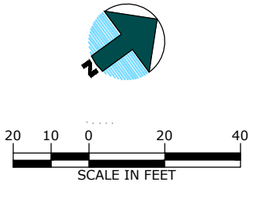


FIGURE 9

Outback Siting Study

Pre-Sedimentation Pond Plan and Section

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Pretreatment Building

Coagulation, flocculation, sedimentation, and sludge removal equipment will all be located in a common building along with chemical addition equipment and storage. The coagulation process consists of two-stage mechanical mixing housed in concrete basins. Two stages of mixing allows one stage to be turned off during times of low flow to provide a higher degree of control of mixing intensity. Flow from the rapid mixing basin is hydraulically split into two flocculation and sedimentation basins. Flow to each basin is controlled by manually operated slide gates. Slide gates also allow for isolation of each basin for basin drawdown, cleaning, and maintenance. Each flocculation basin consists of three stages of mixing by horizontal paddle mixers with tapering mixing intensity to encourage the formation of settleable floc particles. To accommodate horizontal paddle mixers, the flow will follow an over/under pattern created by baffle walls at each stage.

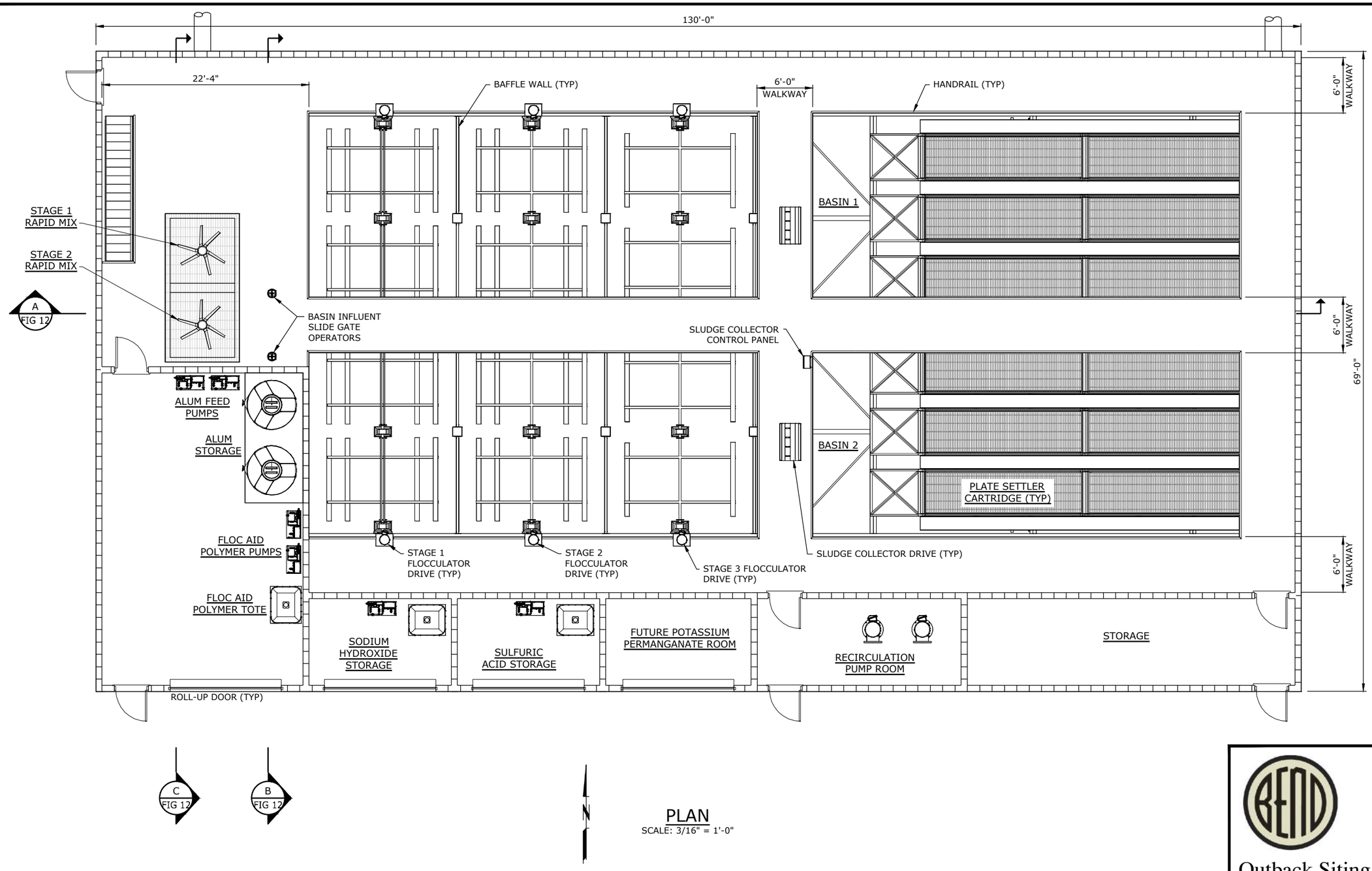
Clarification of the flocculated water is achieved by stainless steel plate settlers. Each basin houses six plate settler cartridges. Flow is passed through the cartridges and discharges into four shared effluent troughs. Discharge from effluent troughs from both basins is discharged into a common effluent channel. Each settling basin will be equipped with a sludge collector system for solids removal. Each collector will operate independently of each other and is expected to run once per day at a flow rate of 100-200 gpm for 30-45 minutes. A common control panel is located on the basin walkways for the sludge collection equipment

Upper level, lower level, and section views as well as a perspective view generated using three-dimensional (3D) modeling software of the pretreatment building can be found in Figure 10 through Figure 13. The upper-level building includes access to all motor drives with concrete walkways located around the pretreatment basins for washdown of the basins. Additional chemical storage is located on the upper level for the following chemicals:

- Alum
- Floc aid polymer
- Sodium hydroxide
- Sulfuric acid
- Potassium permanganate

The listed chemicals are currently used by the plant except potassium permanganate which is widely used in municipal applications for iron and manganese removal. The Outback facility does not currently have issues with iron and manganese; however, these contaminants can be elevated after wildfires in watersheds so provisions for storage and injection should be considered with pretreatment improvements.

Stairs to access the lower level of the building are located on the west end of the building. The flow control valve is located in the lower level on the raw water pipe entering the rapid mix structure. Sludge pumps are also accessed via the lower level and located in a dry space adjacent to the solids holding tank.



PLAN
SCALE: 3/16" = 1'-0"

FIGURE 10

Outback Siting Study

Outback WFF
Pretreatment Basins
Upper Level Plan

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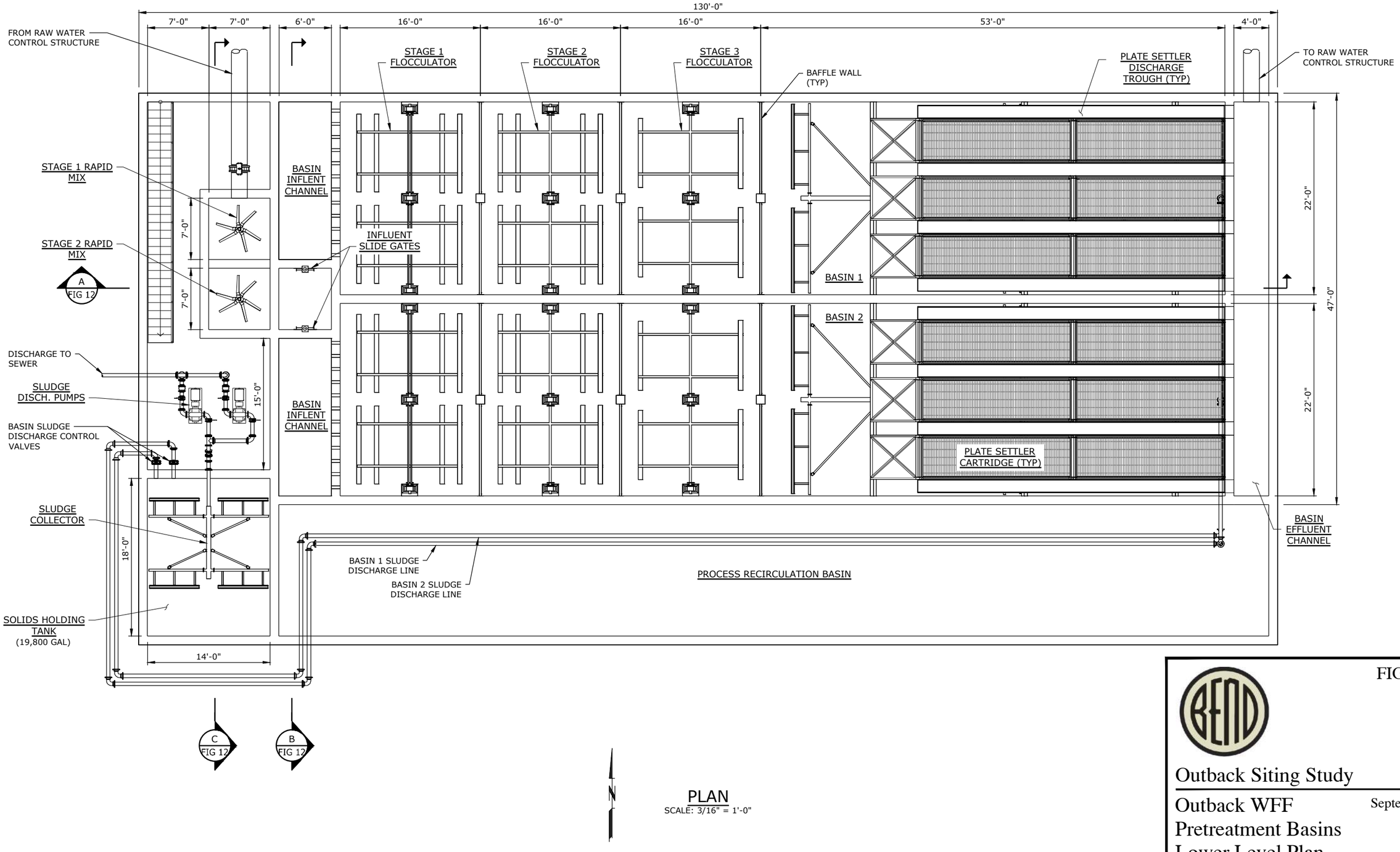

PLAN
SCALE: 3/16" = 1'-0"

FIGURE 11

Outback Siting Study

Outback WFF
Pretreatment Basins
Lower Level Plan

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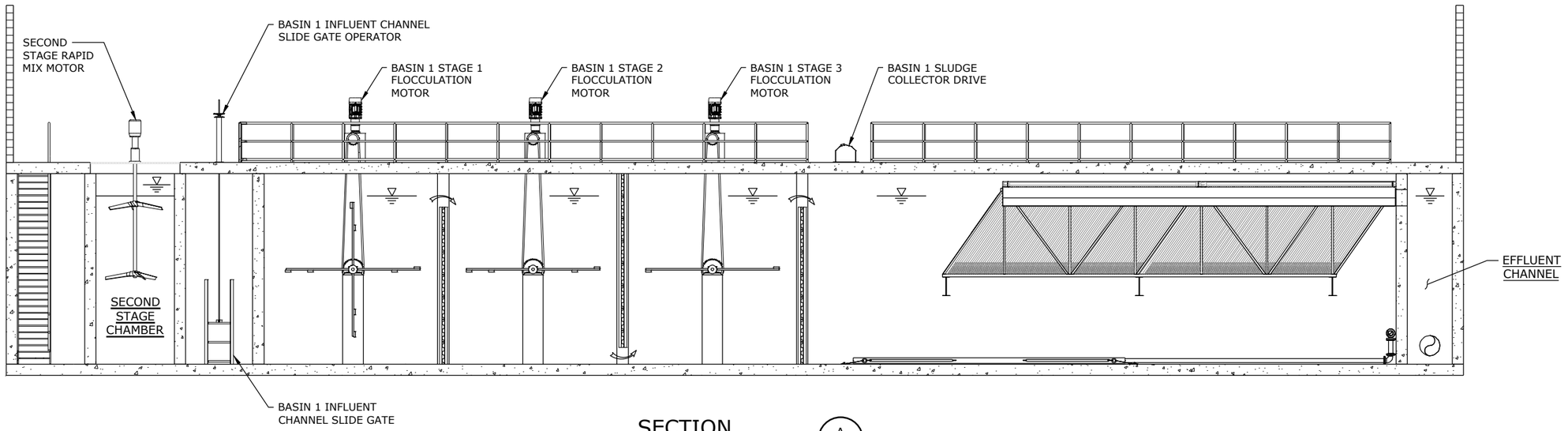
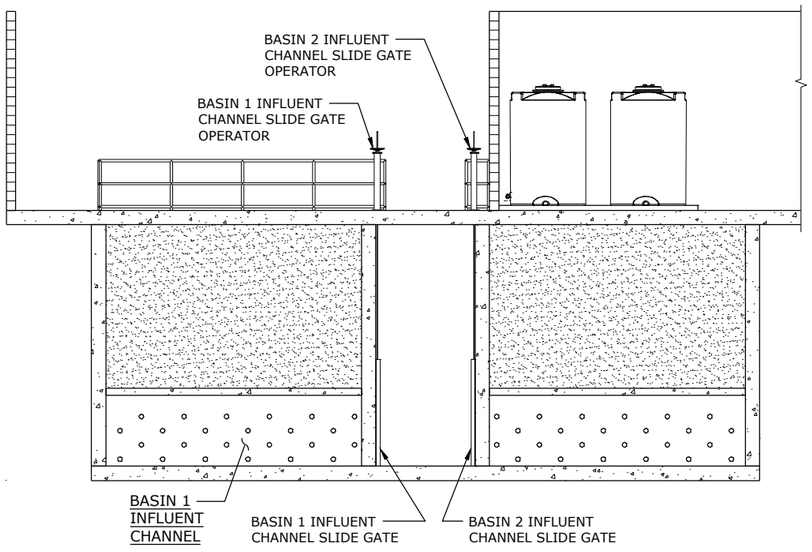
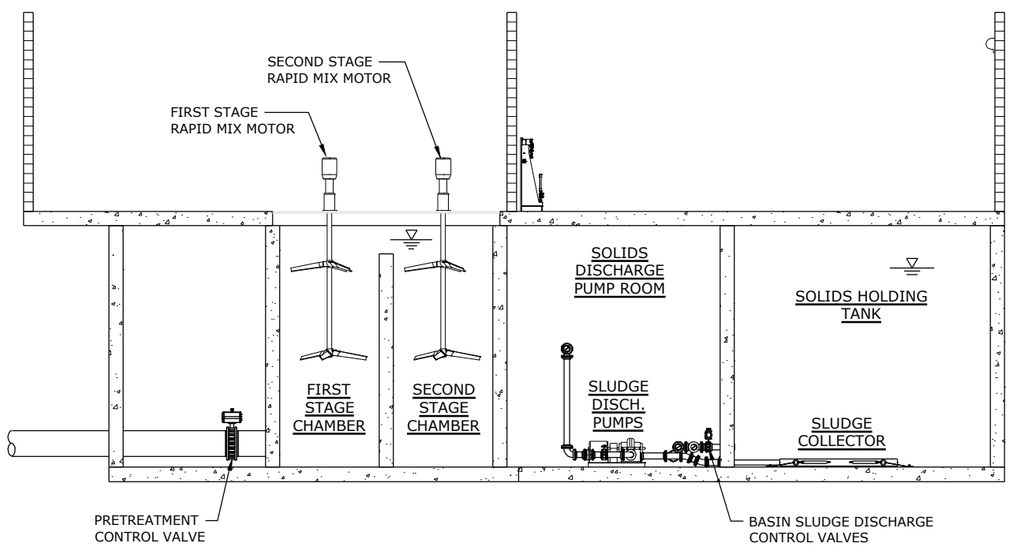
I:\BOI_Projects\19\2484 - Bend IWSMP\1400 Outback Siting Study\CAD\Figures\19-2484-014-OR-FIGURE 11.dwg FIGURE 11 9/16/2021 8:26 AM KENT.HARJALA 23.0s (LMS Tech)



SECTION
SCALE: 3/16" = 1'-0"
A
FIG 10/11



SECTION
SCALE: 3/16" = 1'-0"
B
FIG 10/11



SECTION
SCALE: 3/16" = 1'-0"
C
FIG 10/11

FIGURE 12

Outback Siting Study

Outback WFF
Pretreatment Basins
Elevations

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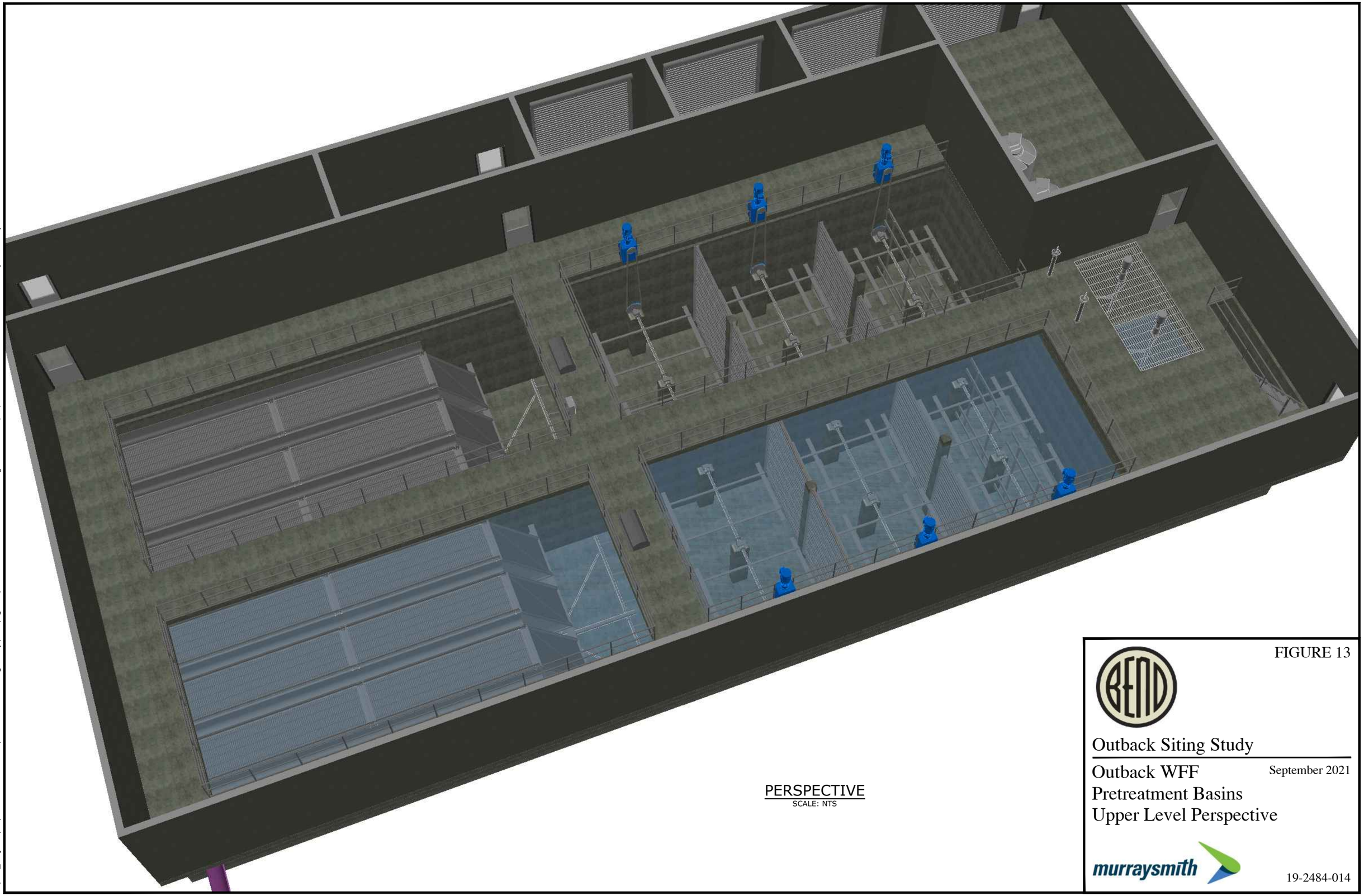

PERSPECTIVE
SCALE: NTS

FIGURE 13

Outback Siting Study

Outback WFF
Pretreatment Basins
Upper Level Perspective

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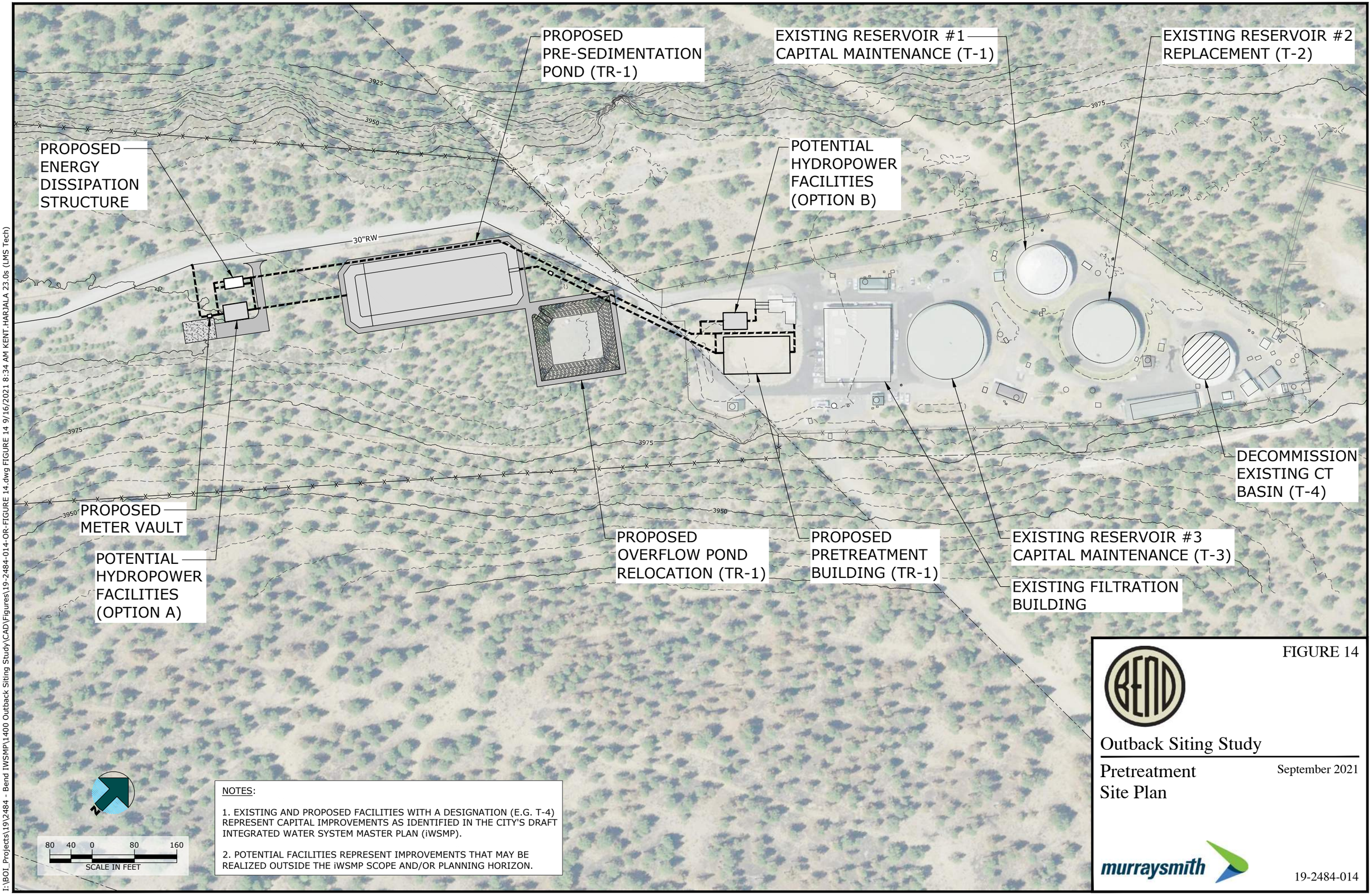
Siting

Location of the pretreatment building, and pre-sedimentation pond are shown in **Figure 14.**

The chosen pretreatment processes are relatively maintenance free, however, they still require visual check-ins by operations staff to monitor equipment and to observe the process. Though not required for adequate treatment, visual monitoring of floc formation can help treatment staff optimize the process, reduce chemical addition, reduce sludge formation, and increase treatment efficiency. Locating the pretreatment facilities as close to the existing filtration building as possible provides a more efficient site layout for operations staff and is more convenient for chemical deliveries. Piping connections to the existing raw water control structure and any possible electrical, process, and controls connection to the existing facilities are minimized by the proposed location.



NOTES:

1. EXISTING AND PROPOSED FACILITIES WITH A DESIGNATION (E.G. T-4) REPRESENT CAPITAL IMPROVEMENTS AS IDENTIFIED IN THE CITY'S DRAFT INTEGRATED WATER SYSTEM MASTER PLAN (iWSMP).

2. POTENTIAL FACILITIES REPRESENT IMPROVEMENTS THAT MAY BE REALIZED OUTSIDE THE iWSMP SCOPE AND/OR PLANNING HORIZON.

FIGURE 14

Outback Siting Study

Pretreatment Site Plan

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I:\BOI_Projects\19\2484 - Bend IWSMP\1400 Outback Siting Study\CAD\Figures\19-2484-014-OR-FIGURE 14.dwg FIGURE 14 9/16/2021 8:34 AM KENT.HARJALA 23.0s (LMS Tech)

Opinion of Probable Construction Costs

An Opinion of Probable Construction Costs (OPCC) was developed for the preferred pretreatment alternative using the cost methodology presented in the iWSMP, Chapter 6. Since schematic designs and layouts have been developed for the major components of the pretreatment process and used in the development of OPCC, the estimates represent AACE International Class 4, study/feasibility level, Estimate. The estimates include a 30% contingency, but do not include any property acquisition or environmental mitigation costs.

The true cost and resulting feasibility of the project will depend on the actual labor and material costs, competitive market conditions, site conditions, final project scope, implementation schedule, continuity of personnel, and other variable factors. Therefore, the actual unit project costs will vary from the estimates presented here. Because of these factors, project feasibility, benefit-to-cost ratios, risks, and funding must be carefully reviewed prior to making specific financial decisions or establishing project-specific budgets. The estimates are preliminary and are based on the level and detail of planning presented in this design memorandum and the conceptual design drawings. A summary of OPCC is present in Table 8 and detailed in **Appendix C**.

Table 8|Opinion of Probable Construction Costs

Item	Cost
Connection/Energy Dissipation	$1,286,000
Pre-Sedimentation	$5,133,000
Pretreatment Basin	$10,778,000
Overflow Pond Relocation	$904,000
Opinion of Probable Construction Cost	**18,101,000**
Engineering, Legal, and Admin (30%)	$5,430,000
Project Total	**$23,531,000**

Implementation

As shown, the existing Outback site does not accommodate the installation of the preferred pretreatment approach. Addition property is needed to accommodate the pre-sedimentation pond and the relocated overflow pond. With the pretreatment building located on the existing Outback site, in the existing overflow pond, there is the opportunity to construct the pretreatment improvements in two phases, allowing the installation of a portion of the pretreatment process on the existing Outback site.

Phase 1 improvements would include the construction of the new plater settler building in the existing overflow pond and existing site modifications. The existing energy dissipation structure would remain in service and supply water to the new plate settler process. A portion of the existing overflow pond could still be used and swales could be constructed on the north side and/or south side of the existing site as an interim measure to compensate for the loss in volume. A new overflow pond would be constructed in Phase 2. This initial phase would provide a high level of

resiliency for the Outback facility to respond to wildfires and climate change effects in the watershed without being delayed due to the acquisition of additional property.

Phase 2 improvements would be implemented once additional property is acquired. This phase would include construction of a new energy dissipation structure, pre-sedimentation pond, new overflow pond and all consequent piping modifications.

Hydroelectrical Power Generation

The raw water supply for the WFF at Outback consists of approximately 9.5 miles (50,000 feet) of 30-inch welded steel, high density polyethene (HDPE) and ductile iron (DI) pipe, the majority of which is welded steel. The conduit, constructed in 2012, connects the City's surface water intake on Bridge Creek to the Outback site, an elevation difference of approximately 1,017 feet. The raw water flow and elevation difference creates significant energy that is currently dissipated prior to the WFF using energy dissipation valves within the raw water control structure.

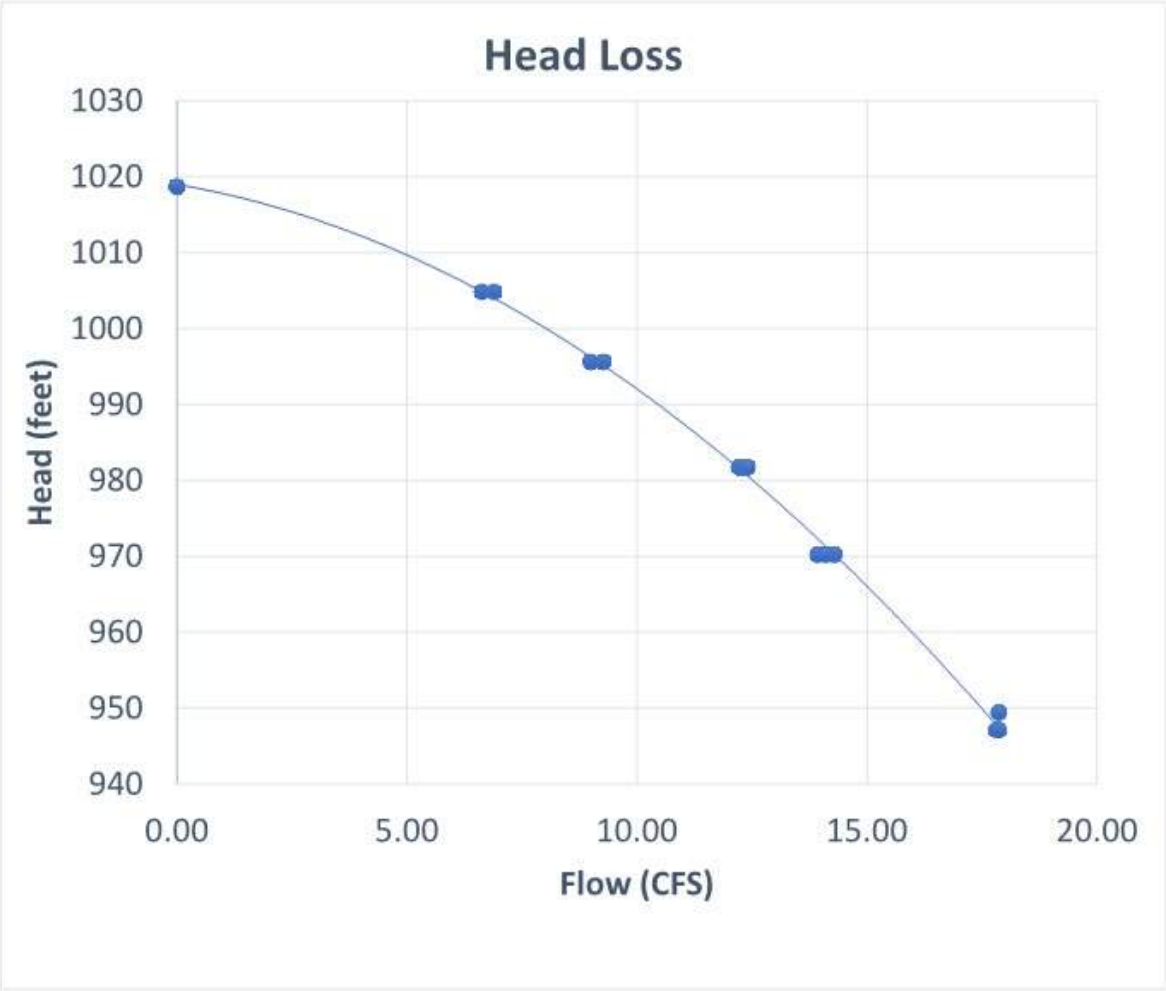
The objective of this section is to review the feasibility for siting of a hydropower generation facility at the Outback site in conjunction with the related improvements to take advantage of the energy associated with the delivery of raw water to the WFF. The feasibility review will focus on compatibility of hydropower with the existing and future water treatment facilities, especially the installation of future pretreatment components. The objective is to define a hydropower siting and operational concept that takes maximum advantage of the available energy and does not interfere or hinder the operation of the WFF.

Planning Criteria

The overarching planning criteria for hydropower is the compatibility with the operation of the WFF and future pretreatment components. Based on the pretreatment discussion in the previous section, the preferred pretreatment system will consist of a two-stage process, pre-sedimentation basin and pretreatment basin. Both processes operate as open channel flow, that is raw water will gravity flow through each basin and not require pressurization. Therefore, a hydropower facility would be located and operated upstream of any pretreatment facilities to provide the same function as the existing energy dissipation valves. The facility would dissipate the excess energy and discharge to atmosphere, flowing by gravity to pretreatment or the WFF.

Based on 2020 flow data from the City, which measured flow at the intake and pressure prior to the existing energy dissipation valves, a system curve was develop and is shown in **Figure 15**.

Figure 15|Raw Water Conduit System Curve



Based on the measured values and at flows near the City's available surface water right of 18.2 cfs, the available pressure in the conduit prior to energy dissipation is approximately 950 feet, or 410 pounds per square inch (psi).

A key consideration in the siting of a hydropower facility is the ability to by-pass flow at any time to maintain flow to the WFF in the event the turbine is offline. This will likely require use of energy dissipation valves in parallel with the hydropower facility; both would discharge to atmosphere and gravity flow into the pretreatment process.

Conceptual Layout

From the planning criteria a conceptual layout of the hydroelectric power system was developed to establish an understanding of the system configuration with respect to the existing WFF and proposed pretreatment improvements and potential costs. The layout was based on a Pelton type turbine with associated generation and control systems. The advantages of a Pelton turbine at the Outback site include:

- Simple design concept and simple to operate,
- Cost effective, capital cost and life cycle costs,
- Can operate with varying flow conditions,
- Discharges to atmosphere, and
- Easily by-passed without interruption of water supply

Key components to the hydropower facility include a powerhouse to house the turbine, generator and controls, and a switch yard adjacent to the powerhouse. Site piping would include an isolation valve on the existing raw water conduit, flow meter, piping to the turbine and by-pass piping with valving and energy dissipation. Site improvements would accommodate access to all components and security fencing around the switch yard.

As previously stated, the scope of this memo is to define the siting of a possible hydro power generation facility that will work in conjunction with planned pretreatment improvements. Additional analysis will be required to determine the power generation potential, construction costs, and overall economic feasibility of adding hydropower generation at the Outback site.

Integrated Water System Master Plan Elements

The iWSMP identified capital improvements for the City's water system to address system condition and hydraulic deficiencies to serve existing and 20-year projected demands. These include capital improvements at the Outback site. Improvements to the majority of existing facilities, wells, and reservoirs, have been identified over the next 20 years and beyond. New facilities at Outback have also been identified, they include pretreatment and a new Well 8. Other projects, that are not the result of hydraulic or condition deficiencies, but contribute to the capacity, condition and resilience of the water system and meeting the system level of service

criteria were also identified in the iWSMP. These projects include an Outback Facility Plan, land acquisition and hydropower.

A summary of capital improvement projects at the Outback site is provided in Table 10. A full list and description of the system wide Capital Improvement Plan is presented in Section 6 and project plates for each project are in Appendix 6D of the iWSMP.

Table 10|Outback Capital Improvement Projects (Draft)

Project ID	Project Name	Type of Improvement
Projects Years 2021 - 2030		
O-1	Outback Facility Plan	Planning
O-11	Outback Land Acquisition	Land Acquisition
O-4	Hydropower Feasibility Study	Power Generation
T-1	Outback Reservoir #1	Reservoir Capital Maintenance
T-18	Outback Reservoir #2, Interior Coating	Reservoir Capital Maintenance
T-4	Outback CT Basin	Decommission Reservoir
TR-1	Pretreatment	Treatment
W-1	Outback Well 1	Well Capital Maintenance
W-2	Outback Well 2	Well Capital Maintenance
Projects Years 2031 - 2040		
W-3	Outback Well 3	Well Capital Maintenance
W-4	Outback Well 4	Well Capital Maintenance
W-5	Outback Well 5	Well Capital Maintenance
Projects Beyond 2040		
P-1	Outback Site Transmission	New Pipe
P-2	Outback North Transmission Replacement	Upsize Pipe
T-2	Replacement Outback Reservoir #2	Reservoir Replacement
T-3	Outback Reservoir #3	Reservoir Capital Maintenance
W-6	Outback Well 6	Well Capital Maintenance
W-7	Outback Well 7	Well Capital Maintenance
W-8	New Outback Well	New Well

Potential Long-Term Outback Capital Needs

The objective of this section is to understand the potential long-term capital improvements, beyond the planning horizon of the current iWSMP, that may be implemented at the Outback site to support the resiliency, security, and sustainability of the City's water system.

Potential Facilities

The Outback site has been developed over the years to support the City's water system needs, in terms of water source, storage and associated support facilities. It is anticipated that with the

increasing water demands, exceptional source water quality and hydraulic conductivity with the distribution system the role of Outback will continue to evolve and grow.

The specific need for capital improvements, beyond the current planning horizon of the iWSMP, are difficult to predict. In a work session with City staff, potential system needs where discussed and inventoried to develop an understanding of potential demands on the current site and the need for additional property. These needs represent a 50-year planning horizon and focused on water source, storage, and associated support facilities, as well as site security and resiliency. Table 11 summarizes the potential facility needs at Outback developed in the work session with City staff.

Table 11|Potential Long-Term Outback Capital Projects (Beyond the iWSMP)

Potential Facility	Description
Wells	Potential expansion of the groundwater supply, taking advantage of the source protection and water quality at Outback. Multiple wells, including well house and associated piping.
Reservoirs	Expansion of finished water storage, maintaining the hydraulic gradient of the system. Multiple reservoirs, size, and type to be determined, associated piping.
Solids Drying Beds	To support the operation of the WFF. Concrete drying beds to accommodate solids from pretreatment process.
Operations	To support the operation of the water system. Reception, Operations Center, Conference Room, Server Room
Office/Staff Facilities	Office space/work areas, storage, work room, kitchen/break room, restrooms, showers, and laundry.) to support water system operations staff.
Training Center	40-person capacity, restrooms to conduct training of City staff and other activities.
Shop	To support the maintenance and operation of the water system. Maintenance building with work bench area, overhead doors with vehicle access, restroom
Warehouse/Storage Yard	To support the maintenance and operation of the water system. Storge building, two rooms, forklift accessible large parts room and adjacent storage yard.
Parking	Employee, Fleet and visitor.
Paved Access Road	Existing access along raw water pipeline. Separated from public access to improve year-round access.
FS 4606 Access Road	New access road from Skyliner Road to access FS Road 4606 and direct traffic away from Outback access road.
Tanker Fill Station	Water tanker fill station to support fire protection.

Other Site Considerations

In work sessions with City staff other site considerations were discussed to ensure the functionality and resiliency of the Outback site and the City's water system infrastructure. These site improvements include:

- Site security. As discussed, there is a significant amount of public activity around Outback. Site security must be maintained to protect the water system in accordance with Federal and State guidelines. Access gates and fencing will be required at the site. Recently the American Water and Infrastructure Act (AWIA) dictated all public utilities review their security goals and requirements and identify necessary improvements.

- Dedicated access off Skyliners Road. With the trail systems surrounding the Outback site, public use and activity in the area is high. The access to Outback is currently off Forest Service Road 4606, a road heavily used by the public for access and parking. The road is

also closed during portions of the year for wildlife management. The public activity and illegal parking, along with seasonal wildlife and road closures can create access challenges for the City. A separate access for Outback off Skyliners Road would eliminate this conflict and help to meet AWIA requirements

- Fire Proofing. Wildfire is a significant threat at Outback, especially with the amount of public activity in the area. Providing a tanker fill station will support fire proofing the site. Also, providing the area needed to create defendable spaces to protect water system assets will be required.

Outback Site Development

The existing site supports the current system infrastructure, but there is little room for additional capital improvements. The current site will accommodate a portion the pretreatment process identified in the iWSMP, however, additional property is needed to fully implement pretreatment.

The City's current SUP from the U.S. Forest Service (USFS) represents an additional 14 acres adjacent to the City's property but has limited purpose based on anticipated needs in 2002. When the SUP was issued, water treatment was not a consideration, site security requirements, pre 9/11, were minimal and fire conditions in the municipal watershed were not as extreme. With the changing conditions and priorities, the SUP no longer represents the current and long-term needs at Outback.

The Outback Site is located within Deschutes County's jurisdiction and any expansion of the site is subject to the County's land use review process. The property directly adjacent to the Outback Site, which is the most likely area for a potential expansion, is zoned Forest Use 1 (F1) and owned by the USFS. The City has had initial conversations with County staff regarding the entitlement process for the adjacent property, which suggest that a zone change from F1 to the Open Space & Conservation (OS&C) zoning district coupled with some specific text amendments may be the best route for entitlement of the property. Additionally, upon completion of the rezoning, the City will be exploring options to acquire the property from the USFS.

Considering all the potential needs at Outback, pretreatment, hydropower, iWSMP elements and future needs, a conceptual site plan was developed with City staff to promote an orderly and logical development of the Outback site, maximizing the use of the existing site, and minimizing the need for additional property. The following criteria was used in the development of the conceptual site plan:

- Sustainability - Creating an operationally efficient and functional site for current and future water supply and infrastructure assets and operations,

- Security - Protecting the City's water supply and infrastructure, meet requirements of the AWIA, and maintaining 24/7 secure site access

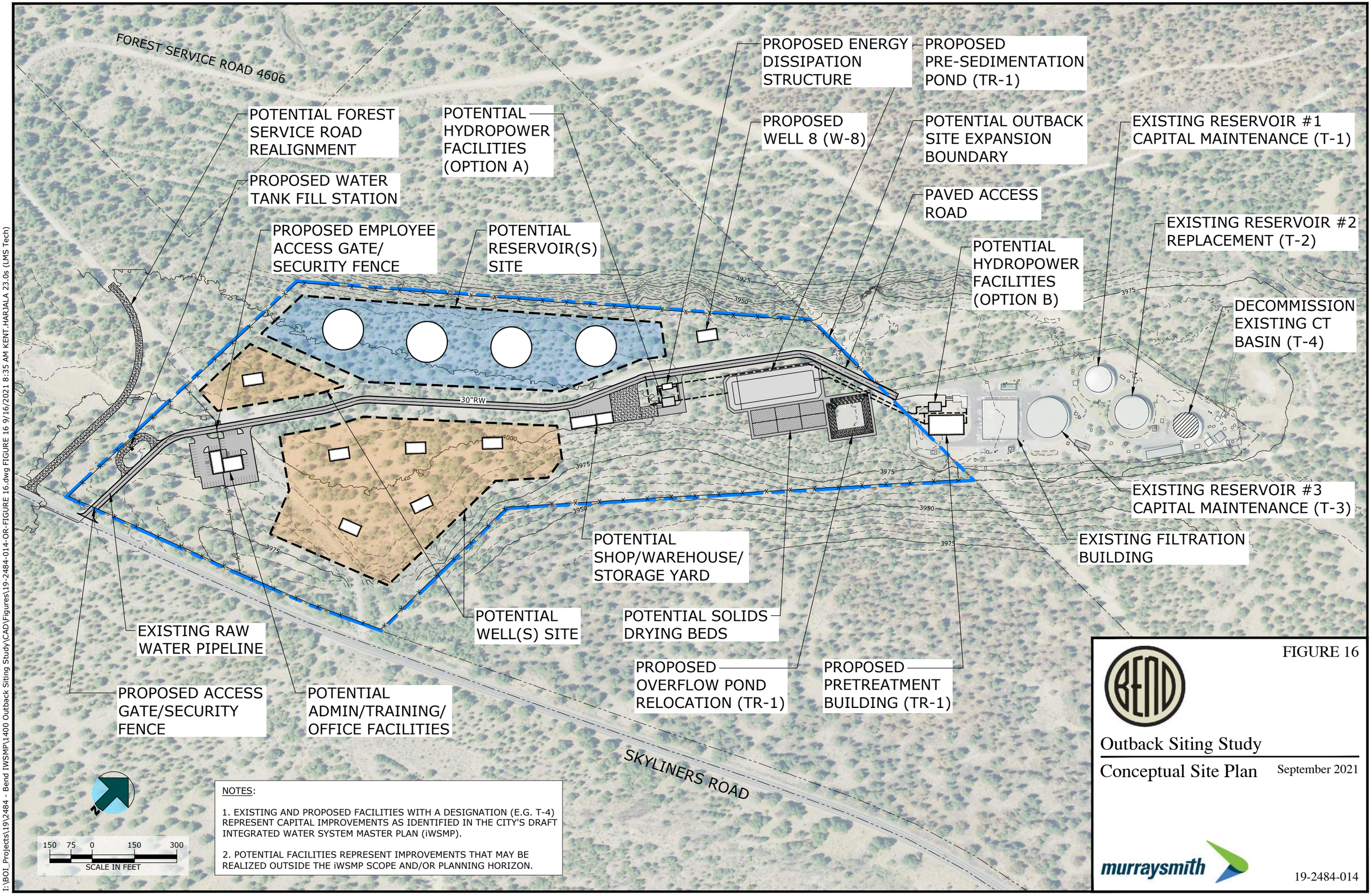
- Resiliency – Measures to address fire proofing and climate change,

- Alignment with the City's Community Climate Action Plan and Strategic Energy Management Plan

Conceptual Site Plan

The Conceptual Site Plan is shown in Figure 16. The site plan identifies the existing Outback site and assets, and identifies an area extending southwest from the exiting site to Skyliners Road to support capital improvements and potential future needs at Outback. This expanded area is approximately 50 acres and encompasses the ridgeline that extends from the existing Outback site.

The proposed site has a ground elevation similar to the existing site, therefore the hydraulic gradient of the system can be maintained, for both the raw water supply and finished water storage and distribution system. As shown in Figure 16, the site provides a direct connection to Skyliners Road and identifies the realignment of Forest Service Road 4606, securing the raw water pipeline route and providing the City a dedicated access from the road, eliminating conflict with public interests and activities.



NOTES:

1. EXISTING AND PROPOSED FACILITIES WITH A DESIGNATION (E.G. T-4) REPRESENT CAPITAL IMPROVEMENTS AS IDENTIFIED IN THE CITY'S DRAFT INTEGRATED WATER SYSTEM MASTER PLAN (iWSMP).

2. POTENTIAL FACILITIES REPRESENT IMPROVEMENTS THAT MAY BE REALIZED OUTSIDE THE iWSMP SCOPE AND/OR PLANNING HORIZON.

FIGURE 16

Outback Siting Study

Conceptual Site Plan

September 2021

murraysmith

19-2484-014

I:\BOI_Projects\19\2484 - Bend IWSMP\1400 Outback Siting Study\CAD\Figures\19-2484-014-OR-FIGURE 16.dwg FIGURE 16 9/16/2021 8:35 AM KENT.HARJALA 23.0s (LMS Tech)

Summary

Pretreatment

Concerns about the long-term resiliency to treat water after events in the watershed have been raised by City staff. Pretreatment upstream of the existing membrane filtration identified as a solution. Through workshops with City staff a pretreatment solution was identified for the WFF at Outback. The solution incorporated two pretreatment technologies, sedimentation and enhanced sedimentation with a pre-sedimentation basin and pretreatment basin. This two-stage process will provide the City a more resilient water supply and treatment process that will improve raw water quality to the WFF, improve finish water quality, increase the life of the existing membrane elements, and allow the WFF to continue to operate when raw water quality is degraded. The pretreatment solution is compatible with a hydropower facility, if pursued.

The two-stage process cannot be accommodated at the current Outback site. The ideal location for the pretreatment basin is immediately upstream of the WFF, at the current overflow pond location, and therefore can be constructed within the current site. The pre-sedimentation basin and the relocated overflow pond will require additional property.

The location of the pretreatment basin within the current Outback site provides the City the opportunity to consider phasing the pretreatment improvements, with the initial phase being the pretreatment basin. This would allow the City to put in a portion of the pretreatment as soon as practical, without the need to acquire property. Provisions would need to be made for relocating a portion of the existing overflow on the existing site, which could be accommodated with a swale along the northwest or southeast property boundary.

Conceptual Outback Site Development

Taking into consideration the current and future needs at Outback, a vision for the longer-term development of the Outback site was developed with City staff. Based on the needs, iWSMP elements and potential future needs beyond the iWSMP planning horizon, and a focus on sustainability, security and resiliency, a conceptual site plan was developed, Figure 16.

The conceptual site plan identifies the need for an additional 50 acres, extending southwest from the existing site to Skyliners Road. The proposed site provides the area needed to accommodate planned and potential water supply and infrastructure improvements as well as measures for site security and resiliency. The site also accommodates the hydraulic gradient of the existing system and a provides a dedicated and secure access to the Outback site.

Next Steps

The Outback Siting Study is the first step in the development of a Facility Plan for Outback. A Facility Plan will take the concepts developed in the Siting Study and the iWSMP and further develop and evaluate them, to provide greater definition, opinions of cost and implementation strategies. The Facility Plan will consider all facilities and processes at the Outback site and will likely include

system modeling to confirm system hydraulics and sizing of components. The Facility Plan will define the necessary environmental reviews, permitting, agency approvals and processes and prioritize facility improvements, and will define projects that can be advanced to the design and construction phases.

As discussed, there is the option to implement the first phase of pretreatment if so desired by the City. With the potential for wildfires or other events in the watershed, the City may elect to pursue the initial phase of pretreatment prior to the completion of a Facility Plan. Implementation of the initial phase of pretreatment will not impact the overall development of the Facility Plan or the site since the preferred location of the proposed pretreatment basin is on the exiting Outback site.

Attachments:

Appendix A – Pretreatment Alternatives Workshop Presentation

Appendix B – Site Development Workshop Presentation

Appendix C – Pretreatment Opinion of Probable Construction Costs

Appendix D – Special Use Permit

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APPENDIX A

Pretreatment Alternatives Workshop Presentation

1/27/21

City of Bend

Pretreatment Alternatives Workshop

1

Agenda/Objective

Agenda

- Pretreatment overview
  - Goals/Objectives
  - Technical overview
- Alternatives review
  - Pre-sedimentation ponds
  - Ballasted Sedimentation (Actiflo)
  - Plate Settlers
  - Evaluation Matrix
- Next steps

2

Project Goals

Parameter	Goal
TOC Removal	Remove dissolved organic carbon
Turbidity Removal	<1 NTU 95% of time, treat raw water events up to 500 NTU
Color Removal	< 5 color units
Fire Resiliency	Maximize ability to treat runoff after fire in watershed (elevated DOC, Turbidity, T&O issues, change in water chemistry)
Operational Intensity	Minimize operator time
Energy Requirements/Sustainability	Meet City requirements/standards
Hydro Electric Power	Compatibility

3

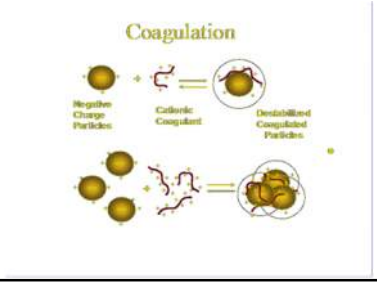
Water Quality Impacts

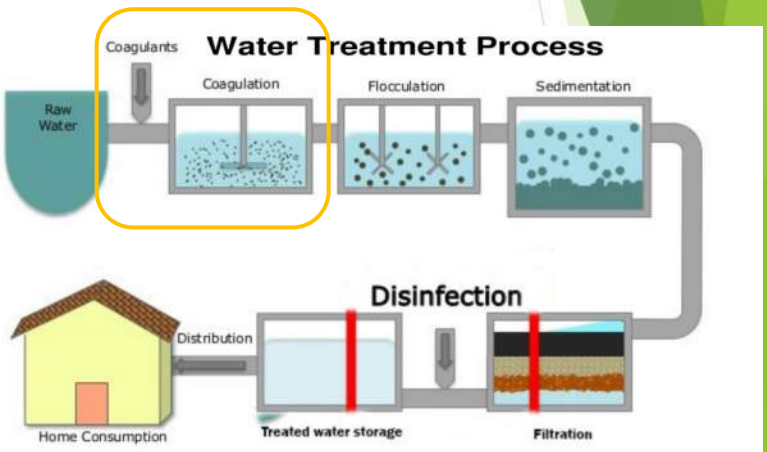
Event	Water Quality Impacts
Forest Fire	Turbidity, TOC, Color, Taste & Odor
Landslide	Turbidity, Iron and Manganese
Algal Bloom	Taste & Odor (algal toxins)
Future Regulations	
Contaminants of Emerging Concerns	TOC Removal
Disinfection By Products	TOC Removal
Lower Lead Levels	TOC Removal

4

Coagulation Overview

Objective
- Effectively disperse coagulant
- High mixing intensity
- Mechanical or hydraulic mixing
- Absorption to soluble particles
- Destabilize particles (charge neutralization)





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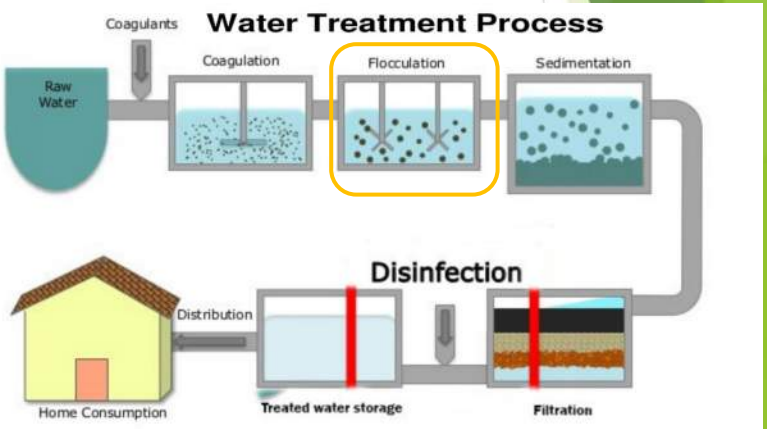
Flocculation Overview

Objective
- Increase particle size by inducing collisions
- Low (and decreasing) mixing intensity



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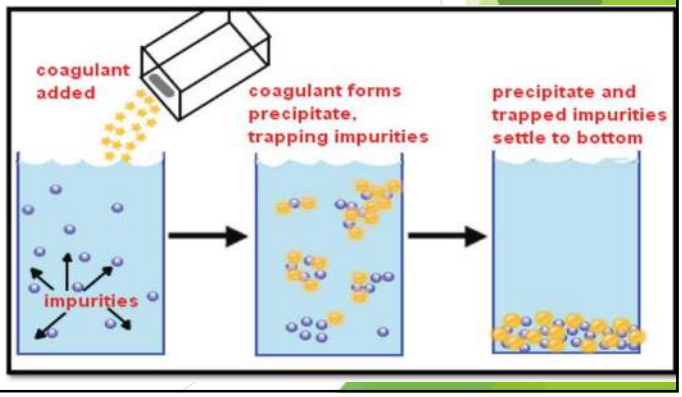
Settling Overview

- Gravity settling
- Rectangular or circular basins.
- Two parameters
  - Overflow rate
  - Detention time.
- Conventional settling = long detention times
- Mechanically intensive
  - Clarification
  - Sludge removal



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Sedimentation Overview

- Stokes Law

$$V_s = \frac{2(\rho_\vartheta - \rho_f)}{9\mu} gR^2$$

ρ_ϑ = Density of particle
ρ_ϑ = Density of liquid
μ= viscosity of fluid
G = gravity
R = radius of particle

Rate of settling in pure, still water (temp=10°C, sp. gravity of particles=2.65, shape of particles=spherical) (Welch, 1935)

Material	Diameter (mm)	Hydraulic subsiding value (mm/sec)	Time required to settle 1 ft.
Gravel	10.0	1000.0	0.3 sec
Coarse sand	1.0	100.0	3.0 sec
Fine sand	0.1	8.0	38.0 sec
Silt	0.01	0.154	33.0 min
Bacteria	0.001	0.00154	55.0 hr
Clay	0.0001	0.0000154	230.0 days
colloidal particles	0.00001	0.000000154	63 years

Settling dominated by:
- Water temperature
- Coagulation and flocculation effectiveness (particle size)

8

Pretreatment Alternatives

- Pre-sedimentation Ponds
- Ballasted Sedimentation (Actiflo)
- Plate Settlers
- Upflow Clarifier
- Pulsed Sludge Blanket Clarification
- Dissolved Air Flotation (DAF)

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Pre-sedimentation Ponds

Overview:

- Basic clarification process
- Open basin
- Large detention time
- Sedimentation only
- No chemical addition

10

Ballasted Sedimentation

Overview:
- Uses coagulation/flocculation/sedimentation (plate settlers)
- Sand addition
- Small footprint

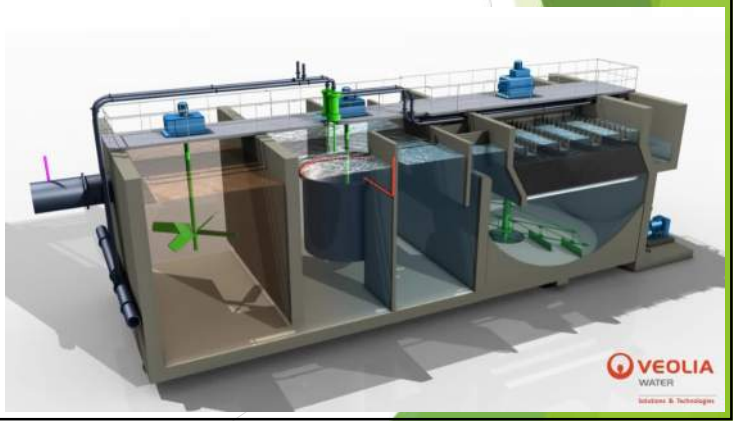

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Plate Settlers

Overview:
- Settling process
- Inclined plates
- Paired with standard coagulation/flocculation process
- Stainless steel construction
- Typically hydraulic sludge removal

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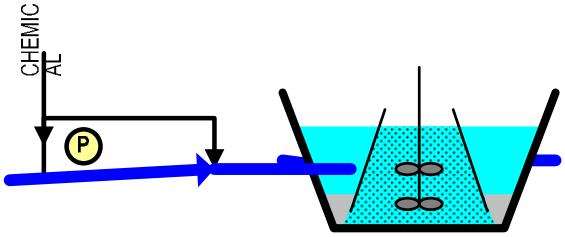
Upflow Clarifier

Overview:
- Coagulation/flocculation/sedimentation in one tank
- Coagulant addition
- Upward flow through sludge blanket



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Pulsed Sludge Blanket Clarification

Overview:
- Coagulation tank
- Coagulant addition (and possibly polymer)
- flocculation/sedimentation in one tank
- Vacuum pulsation flow
- Sludge blanket

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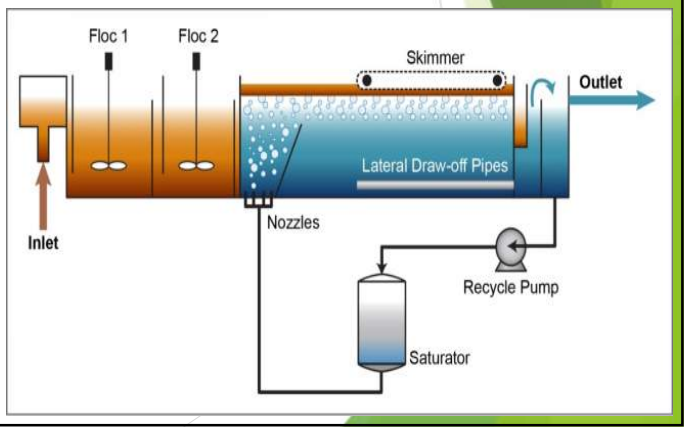
Dissolved Air Flotation

Overview:
- Coagulation tank
- Flocculation zone
- Clarification through flotation
- Air addition
- Low density flocs/contaminants
  - Algae
- Mechanical sludge removal (scraper)



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Alternatives

Feasible Alternatives
- Pre-sedimentation Ponds
- Ballasted Sedimentation (Actiflo)
- Plate Settlers

Other Alternatives
- Upflow Clarifiers
- Pulsed Sludge Blanket Clarification
- Dissolved Air Flotation (DAF)

16

Selected Alternatives

- Process Overview
- Basis of design
- Advantages/Disadvantages
- Process Layout
- Site layout

17

Pre-sedimentation Ponds

- Goal: Reduce raw water turbidity prior to downstream treatment processes
- No chemical addition
- Typically upstream of pretreatment processes during
- High turbidity or other natural events
- Efficiency dominated by detention time

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Pre-sedimentation Ponds

- Basis of design:
  - Minimum of 3 hours detention time (10-State Standards)
  - Maximum size based on available land
  - Hydraulically optimized
  - No chemical addition
  - No particle destabilization

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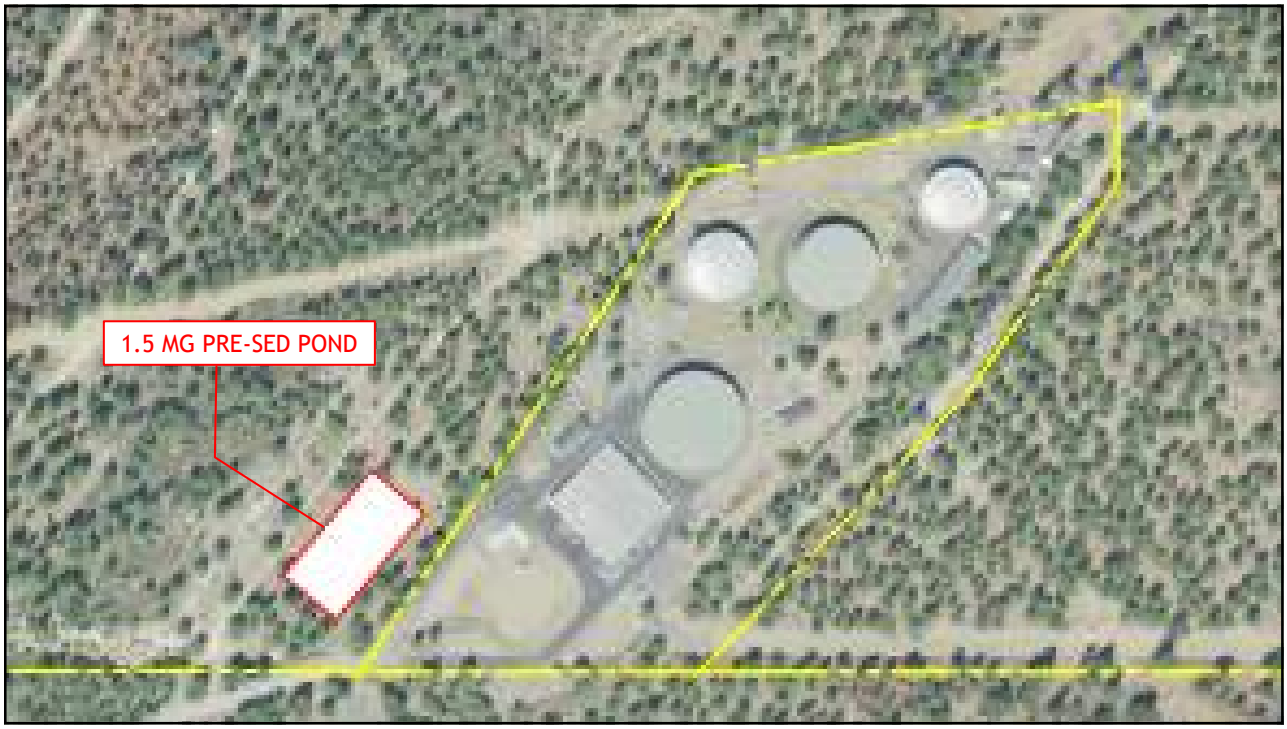
Pre-sedimentation Ponds

- Advantages
  - Simplicity
  - Provides flow attenuation
  - Can help storm and fire events
- Disadvantages
  - No DOC removal
  - No particle destabilization
  - Particle removal efficiency dependent on particles size, water temperature
  - Large footprint
  - Manual sludge removal

20



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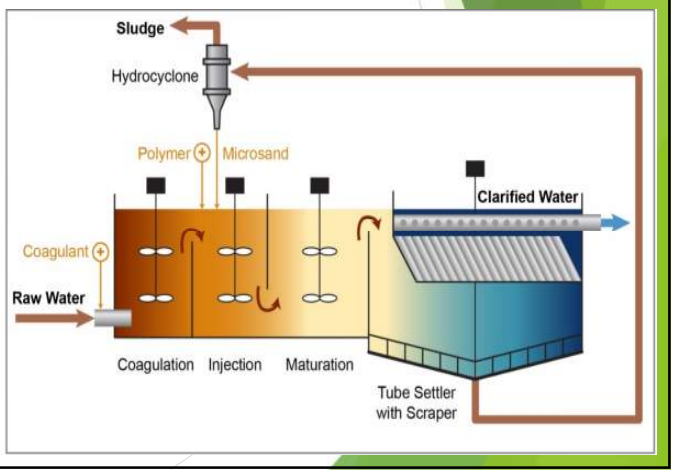
Ballasted Sedimentation

Process Overview
- Utilizes micro-sand and polymer
- Increased particle specific gravity
  - Enhanced settling
- Higher sedimentation rate
  - Reduced required footprint
- Proprietary system



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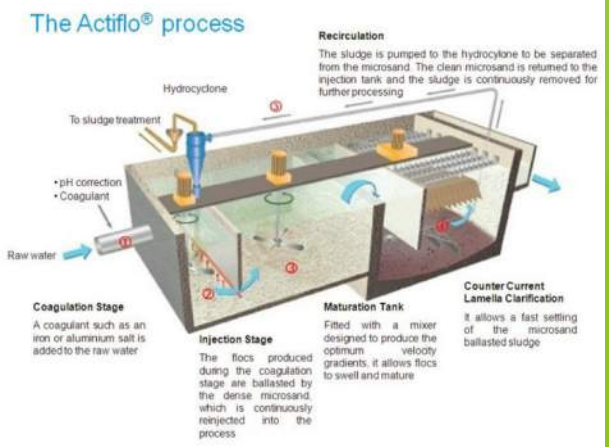
Ballasted Sedimentation

Basis of design:

- Detention times
  - Rapid mix
  - Injection
  - Maturation tanks
- Lamella settler overflow rate
- Mixing intensity
- Sand recirculation ratio
- System recovery
- Solids handling
- Materials of construction



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Ballasted Sedimentation

- Advantages
  - Rapid start-up (30 to 60 minutes)
  - Rapid water quality changes
  - Highly effective treatment:
    - High turbidity
    - Rapidly changing conditions
    - Low turbidity, highly color
- Disadvantages
  - Mechanically intensive
  - Requires operator expertise:
    - Recycle stream
    - Prompt operator response
  - Coagulant dose dependent
  - pH dependent
  - Polymer dependent

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Ballasted Sedimentation

Process Flow/Typical Layout

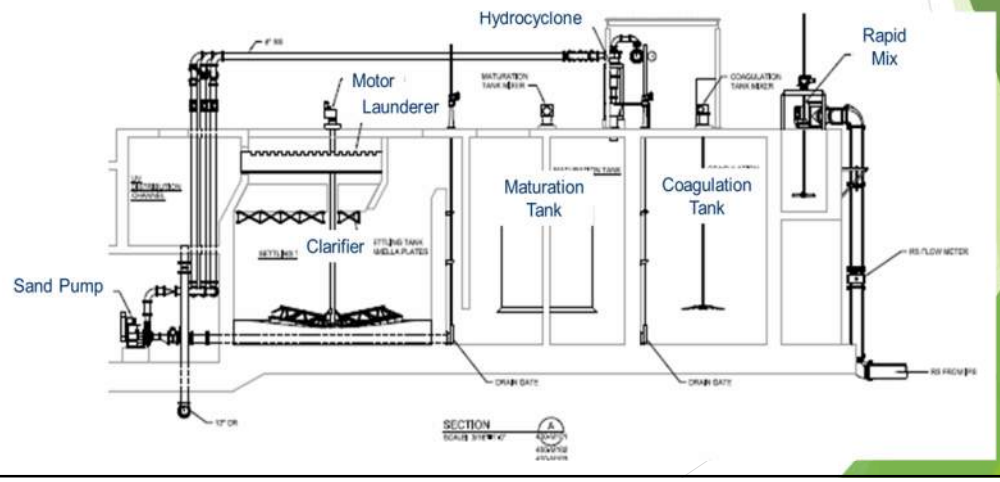

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Plate Settlers

Process Overview
- Sedimentation process
- Cartridges of inclined plates
- Reduced particle paths
  - Enhanced settling
- System consists of the following subsystems:
  - Inlet distribution
  - Plate settlers
  - Effluent collection
  - Sludge removal
- Upflow velocity < settling velocity
- Requires coagulation/flocculation
- Multiple manufacturers

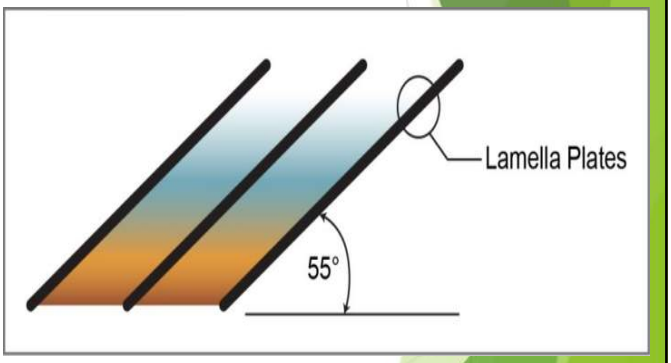

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Plate Settlers

Basis of Design
- Loading rates based on projected plate area:
  - 0.3 gpm/ft^2 typical for conventional filtration
  - 0.35 gpm/ft^2 typical for membrane filtration
  - 2 basins
  - 10 ft quiescent zone
- Flocculation
  - 30 minutes detention time
  - 3 stages
  - Paddle flocculation
- Coagulation
  - 60 seconds detention time total
  - 2 stages
  - Mechanical mixing

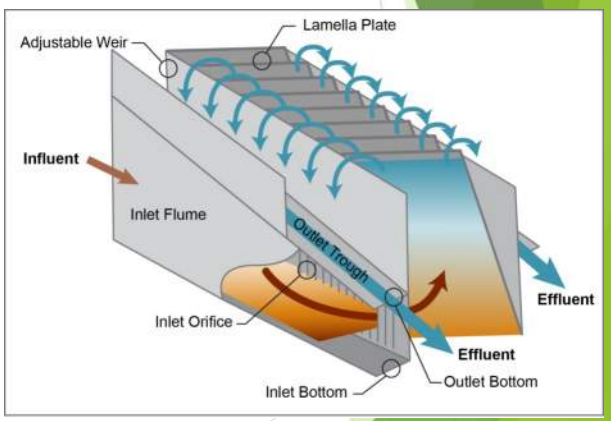

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Plate Settlers

Advantages
- Increased surfing loading (over standard settling basin)
- Variety of raw water treatment
- Low maintenance
- Mechanically simple
- Proven performance (< 5 NTU)
- Variety of flow rates
- Simple construction

- Disadvantages
  - Sludge removal maintenance

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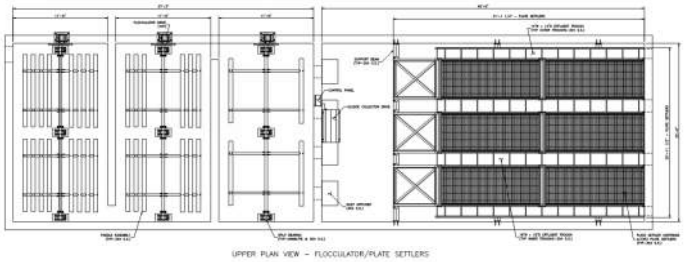
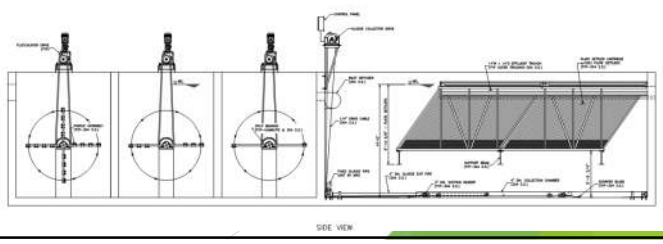
Plate Settlers

Basin Layout/Process Flow
- 16’ water depth
- 22’ basin width
- 2 basins
- 48’ flocculation basin (length)
- 50’ sedimentation basin (length)





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Evaluation Introduction

- Evaluation criteria
  - 1 through 5 scoring
    - 5 – most favorable
    - 1 – least favorable
  - Score weighting
    - 1 through 3
      - 3 - Greatest importance
      - 2 – Moderate importance
      - 1 – Least importance
  - Combined in scoring matrix

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Evaluation Criteria

Evaluation Criteria

- Capital costs
- Life cycle costs
- Redundancy/Failure Resiliency
- TOC removal efficiency
- Turbidity removal efficiency
- Color removal efficiency
- T&O removal efficiency
- Disinfection byproduct reduction
- Future regulatory compliance
- Flow attenuation capability
- Complexity of operation
- Power use
- Process footprint
- Proprietary parts/spare parts availability
- Ease of implementation
- Compatibility with hydroelectric power generation

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Scoring Matrix Weighting

Evaluation Criteria	Criteria Weighting Score
Capital costs	2
Life cycle costs	2
Redundancy/Failure resiliency	2
TOC removal efficiency	3
Turbidity removal efficiency	3
Color removal efficiency	3
T&O removal efficiency	2
Disinfection byproduct reduction	2
Future regulatory compliance	3
Flow attenuation capability	2
Complexity of operation	2
Power use	3
Process footprint	3
Proprietary parts/spare parts	3
Easy of implementation	2
Hydropower Compatibility	3

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Scoring Matrix

Pretreatment Alternatives Evaluation Matrix							
	Criteria Weighting Factor	Alternative 1 - Pre-Sed Ponds		Alternative 2 - Actiflo		Alternative 3 - Plate Settlers	
		Raw Score	Weighted Score	Raw Score	Weighted Score	Raw Score	Weighted Score
Capital Costs	1	1	1	1	1	1	1
Life Cycle Costs	1	1	1	1	1	1	1
Redundancy/Resiliency	1	1	1	1	1	1	1
TOC Removal Efficiency	1	1	1	1	1	1	1
Turbidity Removal Efficiency	1	1	1	1	1	1	1
Color Removal Efficiency	1	1	1	1	1	1	1
T&O Removal Efficiency	1	1	1	1	1	1	1
DBP Reduction	1	1	1	1	1	1	1
Future Regulatory Compliance	1	1	1	1	1	1	1
Flow Attenuation	1	1	1	1	1	1	1
Complexity of Operations	1	1	1	1	1	1	1
Power Use	1	1	1	1	1	1	1
Process Footprint	1	1	1	1	1	1	1
Proprietary parts/spare parts	1	1	1	1	1	1	1
Ease of Implementation	1	1	1	1	1	1	1
Hydropower Compatability	1	1	1	1	1	1	1
Total Weighted Scores:		13	**13**	13	**13**	13	**13**
			3 = Greatest Importance			High Score =Favorabe	
Weighting Factors:			2 = Moderate Importance			Low Score = Least Favorable	
			1 = Least Importance				

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Next steps

- Send out matrix and scoring
- Finalize alternatives scoring
- Finalize selection
- Further develop alternative (pre-design)
  - Develop costs

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APPENDIX B

Site Development Workshop Presentation

3/9/21

City of Bend

Outback Site Development Workshop

1

Agenda/Objective

Agenda

- Pretreatment Alternatives Workshop Review
- Site Development components
  - Pretreatment
  - Hydropower
  - iWSMP Capital Improvements
  - Other considerations
- Site Development Evaluation
  - Hydraulic Profile
  - Process Flow Schematic
  - Site Development Considerations
  - Site Development Alternatives
- Next steps

2

Pretreatment Alternatives Workshop Recap

- Reviewed project goals and design criteria
- Pretreatment process overview
- Pretreatment alternatives
- Evaluation of alternatives
- Selection of preferred alternative

3

Scoring Matrix

Pretreatment Alternatives Evaluation Matrix							
	Criteria Weighting Factor	**Alternative 1 - Pre-Sed Ponds**		**Alternative 2 - Actiflo**		**Alternative 3 - Plate Settlers**	
		Raw Score	Weighted Score	Raw Score	Weighted Score	Raw Score	Weighted Score
Capital Costs	3	5	15	3	9	2	6
Life Cycle Costs	3	5	15	2	6	3	9
Redundancy/Resiliency	3	2	6	4	12	5	15
TOC Removal Efficiency	3	2	6	4	12	4	12
Turbidity Removal Efficiency	3	2	6	5	15	4	12
Color Removal Efficiency	3	1	3	4	12	4	12
T&O Removal Efficiency	2	1	2	3	6	3	6
DBP Reduction	2	2	4	4	8	4	8
Future Regulatory Compliance	3	1	3	4	12	4	12
Flow Attenuation	2	5	10	1	2	3	6
Complexity of Operations	3	5	15	2	6	4	12
Power Use	3	5	15	2	6	3	9
Process Footprint	1	1	1	5	5	3	3
Proprietary parts/spare parts	3	5	15	2	6	4	12
Ease of Implementation	2	1	2	3	6	5	10
Hydropower Compatability	3	5	15	5	15	5	15
Total Weighted Scores:		48	**133**	53	**138**	60	**159**

Weighting Factors:
3 = Greatest Importance
2 = Moderate Importance
1 = Least Importance

High Score =Favorable
Low Score = Least Favorable

4

Preferred Alternative

Plate Settlers with Sedimentation Pond

5

Purpose of Workshop

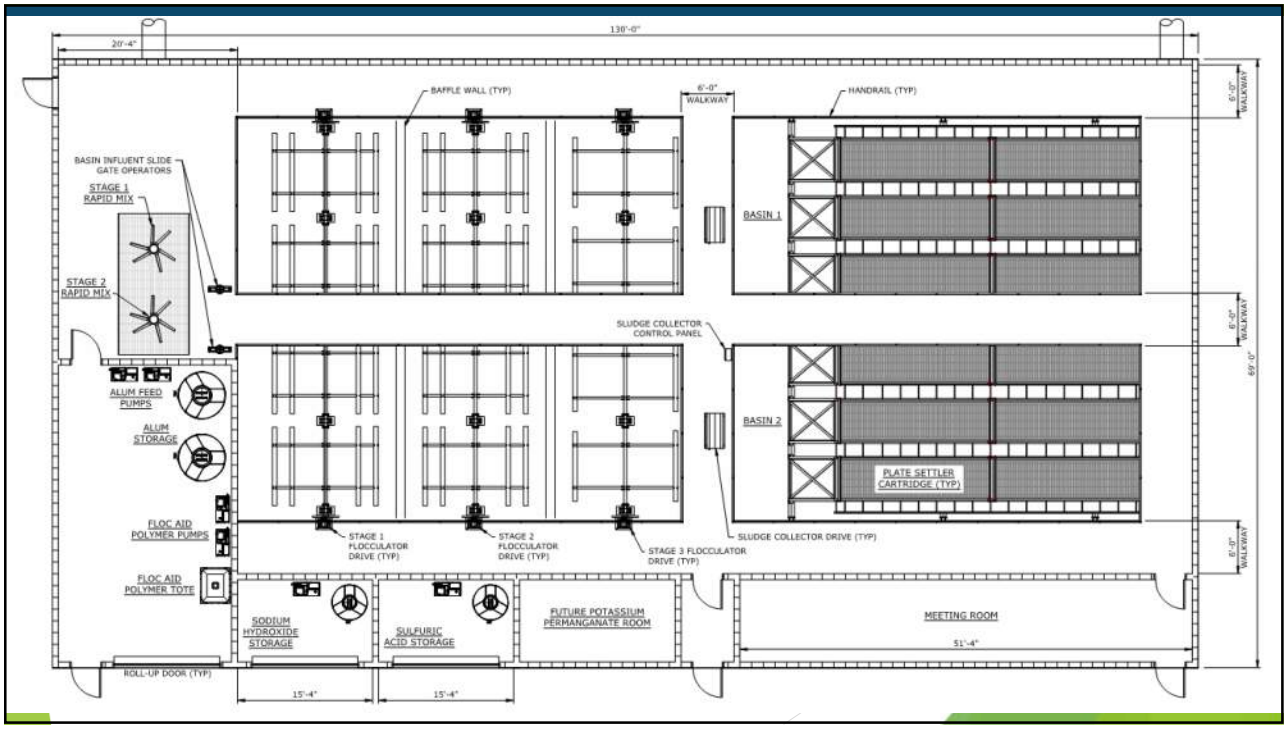
- Review options to incorporate improvements at site.
- Obtain staff input.
- Define a preferred site layout.

6

Key Considerations

- Pretreatment
- Hydropower
- iWSMP Capital Improvements
- Understanding other needs

7



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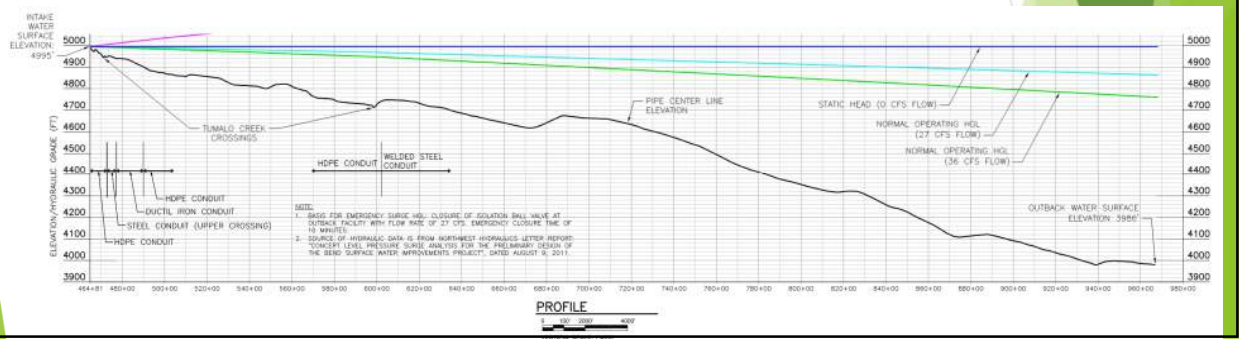
Pretreatment – Sedimentation

- Variable water level
  - 6 ft min depth
  - 10 ft max depth
- Storage Volume
  - 1.5 MG at min depth
  - 2.6 MG at max depth
- 135’ x 345’ (1.06 acre)

9

Hydropower

- Proof of concept
- Compatibility with pretreatment
- Design conditions
  - 1,000 feet of static head
  - 4 - 11.8 mgd



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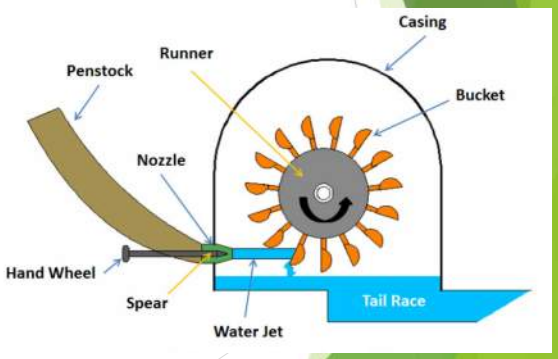
Hydropower - Alternatives

Pelton Turbine



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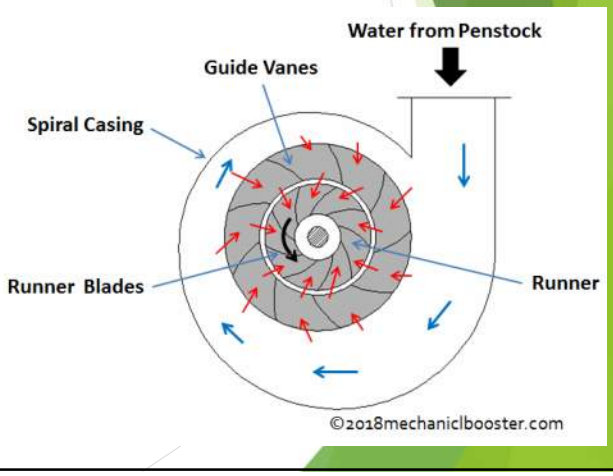
Hydropower - Alternatives

Francis Turbine



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Hydropower - Concept

- Pelton Turbine appears to be most favorable
  - Simple
  - Cost effective
- Key considerations
  - Hydraulic conditions – free discharge
  - Powerhouse
  - Switch yard
  - By-pass

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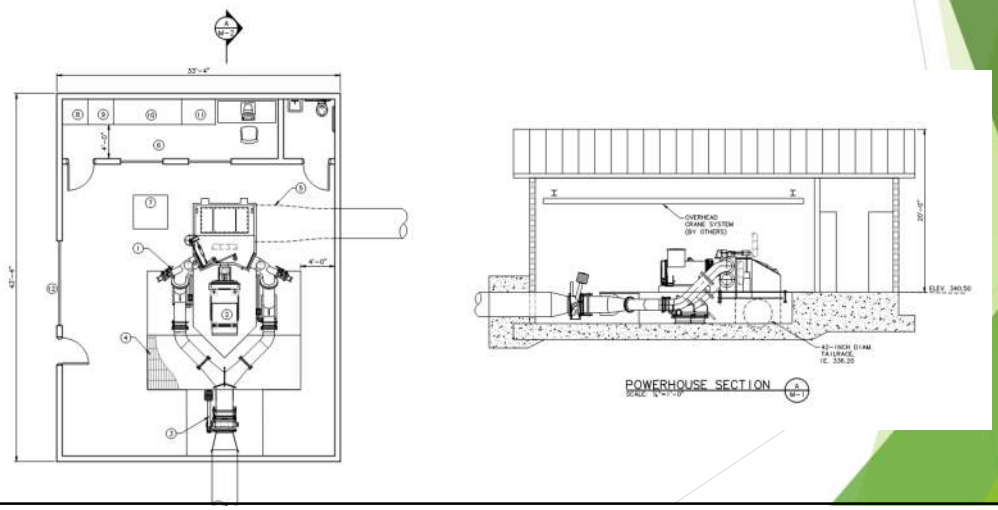
Hydropower - Concept



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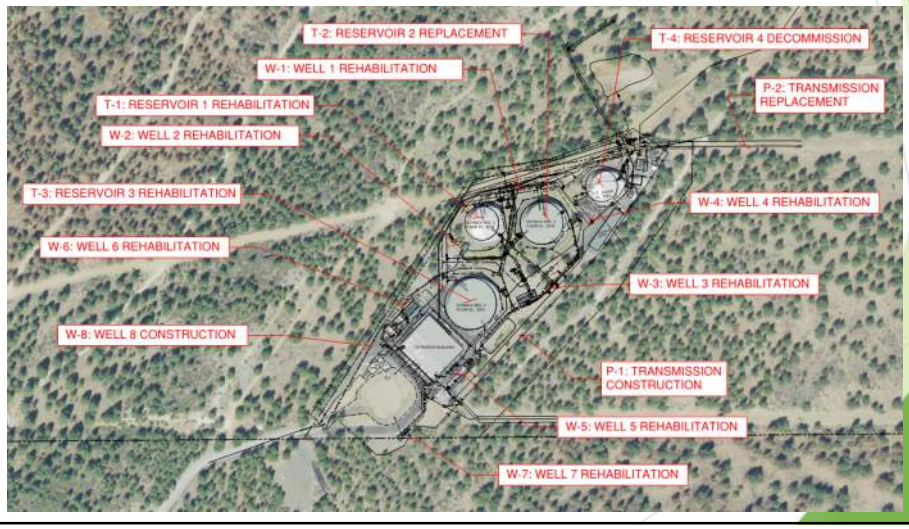
iWSMP Capital Improvement



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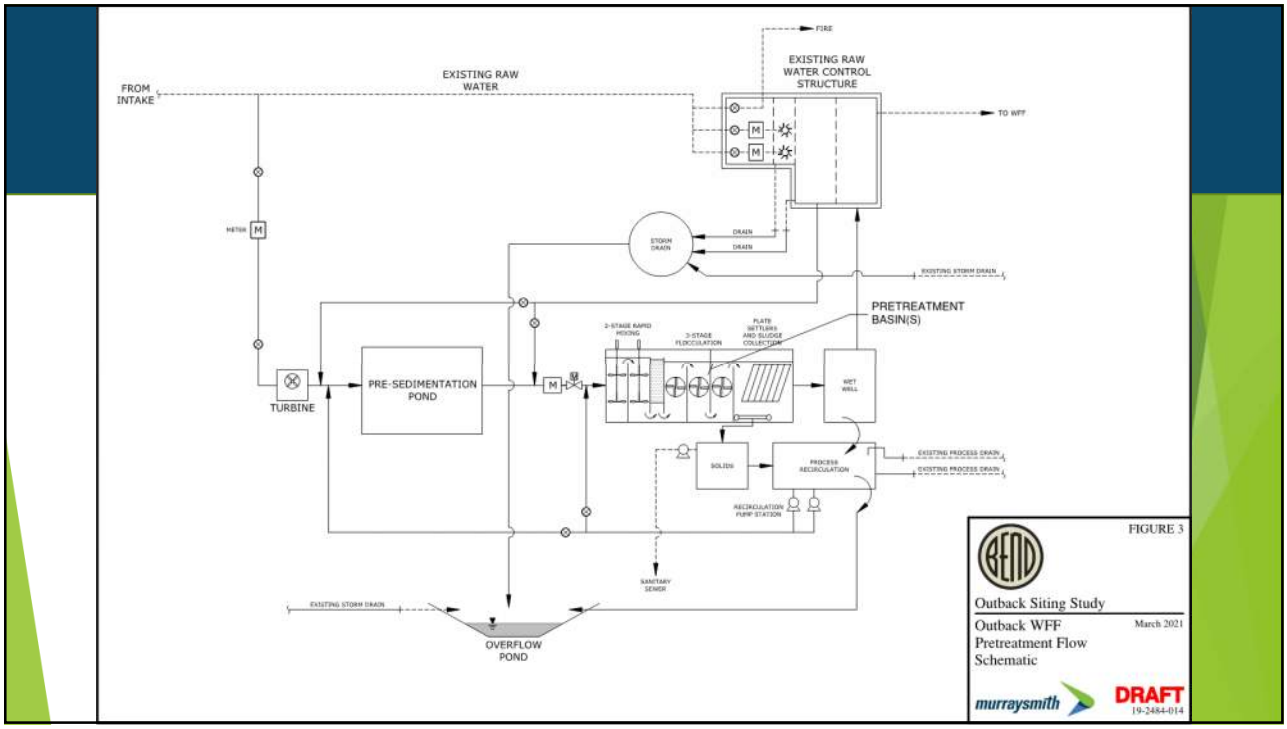

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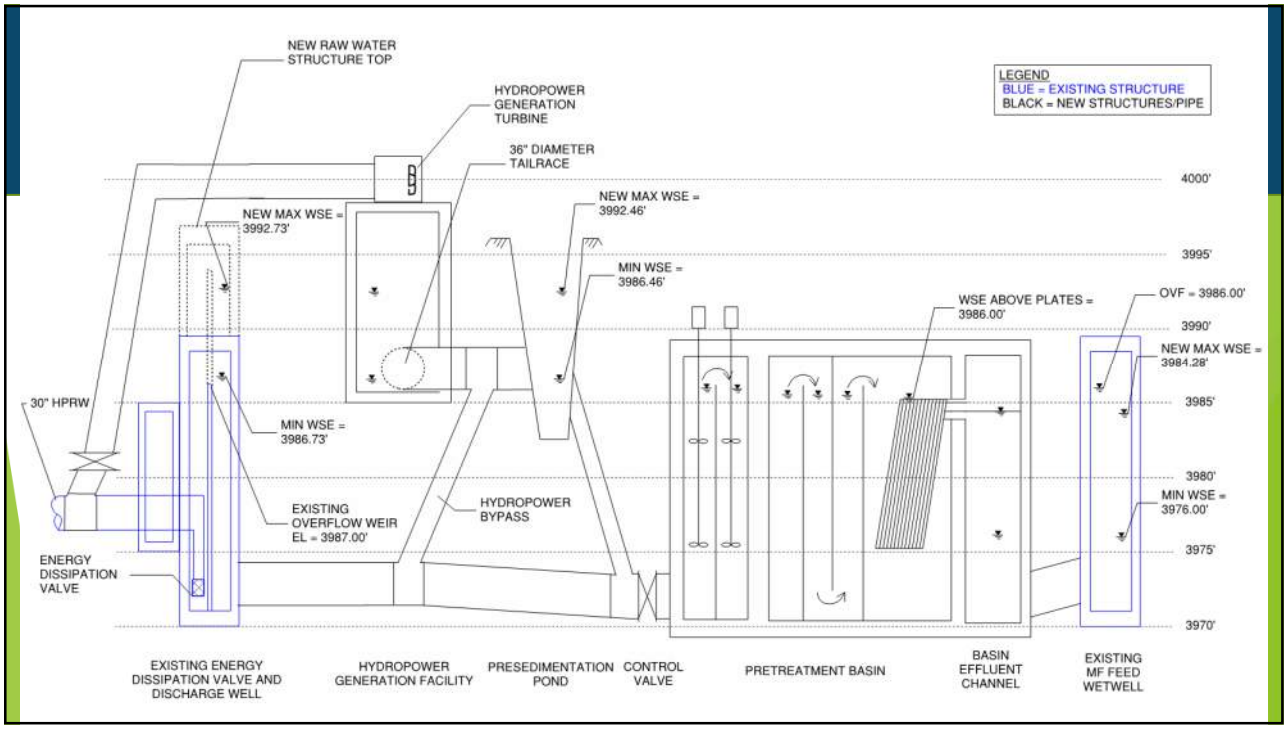

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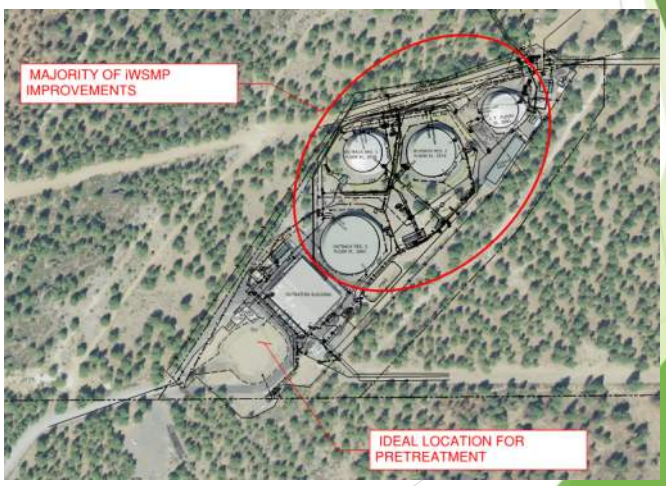
Site Development Considerations

Location of Improvements
- Pretreatment
- Hydro
- iWSMP (Well 8)



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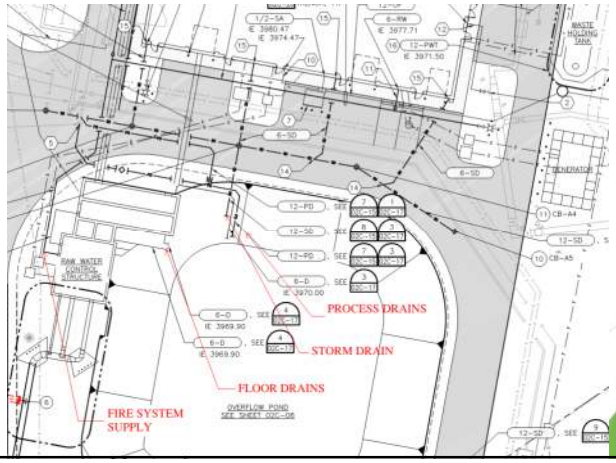
Site Development Considerations

Maintain existing operations
- Overflow pond
- Pump to waste
- Fire system supply
- Other



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Site Development Considerations

Improvements to current operations, site and/or access
- Potential relocation of MF Feed Pumps
- Other

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Site Development Considerations

Phasing Improvements
- Availability of property
- Funding
- Other

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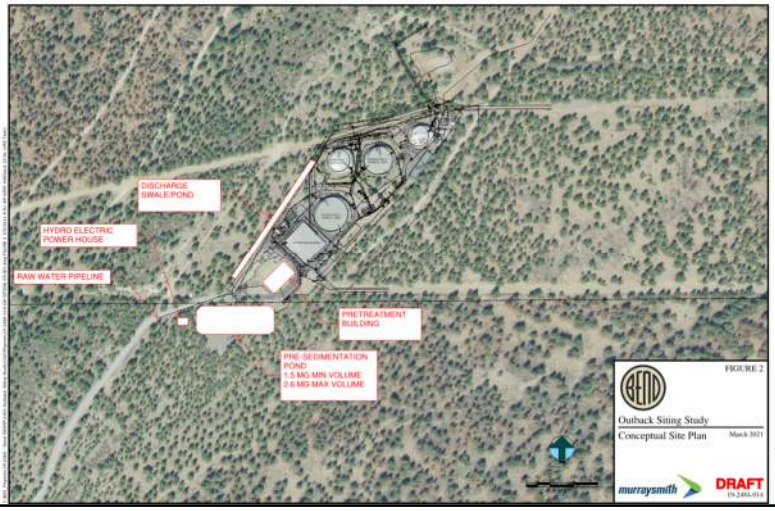
Site Plan Alternatives



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Next steps

- Conceptual Site Plan Development
- Cost Estimates
- Permitting/Property needs
- Implementation

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APPENDIX C

Pretreatment Opinion of Probable Construction Costs

Probable Cost of Construction
Bend iWSMP - Outback Siting Study

Project: Bend iWSMP
Submittal: Outback Siting Study
Owner: Bend
Project No.: 19-2484
Date: 07/8/20

Project Element: Connection/Energy Dissipation

Item No.	Item	Quantity		Unit Costs			Total Cost
				Material	Labor/Equipment (L/E)	Total	
Civil (site work)							
A1	Connection to Existing Pipeline	1	LS			$100,000.00	$100,000.00
A2	30-inch Site Piping	100	LF			$905.00	$90,500.00
A3	General Site Piping	1	LS			$75,000.00	$75,000.00
A4	Excavation	304	CY		$30.00	$30.00	$9,111.11
A5	Gravel Surfacing	111	SY	$15.00	$5.00	$20.00	$2,222.22
				SubTotal:			**$276,800**
Concrete							
C1	Walls	72.0	CY	$850.00	$400.00	$1,250.00	$90,000.00
C2	Elevated Slab	30.4	CY	$850.00	$400.00	$1,250.00	$37,962.96
C3	Slab	60.7	CY	$550.00	$200.00	$800.00	$48,592.59
				SubTotal:			**$176,600.00**
Mechanical							
D1	Piping	1	LS	$75,000.00	$25,000.00	$100,000.00	$100,000.00
D2	Meter	1	EA	$12,000.00	$3,000.00	$15,000.00	$15,000.00
D3	Isolation Valve	1	EA	$8,000.00	$2,000.00	$10,000.00	$10,000.00
D4	Dissapation Valve	1	LS	$36,000.00	$7,500.00	$43,500.00	$43,500.00
D5	HVAC	1	LS	$5,000.00	$2,000.00	$7,000.00	$7,000.00
				SubTotal:			**$175,500.00**
Electrical and Control							
F1	Electrical and I&C	1	LS		$0.00	$150,000.00	$150,000.00
				SubTotal:			**$150,000.00**

Material & Labor Total:		**$778,900.00**
Bonds and Insurance:	2%	$15,578
Mobilization:	10%	$77,890
	0%	$0
Contractor's Overhead & Profit:	15%	$116,835
Subtotal		**$989,200**
Owner's Allowance/Contingency:	*30%*	*$296,760*
Environmental Mitigation	*Not included*	
Property Acquisition	*Not included*	
Estimated Construction Cost		***$1,286,000***
Engineering	20%	$257,200
Construction Eng./Admin.	10%	$128,600
Estimated Project Cost		***$1,672,000***

Probable Cost of Construction
Outback Siting Study - Outback Siting Study

Project: Outback Siting Study
Submittal: Outback Siting Study
Owner: Bend
Project No.: 19-2484
Date: 07/8/20

Project Element: Overflow Pond Relocation

Item No.	Item	Quantity		Unit Costs			Total Cost
				Material	Labor/Equipment (L/E)	Total	
Civil (site work)							
A1	Site Piping (redirect and extend existing piping)	1	LS			$300,000.00	$300,000.00
A2	Excavation	5878	CY		$35.00	$35.00	$205,722.22
A3	Gravel Surfacing (perimeter and access road)	853	SY	$15.00	$5.00	$20.00	$17,066.67
				SubTotal:			**$522,800**
Electrical and Control							
F1	Electrical (pond level monitoring)	1	LS	$15,000.00	$10,000.00	$25,000.00	$25,000.00
				SubTotal:			**$25,000.00**
	Material & Labor Total:						**$547,800.00**
	Bonds and Insurance:	2%					$10,956
	Mobilization:	10%					$54,780
		0%					$0
	Contractor's Overhead & Profit:	15%					$82,170
Subtotal							**$695,700**
	Owner's Allowance/Contingency:	*30%*					*$208,710*
	Environmental Mitigation	*Not included*					
	Property Acquisition	*Not included*					
Estimated Construction Cost							***$904,400***
	Engineering	20%					$180,880
	Construction Eng./Admin.	10%					$90,440
Estimated Project Cost							***$1,176,000***

Probable Cost of Construction
Bend iWSMP - Outback Siting Study

Project: Bend iWSMP
Submittal: Outback Siting Study
Owner: Bend
Project No.: 19-2484
Date: 07/8/20

Project Element: Pre-Sedimentation Basin

Item No.	Item	Quantity		Unit Costs			Total Cost
				Material	Labor/Equipment (L/E)	Total	
Civil (site work)							
A1	30-inch Site Piping	1500	LF			$905.00	$1,357,500.00
A2	Misc. Piping	1	LS			$50,000.00	$50,000.00
A3	Excavation	11733	CY		$30.00	$30.00	$352,000.00
A4	Gravel Surfacing	1022	SY	$15.00	$5.00	$20.00	$20,444.44
				SubTotal:			**$1,779,900**
Concrete							
C1	Sloped Basin Walls	668.1	CY	$400.00	$200.00	$600.00	$400,888.89
C2	Basin Slab	859.3	CY	$350.00	$150.00	$500.00	$429,629.63
C3	Concrete Baffle Wall	53.3	CY	$650.00	$350.00	$1,000.00	$53,333.33
				SubTotal:			**$883,900.00**
Mechanical							
D1	Inlet (pipe header)	1	LS	$50,000.00	$25,000.00	$75,000.00	$75,000.00
D2	Outlet (control gates)	1	LS	$150,000.00	$50,000.00	$200,000.00	$200,000.00
D3	Meter (downstream of outlet)	1	LS	$50,000.00	$20,000.00	$70,000.00	$70,000.00
				SubTotal:			**$345,000.00**
Electrical and Control							
F1	Electrical and I&C	1	LS	$100,000.00	$0.00	$100,000.00	$100,000.00
				SubTotal:			**$100,000.00**

Material & Labor Total:		**$3,108,800.00**
Bonds and Insurance:	2%	$62,176
Mobilization:	10%	$310,880
	0%	$0
Contractor's Overhead & Profit:	15%	$466,320
Subtotal		**$3,948,200**
Owner's Allowance/Contingency:	*30%*	*$1,184,460*
Environmental Mitigation	*Not included*	
Property Acquisition	*Not included*	
Estimated Construction Cost		***$5,132,700***
Engineering	20%	$1,026,540
Construction Eng./Admin.	10%	$513,270
Estimated Project Cost		***$6,673,000***

Probable Cost of Construction
Bend iWSMP - Outback Siting Study

Project: Bend iWSMP
Submittal: Outback Siting Study
Owner: Bend
Project No.: 19-2484
Date: 07/8/20

Project Element: Pretreatment Basin

Item No.	Item	Quantity		Unit Costs			Total Cost
				Material	Labor/Equipment (L/E)	Total	
Civil (site work)							
A1	30-inch Site Piping	300	LF			$905.00	$271,500.00
A2	General Site Piping	1	LS			$150,000.00	$150,000.00
A3	Excavation	2,800	CY		$30.00	$30.00	$84,000.00
A4	Backfill	200	Ton	$18.00	$4.00	$22.00	$4,400.00
A5	AC Paving	10,000	SF	$5.00	$1.00	$6.00	$60,000.00
A6	Misc. Site Work and Restoration	1	LS			$150,000.00	$150,000.00
				SubTotal:			**$719,900**
Equipment							
B1	Rapid Mixers	2	LS	$20,000.00	$4,000.00	$24,000.00	$48,000.00
B2	Plates + Flocculators	1	LS	$800,000.00	$160,000.00	$960,000.00	$960,000.00
				SubTotal:			**$1,008,000.00**
Concrete							
C1	Basin Walls	503.1	CY	$850.00	$400.00	$1,250.00	$628,888.89
C2	Elevated Slab	90.4	CY	$850.00	$400.00	$1,250.00	$112,962.96
C3	Slab	300.0	CY	$550.00	$200.00	$800.00	$240,000.00
				SubTotal:			**$981,900.00**
Mechanical							
D1	Process Piping	1	LS	$100,000.00	$50,000.00	$150,000.00	$150,000.00
D2	Chemical Equipment	6	EA	$20,000.00	$10,000.00	$30,000.00	$180,000.00
D3	Recirculation Pumps	2	EA	$36,000.00	$8,000.00	$44,000.00	$88,000.00
D4	Misc. Mechanical	1	LS			$100,000.00	$100,000.00
				SubTotal:			**$518,000.00**
Archiectural							
E1	Building (Inlcuding building electrical and HVAC)	8970	SF	$100.00	$100.00	$200.00	$1,794,000.00
				SubTotal:			**$1,794,000.00**
Electrical and Control							
F1	Electrical and I&C	1	LS	$1,506,540.00	$0.00	$1,506,540.00	$1,506,540.00
				SubTotal:			**$1,506,540.00**

Material & Labor Total:		**$6,528,300.00**
Bonds and Insurance:	2%	$130,566
Mobilization:	10%	$652,830
	0%	$0
Contractor's Overhead & Profit:	15%	$979,245
Subtotal		**$8,290,900**
Owner's Allowance/Contingency:	*30%*	*$2,487,270*
Environmental Mitigation	*Not included*	
Property Acquisition	*Not included*	
Estimated Construction Cost		***$10,778,200***
Engineering	20%	$2,155,640
Construction Eng./Admin.	10%	$1,077,820
Estimated Project Cost		***$14,012,000***

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APPENDIX D

Special Use Permit

Authorization ID BEN076
Contact ID BEN076
Expiration Date: 12/31/2022

FS-2700-4 (8/99)
OMB 0596-0082

U.S. DEPARTMENT OF AGRICULTURE
Forest Service
SPECIAL USE PERMIT
AUTHORITY:
676 Federal Land Policy and Management Act 10/21/1976

City of Bend. Department of Public Works of 1375 N. E. Forbes Road. Bend, OR 97701 (hereinafter called the Holder) is hereby authorized to use or occupy National Forest System lands. to use subject to the conditions set out below. on the Deschutes National Forest. Bend/Fort Rock Ranger District.

This permit covers 14.14 acres. and/or N/A miles and is described as NW1/4. Section 3. T. 18 S.·R. 11 E.• W.M. as shown on the location map attached to and made a part of this permit, and is issued for the purpose of:

> Constructing, operating, and maintaining the following: three water storage tanks, nine water wells, several dry wells, three 16x50 control buildings to be constructed over wellheads that will contain monitoring and disinfecting equipment, six 12 x 20 foot buildings to be constructed over the remaining well heads, water pipelines, and roads. The entire area will be fenced.

See the plat and Exhibits A-D that are attached to and made a part of the permit.

The above described or defined area shall be referred to herein as the "permit area".

TERMS AND CONDITIONS

I. AUTHORITY AND GENERAL TERMS OF THE PERMIT

A. Authority. This permit is issued pursuant to the authorities enumerated at Title 36, Code of Federal Regulations, Section 251 Subpart B, as amended. This permit, and the activities or use authorized, shall be subject to the terms and conditions of the Secretary's regulations and any subsequent amendment to them.

B. Authorized Officer. The authorized officer is the Forest Supervisor or a delegated subordinate officer.

C. License. This permit is a license for the use of federally owned land and does not grant any permanent, possessory interest in real property; nor shall this permit constitute a contract for purposes of the Contract Disputes Act of 1978 (41 U.S.C. 611). Loss of the privileges granted by this permit by revocation, termination, or suspension is not compensable to the holder.

D. Amendment. This permit may be amended in whole or in part by the Forest Service when, at the discretion of the authorized officer, such action is deemed necessary or desirable to incorporate new terms, conditions, and stipulations as may be required by law, regulation, land management plans, or other management decisions.

E. Existing Rights. This permit is subject to all valid rights and claims of third parties. The United States is not liable to the holder for the exercise of any such right or claim.

F. Nonexclusive Use and Public Access. Unless expressly provided for in additional terms, use of the permit area is not exclusive. The Forest Service reserves the right to use or allow others to use any part of the permit area, including roads, for any purpose, provided, such use does not materially interfere with the holder's authorized use. A final determination of conflicting uses is reserved to the Forest Service.

G. Forest Service Right of Entry and Inspection. The Forest Service has the right of unrestricted access of the permitted area or facility to ensure compliance with laws, regulations, and ordinances and the terms and conditions of this permit.

H. Assignability. This permit is not assignable or transferable. If the holder through death, voluntary sale or transfer, enforcement of contract, foreclosure, or other valid legal proceeding ceases to be the owner of the improvements, this permit shall terminate.

I. Permit Limitations. Nothing in this permit allows or implies permission to build or maintain any structure or facility, or to conduct any activity unless specifically provided for in this permit. Any use not specifically identified in this permit must be approved by the authorized officer in the form of a new permit or permit amendment.

II. TENURE AND ISSUANCE OF A NEW PERMIT

A. Expiration at the End of the Authorized Period. This permit will expire at midnight on 12/31/2022. Expiration shall occur by operation of law and shall not require notice, any decision document, or any environmental analysis or other documentation.

B. Minimum Use or Occupancy of the Permit Area. Use or occupancy of the permit area shall be exercised at least 365 days each year, unless otherwise authorized in writing under additional terms of this permit.

C. Notification to Authorized Officer. If the holder desires issuance of a new permit after expiration, the holder shall notify the authorized officer in writing not less than six (6) months prior to the expiration date of this permit.

D. Conditions for Issuance of a New Permit. At the expiration or termination of an existing permit, a new permit may be issued to the holder of the previous permit or to a new holder subject to the following conditions:

1. The authorized use is compatible with the land use allocation in the Forest Land and Resource Management Plan.
2. The permit area is being used for the purposes previously authorized.
3. The permit area is being operated and maintained in accordance with the provisions of the permit.
4. The holder has shown previous good faith compliance with the terms and conditions of all prior or other existing permits, and has not engaged in any activity or transaction contrary to Federal contracts, permits, laws, or regulation.

E. Discretion of Forest Service. Notwithstanding any provisions of any prior or other permit, the authorized officer may prescribe new terms, conditions, and stipulations when a new permit is issued. The decision whether to issue a new permit to a holder or successor in interest is at the absolute discretion of the Forest Service.

F. Construction. Any construction authorized by this permit may commence by _____ and shall be completed by _____. If construction is not completed within the prescribed time, this permit may be revoked or suspended.

III. RESPONSIBILITIES OF THE HOLDER

A. Compliance with Laws, Regulations. and other Legal Requirements. The holder shall comply with all applicable Federal, State, and local laws, regulations, and standards, including but not limited to, the Federal Water Pollution Control Act, 33 U.S.C. 1251 et seq., the Resource Conservation and Recovery Act, 42 U.S.C. 6901 et seq., the Comprehensive Environmental Response, Control, and Liability Act, 42 U.S. C. 9601 et seq. and other relevant environmental laws, as well as public health and safety laws and other laws relating to the siting, construction, operation, and maintenance of any facility, improvement, or equipment on the property.

B. Plans. Plans for development, layout, construction, reconstruction, or alteration of improvements on the permit area, as well as revisions of such plans, must be prepared by a qualified individual acceptable to the authorized officer and shall be approved in writing prior to commencement of work. The holder may be required to furnish as-built plans, maps, or surveys, or other similar information, upon completion of construction.

C. Maintenance. The holder shall maintain the improvements and permit area to standards of repair, orderliness, neatness, sanitation, and safety acceptable to the authorized officer and consistent with other provisions of this authorization. If requested, the holder shall comply with inspection requirements deemed appropriate by the authorized officer.

D. Hazard Analysis. The holder has a continuing responsibility to identify all hazardous conditions on the permit area which would affect the improvements, resources, or pose a risk of injury to individuals. Any non-emergency actions to abate such hazards shall be performed after consultation with the authorized officer. In emergency situations, the holder shall notify the authorized officer of its actions as soon as possible, but not more than 48 hours, after such actions have been taken.

E. Change of Address. The holder shall immediately notify the authorized officer of a change in address.

F. Change in Ownership. This permit is not assignable and terminates upon change of ownership of the improvements or control of the business entity. The holder shall immediately notify the authorized officer when a change in ownership or control of business entity is pending. Notification by the present holder and potential owner shall be executed using Form FS-2700-3, Special Use Application and Report, or Form FS-2700-3a, Request for Termination of and Application for Special-Use Permit. Upon receipt of the proper documentation, the authorized officer may issue a permit to the party who acquires ownership of, or a controlling interest in, the improvements or business entity.

IV. LIABILITY

For purposes of this section, "holder" includes the holder's heirs, assigns, agents, employees, and contractors.

A. The holder assumes all risk of loss to the authorized improvements.

B. The holder shall indemnify, defend, and hold the United States harmless for any violations incurred under any such laws and regulations or for judgments, claims, or demands assessed against the United States in connection with the holder's use or occupancy of the property. The holder's indemnification of the United States shall include any loss by personal injury, loss of life or damage to property in connection with the occupancy or use of the property during the term of this permit. Indemnification shall include, but is not limited to, the value of resources damaged or destroyed; the costs of restoration, cleanup, or other mitigation; fire suppression or other types of abatement costs; third party claims and judgments; and all administrative, interest, and other legal costs. This paragraph shall survive the termination or revocation of this authorization, regardless of cause.

C. The holder has an affirmative duty to protect from damage the land, property, and interests of the United States.

D. In the event of any breach of the conditions of this authorization by the holder, the authorized officer may, on reasonable notice, cure the breach for the account at the expense of the holder. If the Forest Service at any time pays any sum of money or does any act which will require payment of money, or incurs any expense, including reasonable attorney's fees, in instituting, prosecuting, and/or defending any action or proceeding to enforce the United States rights hereunder, the sum or sums so paid by the United States, with all interests, costs and damages shall, at the election of the Forest Service, be deemed to be additional fees hereunder and shall be due from the holder to the Forest Service on the first day of the month following such election.

E. With respect to roads, the holder shall be proportionally liable for damages to all roads and trails of the United States open to public use caused by the holder's use to the same extent as provided above, except that liability shall not include reasonable and ordinary wear and tear.

F. The Forest Service has no duty to inspect the permit area or to warn of hazards and, if the Forest Service does inspect the permit area, it shall incur no additional duty nor liability for identified or non-identified hazards. This covenant may be enforced by the United States in a court of competent jurisdiction.

V. TERMINATION, REVOCATION, AND SUSPENSION

A. General. For purposes of this permit, "termination", "revocation", and "suspension" refer to the cessation of uses and privileges under the permit.

"Termination" refers to the cessation of the permit under its own terms without the necessity for any decision or action by the authorized officer. Termination occurs automatically when, by the terms of the permit, a fixed or agreed upon condition, event, or time occurs. For example, the permit terminates at expiration. Terminations are not appealable.

"Revocation" refers to an action by the authorized officer to end the permit because of noncompliance with any of the prescribed terms, or for reasons in the public interest. Revocations are appealable.

"Suspension" refers to a revocation which is temporary and the privileges may be restored upon the occurrence of prescribed actions or conditions. Suspensions are appealable.

B. Revocation or Suspension. The Forest Service may suspend or revoke this permit in whole or part for:

1. Noncompliance with Federal, State, or local laws and regulations.
2. Noncompliance with the terms and conditions of this permit.
3. Reasons in the public interest.
4. Abandonment or other failure of the holder to otherwise exercise the privileges granted.

C. Opportunity to Take Corrective Action. Prior to revocation or suspension for cause pursuant to Section V (B), the authorized officer shall give the holder written notice of the grounds for each action and a reasonable time, not tp exceed 90 days, to complete the corrective action prescribed by the authorized officer.

D. Removal of Improvements. Prior to abandonment of the improvements or within a reasonable time following revocation or termination of this authorization, the holder shall prepare, for approval by the authorized officer, an abandonment plan for the permit area. The abandonment plan shall address removal of improvements and restoration of the permit area and prescribed time frames for these actions. If the holder fails to remove the improvements or restore the site within the prescribed time period, they become the property of the United States and may be sold, destroyed or otherwise disposed of without any liability to the United States. However, the holder shall remain liable for all cost associated with their removal, including costs of sale and impoundment, cleanup, and restoration of the site.

VI. FEES

A. Termination for Nonpayment. This permit shall automatically terminate without the necessity of prior notice when land use rental fe◆s are 90 calendar days from the due date in arrears.

B. The holder shall pay an annual fee of Four Hundred Twenty Five Dollars ($425.00) for the period from January 1 to December 31 and thereafter annually on January 1, For Hundred Twenty Five Dollars ($425.00): Provided, charges for this use shall be made or readjusted whenever necessary to place the charges on a basis commensurate with the fair market value of the authorized use.

C. Payment Due Date. The payment due date shall be the close of business on January 1 of each calendar year-payment is due. Payments due the United States for this use shall be deposited at Unit Collection Offier. USDA Forest Service. PNW Region. File #71652, P.O. 60000, San Francisco. CA 94160-1652 in the form of a check, draft, or money order payable to "Forest Service, USDA." Payments shall be credited on the date received by the designated Forest Service collection officer or deposit location. If the due date for the fee or fee calculation statement falls on a non workday, the charges shall not apply until the close of business on the next workday.

D. Late Payment Interest. Administrative Costs and Penalties Pursuant to 31 U.S.C. 3717, et seq., interest shall be charged on any fee amount not paid within 30 days from the date the fee or fee calculation financial statement specified in this authorization becomes due. The rate of interest assessed shall be the higher of the rate of the current value of funds to the U.S. Treasury (i.e., Treasury tax and loan account rate), as prescribed and published by the Secretary of the Treasury in the Federal Register and the Treasury Fiscal Requirements Manual Bulletins annually or quarterly or at the Prompt Payment Act rate. Interest on the principal shall accrue from the date the fee or fee calculation financial statement is due.

In the event the account becomes delinquent, administrative costs to cover processing and handling of the delinquency will be assessed.

A penalty of 6 percent per annum shall be assessed on the total amount delinquent in excess of 90 days and shall accrue from the same date on which interest charges begin to accrue.

Payments will be credited on the date received by the designated collection officer or deposit location. If the due date for the fee or fee calculation statement falls on a non-workday, the charges shall not apply until the close of business on the next workday.

Disputed fees are due and payable by the due date. No appeal of fees will be considered by the Forest Service without full payment of the disputed amount. Adjustments, if necessary, will be made in accordance with settlement terms or the appeal decision.

If the fees become delinquent, the Forest Service will:

Liquidate any security or collateral provided by the authorization.

If no security or collateral is provided, the authorization will terminate and the holder will be responsible for delinquent fees as well as any other costs of restoring the site to it's original condition including hazardous waste cleanup.

Upon termination or revocation of the authorization, delinquent fees and other charges associated with the authorization will be subject to all rights and remedies afforded the United States pursuant to 31 U.S.C. 3711 *et seq.* Delinquencies may be subject to any or all of the following conditions:

Administrative offset of payments due the holder from the Forest Service.

Delinquencies in excess of 60 days shall be referred to United States Department of Treasury for appropriate collection action as provided by 31 U.S.C. 3711 (g), (1).

The Secretary of the Treasury may offset an amount due the debtor for any delinquency as provided by 31 U.S.C. 3720, *et seq.)*

VII. OTHER PROVISIONS

A. Members of Congr . No Member of or Delegate to Congress or Resident Commissioner shall benefit from this permit either directly or indirectly, except when the authorized use provides a general benefit to a corporation.

B. Appeals and Remedies. Any discretionary decisions or determinations by the authorized officer are subject to the appeal regulations at 36 CFR 251, Subpart C, or revisions thereto.

C. Superior Clauses. In the event of any conflict between any of the preceding printed clauses or any provision thereof and any of the following clauses or any provision thereof, the preceding printed clauses shall control.

D. NONDISCRIMINATION IN EMPLOYMENT AND SERVICES: (81):

During the performance of this authorization, the holder agrees:

1. In connection with the performance of work under this authorization, including construction, maintenance, and operation of the facility, the holder shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin, age, or disability. (Ref. Title VII of the Civil Rights Act of 1964, as amended).

2. The holder and employees shall not discriminate by segregation or otherwise against any person on the basis of race, color, religion, sex national origin, age, or disability, by curtailing or refusing to furnish accommodations, facilities, services, or use privileges offered to the public generally. (Ref. Title VI of the Civil Rights Act of 1964, as amended; Section 504 of the Rehabilitation Act of 1973; Title IX of the Education Amendments, and the Age Discrimination Act of 1975).

3. The holder shall include and require compliance with the above nondiscrimination provisions in any subcontract made with respect to the operations under this authorization.

4. When furnished by the Forest Service, signs setting forth this policy of non discrimination will be conspicuously displayed at the public entrance to the premises, and at other exterior or interior locations as directed by the Forest Service.

5. The Forest Service shall have the right to enforce the foregoing nondiscrimination provisions by suit for specific performance or by any other available remedy under the laws of the United States or the State in which the breach or violation occurs.

E. SITE PLAN. (C2}: The holder shall prepare site plans to show the location of all buildings, service areas, roads, and structures. Such plans shall be on a scale of at least one inch equals 200 horizontal feet with 1Ofoot or less contour intervals. The holder is encouraged to consult with the authorized officer during the preparation of the site plan to ensure that it is adequate. No construction shall be undertaken by the holder prior to site plan approval.

F. OPERATING PLAN (CB): The holder shall provide an Operating Plan. The plan shall be prepared in consultation with the authorized officer or designated representative and cover operation and maintenance of facilities, dates or season of operations, and other information required by the authorized officer to manage and evaluate the occupation and/or use of National Forest System lands. The provisions of the Operating Plan and the annual revisions shall become a part of this authorization and shall be submitted by the holder and approved by the authorized officer or their designated representative(s). This Operating Plan is hereby made a part of the authorization.

G. REMOVAL AND PLANTING OF VEGETATION AND OTHER RESOURCES (D5): The holder shall obtain prior written approval from the authorized officer before removing or altering vegetation or other resources. The holder shall obtain prior written approval from the authorized officer before planting trees,hrubs, or other vegetation within the authorized area.

H. REVEGETATION OF GROUND COVER AND SURFACE RESTORATION (D9): The holder shall be responsible for prevention and control of soil erosion and gullying on lands covered by this authorization and adjacent thereto, resulting from construction, operation, maintenance, and termination of the authorized use. The holder shall so construct permitted improvements to avoid the accumulation of excessive heads of water and to avoid encroachment on streams. The holder shall revegetate or otherwise stabilize all ground where the soil has been exposed as a result of the holder's construction, maintenance, operation, or termination of the authorized use and shall construct and maintain necessary preventive measures to supplement the vegetation.

I. ARCHAEOLOGICAL-PAL iIPI,.Q C,-AL DISCOVERIES (X17): The holder shall immediately notify the authorized officer of any and all antiquities or other objects of historic or scientific interest. These include, but are not limited to, historic or prehistoric ruins, fossils, or artifacts discovered as the result of operations under this authorization, and shall leave such discoveries intact until authorized to proceed by the authorized officer. Protective and mitigative measures specified by the auth()t'lzed officer shall be the responsibility of the holder.

J. SIGNS (X29): Signs ci dv ising aevic•e Jrected on National Forest System lands shall have prior approval by the Forest Service as to location, design, size, color, and message. Erected signs shall be maintained or renewed as necessary to neat and presentable standards, as determined by the Forest Service.

K. IMPROVEMENT RELOCATION (X33): This authorization is granted with the express understanding that should future location of United States Government-owned improvements or road rights-of-way require the relocation of the holder's improvements, such relocation will be done by, and at the expense of, the holder within a reasonable time as specified by the authorized officer.

L. WATER RIGHTS (X74): This authorization does not convey any legal interest in water rights as defined by applicable State law.

This permit is accepted subject to the conditions set out above.

HOLDER NAME:

By _____
(HoldeSignatur)

Date: June 28, 2003

U.S. DEPARTMENT OF AGRICULTURE
Fores••

By: ◆◆◆===-=:....=_=---=----------
(Authorized Officer Signature)

Leslie A. Weldon, Forest Supervisor (Title)

Date: 7-20-'2-

EXHIBIT A

CONSTRUCTION MITIGATION MEASURES

WILDLIFE:

- To avoid potential nest destruction and loss of broods for cavity nesters and passerine birds, avoid site-disturbing activities, such as logging, during the period from April 1st to August 15th. If the specified restriction period must be compromised, project activity at the end of the period (the last month) is least likely to cause nest abandonment or loss of broods.

- Logging operations and all pertinent construction activities would be prohibited during the Deer Habitat/Tumalo Winter Range road closure from December 1 to March 31 to avoid disturbance to wintering deer.

MISCELLANEOUS MEASURES:

- All power lines to the site will be buried

- The area of construction of the storage tanks will be about 20-50 feet greater than the circumference of the reservoir. Excess material will be hauled from the site to a location agreed to with the Forest Service.

- Staging areas will be contained within the existing City of Bend compound until distances impact construction efficiencies.

- A construction schedule will be provided in to the Forest Service authorized officer for review.

- The Forest Service authorized officer will designate stump and slash disposal area and/or methods before construction begins.

- Minimize dust during construction by watering sites.

- Sites for disposal, temporary storage and long term stockpiling of excess materials will be agreed upon before construction begins.

- **Equipment Cleaning Clause:**

  To prevent the introduction of the seeds of noxious weeds onto National Forest system lands, the Holder shall insure all equipment moved onto the National Forest is free of soil, seeds, vegetative matter, or other debris that could contain or hold seeds. The Holder shall employ whatever cleaning methods are necessary to ensure compliance with the terms of this provision, and shall notify the Forest Service prior to moving each piece of equipment onto the National Forest. Notification will include identifying the location of the equipment's most recent operations. Upon request of the Forest Service, arrangements will be made for the Forest Service to inspect each piece of equipment prior to it being placed in service.

  The Holder shall certify, in writing, compliance with the terms of this provision prior to each start up of operations. Measures taken to ensure compliance for equipment present at start up and planned to be taken for equipment to be moved in later, will be identified in the certification.

EXHIBITB

REVEGETATION PLAN:

I.Objectives of Revegetation:

a. Prevent noxious weeds
b. Provide erosion control
c. Protect ecological and botanical values of adjacent areas
d. Follow National and Regional direction regarding revegetation

2. Recommendations

a. Minimize area of disturbance requiring revegetation:

Minimize revegetation needs and noxious weed risks by minimizing area of ground disturbance. Establish clearing limits and protective mitigation concepts. Use of visible fencing or other methods to delineate clearing limits can be helpful.

b. Salvage topsoil and reapply:

This will salvage portions of the existing local seed bank and provide a diversity of native plant species.

c. Revegetate bare soil:

Use a combination of top soil/ seed bank salvage to reintroduce native plants and non-native grass to provide erosion control and reduce· the weed invasion risk. The recommended grass at this time for the cut slope area revegetation is a commercially available, non-native grass - Thick spike wheat grass. Sowing rate is about 6-8 pounds per acre. This recommendation should be revisited at the time of construction in case an appropriate native grass is available. Monitor effectiveness of revegation effort and prevent weed invasion and spread with early detection. Recommend involvement by the District botanist during the revegetation process and I visit per year by District Botanists for 5 years to detect weeds. Salvage topsoil from the tank construction area to save native plant seed bank, store adjacent to site and reapply after construction. ·Construction: Complete construction using weed initigation (clean equipment, weed free gravel, limit area of disturbance) reapply salvaged topsoil. Plant non native grass and irrigate - Plant Thickspike wheat grass and provide temporary irrigation and the grass is established.

d. Post construction :

Do intensive weed recon and remove all weed seedlings. Evaluate revegetation success and replant if necessary.

EXHIBIT C

DESIGN GUIDELINES

Scenic Environment:

- Each storage tank will be sited 5 to 15 feet below the existing grade.
- Existing trees on the site will remain to provide screening from the access road and areas immediately adjacent to the site.
- Darker colors (such as green) and non-reflective roofing material will be used in construction of buildings.
- The access road will be paved on the portion nearest the facilities. A non-paved surface will continue to be maintained on the part of the access road visible from Skyliner Road to discourage unwanted traffic from driving onto the project site.
- The roads surrounding the storage tanks will be paved.and the roads leading to the water wells will be paved. The view of these paved surfaces Would be screened from areas adjacent to the site by existing trees.
- The excavation areas where the water storage tanks are sited will have a 2:1 cut bank that slopes away from the tanks to a maximum height of 15 feet. The slope areas will be planted with groundcover and low to medium height shrubs to control dust and erosion and to improve the appearance of the excavated rock. The lawn or grass areas on the site would provide continuity to the grassed areas on the adjacent existing site and would softeri the appearance of the paved areas on the site.
- The nine buildings to be constructed over the water wells will have metal roofs that will be of a color that blends in with the surrounding landscape. These roofs will be constructed of a non-reflective material. The walls will be constructed of raked style tilt up concrete. The existing trees to remain on the site will provide screening of these buildings from areas adjacent to the site.
- The security fence surrounding thy site will be 8 feet high with barbed wire. The fence will be painted with a color that will blend with the site and complement the surroundings. A buffer of trees is included inside the perimeter of the fence in addition to a buffer of trees outside of the project area.

EXHIBIT D

REGULATORY REQUIREMENTS

- Oregon State Department of Environmental Quality (ODEQ) regulates all underground injection wells and waste drainage systems. The proposed dry wells will fall under this authority. The City of Bend will be required to register all injection wells with ODEQ. Provide the Forest Service copies of all registrations and any follow-up communications concerning this process.

- Water rights dwell construction shall follow Oregon Water Resources Department regulations. Provide copies of all well logs to the Forest Service.

- The overall potable water supply system operation is under the jurisdiction of Oregon State Health Division, Drinking Water Section. Provide a yearly summary of water quality test results to the Forest Service.

City of Bend Water Tanks

D Deschutes National Forest

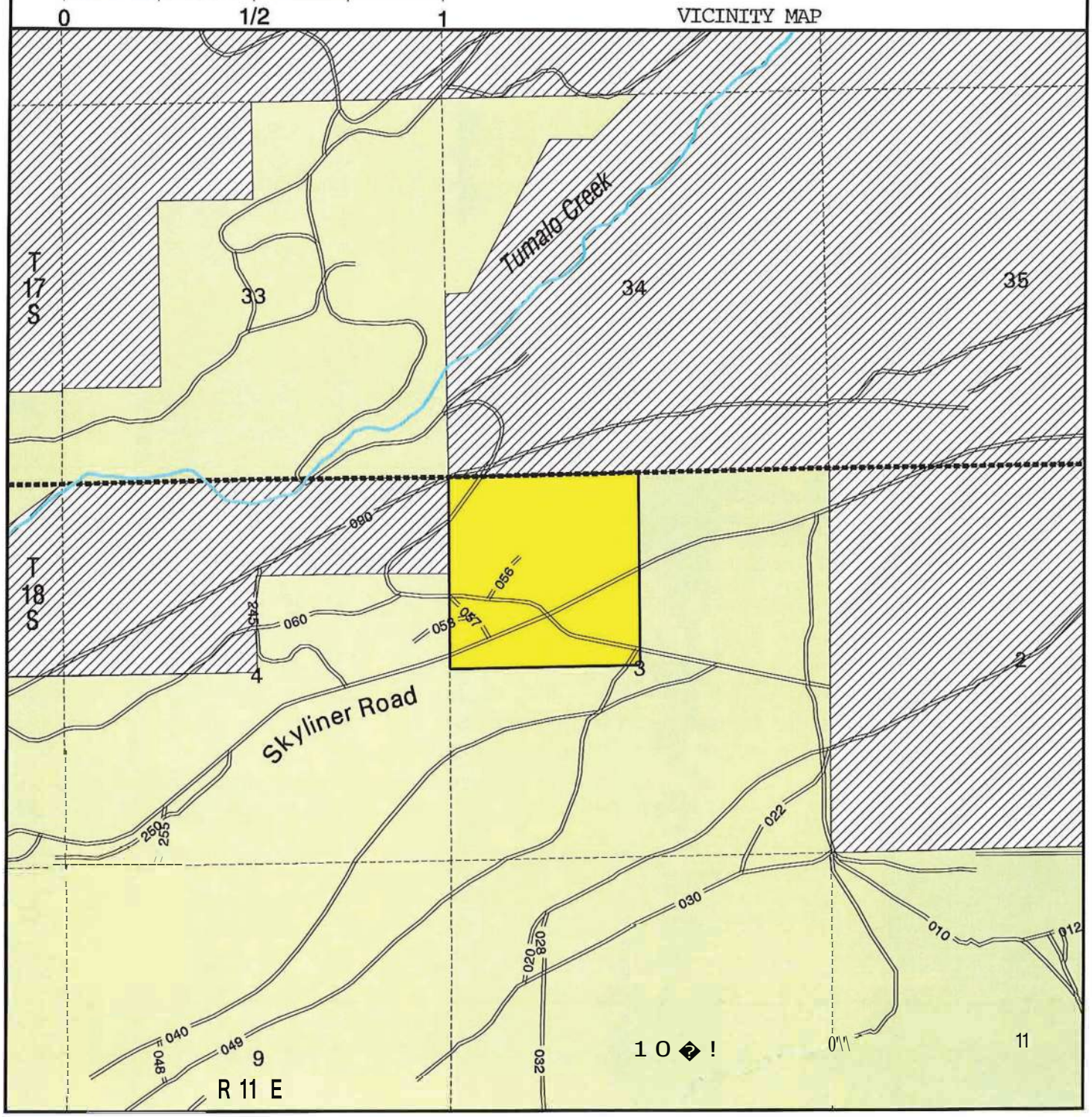
♦ Private Ownership

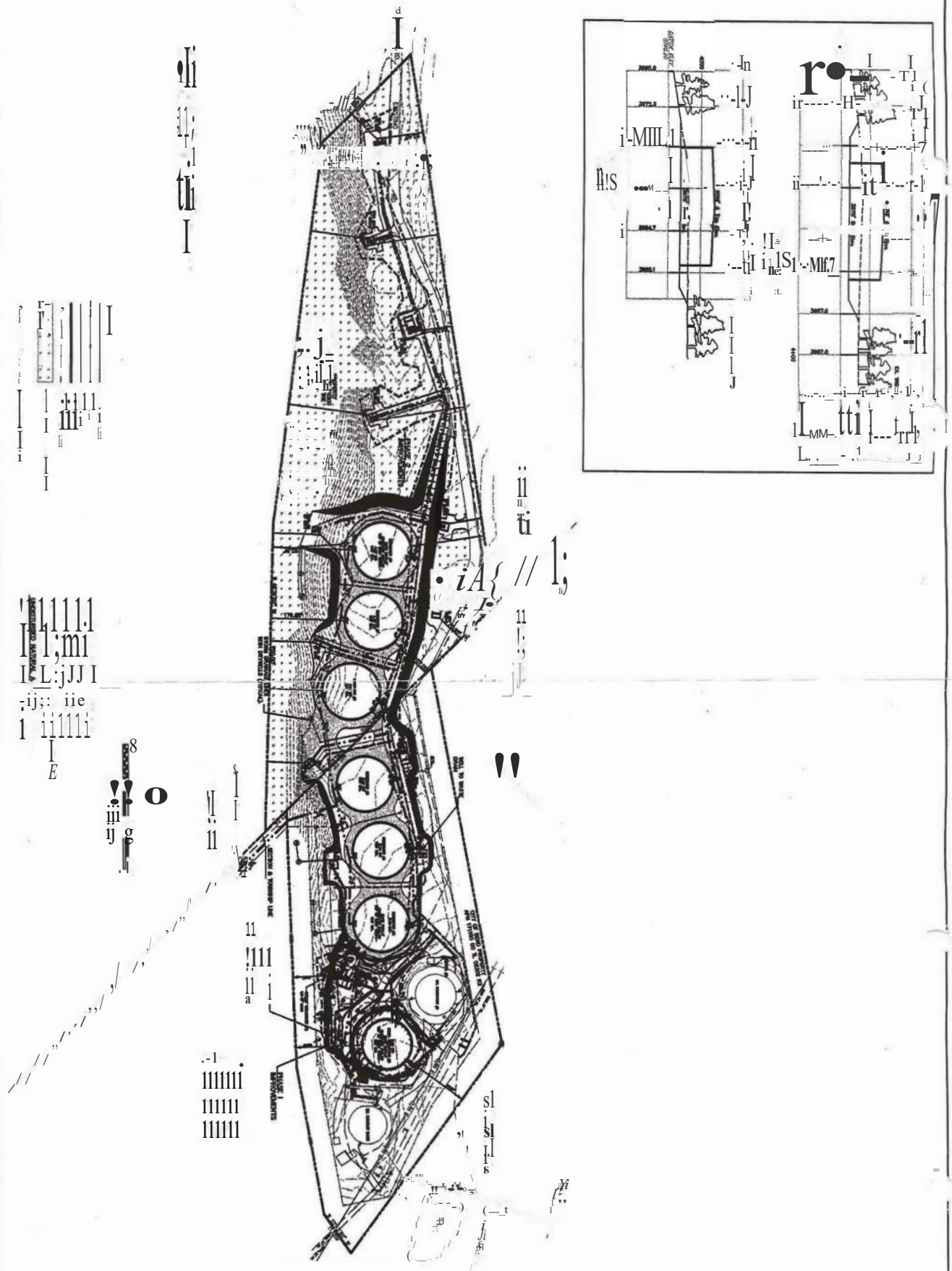
D NW Quarter of Section 3

Scale 1:24000

Miles

0 1/2 1





MASTER SITE PLAN
OUTBACK RESERVOIR AND WELLS
OF BEND
BEND, OREGON

IL CENTURY WEST
IL ENGINEERING CORPORATION
549 SW Mill View Way, Bend, OR 97702
541-388-1500 ph, 541-388-5062 fax
PROJECT mail: bend@centurywest.com

100 E.083.01

REGISTERED PROFESSIONAL ENGINEER
OREGON
JULY 10, 1981
JOSEPH M. BOSWELL
EXPIRES: 12/31/02

DESIGNED BY: SAL
DRAWN BY: WW
CHECKED BY: TLA
SCALE: 1" = 100'
12/11/00

REUSE OF DOCUMENTS