USDA Forest Service

Region 6

Tiller Ranger District

Water Facilities Study

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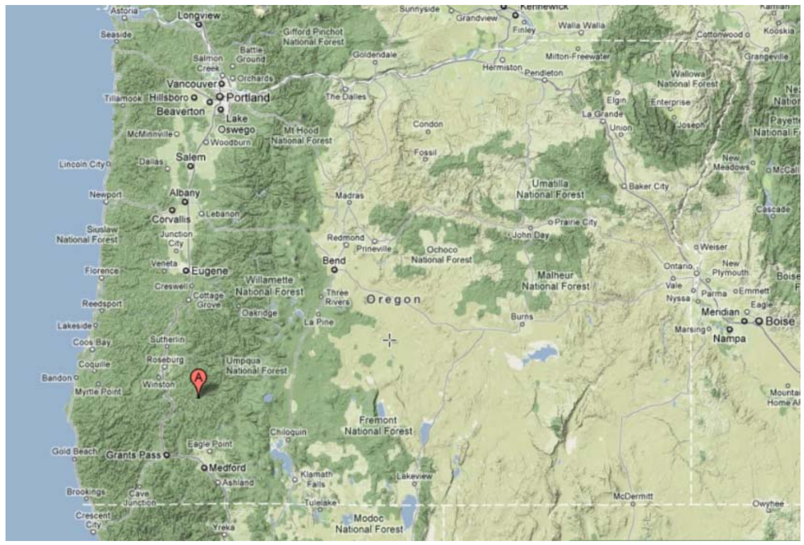
1.0 Executive Summary

1.1 Background

The USFS Tiller Ranger Station (RS) includes facilities for the treatment, storage and delivery of potable water and facilities for the collection, treatment, and disposal of wastewater. This Report covers improvement needs for the water treatment facility and raw water intake. Wastewater needs are discussed under a separate Report.



The USFS Tiller RS is located within the Umpqua National Forest in Douglas County, Oregon. The compound is near the unincorporated community of Tiller along the South Umpqua River, at an elevation of approximately 1,000 feet above sea level. The Tiller RS is the headquarters for the Tiller Ranger District and is listed on the National Register of Historic Places.

The Tiller Ranger Station compound includes numerous residential structures and other buildings with a seasonally varying population of between 10 and 91 people. The complex is provided potable water year round through a Community Water System (CWS) with public water system identification number OR41-01092. The State of Oregon has primacy for compliance and enforcement for EPAs Public Water System (PWS) program. The water system for the Tiller RS is regulated under Oregon Administrative Rules Chapter 333, Division 61 (OAR 333-061) and must provide safe drinking water meeting State and Federal standards.

1.2 Existing Water System

Being utilized from before the 1920s until today, the RS has had various constructions, alterations, and other improvements to the water system. The current water system in use today includes:

- Infiltration gallery type intake (constructed in 1968) with single submersible raw water pump in inclined tube. Water source is the South Umpqua River.
- Conventional package water treatment plant (Rotoflow installed in 1968) with hydraulic flocculation, sedimentation, dual-media constant-rate gravity filtration, and integral clearwell. Polyaluminum Chloride is used as the primary coagulant.
- Hypochlorite disinfection, added at front of process prior to sedimentation basin (pre-chlorination), with standard chemical feed pumps.
- Wood framed building (constructed in 1968) measuring 20 feet by 28 feet housing the package WTP equipment and appurtenances.
- Bolted steel 43,000-gallon storage tank (erected in 2011) for finish water storage.
- Various distribution piping ranging from 1- to 6-inch diameter.

The water treatment plant primary process equipment is an old steel package Rotoflow unit with various modifications since the original installation 44 years ago. Deficiencies noted within the treatment plant include:

- Significant corrosion at steel tank base and other areas
- Lack of filter-to-waste provisions
- Chlorine contact time met only through pre-chlorination
- Unbalanced flows entering and exiting the package plant
- Antiquated filter backwash system without air scour
- Improper turbidity sampling point
- Some antiquated and limited controls
- Some antiquated electrical system components
- Filter bed past expected design life
- Relatively poor turbidity removal performance
- General age related deterioration

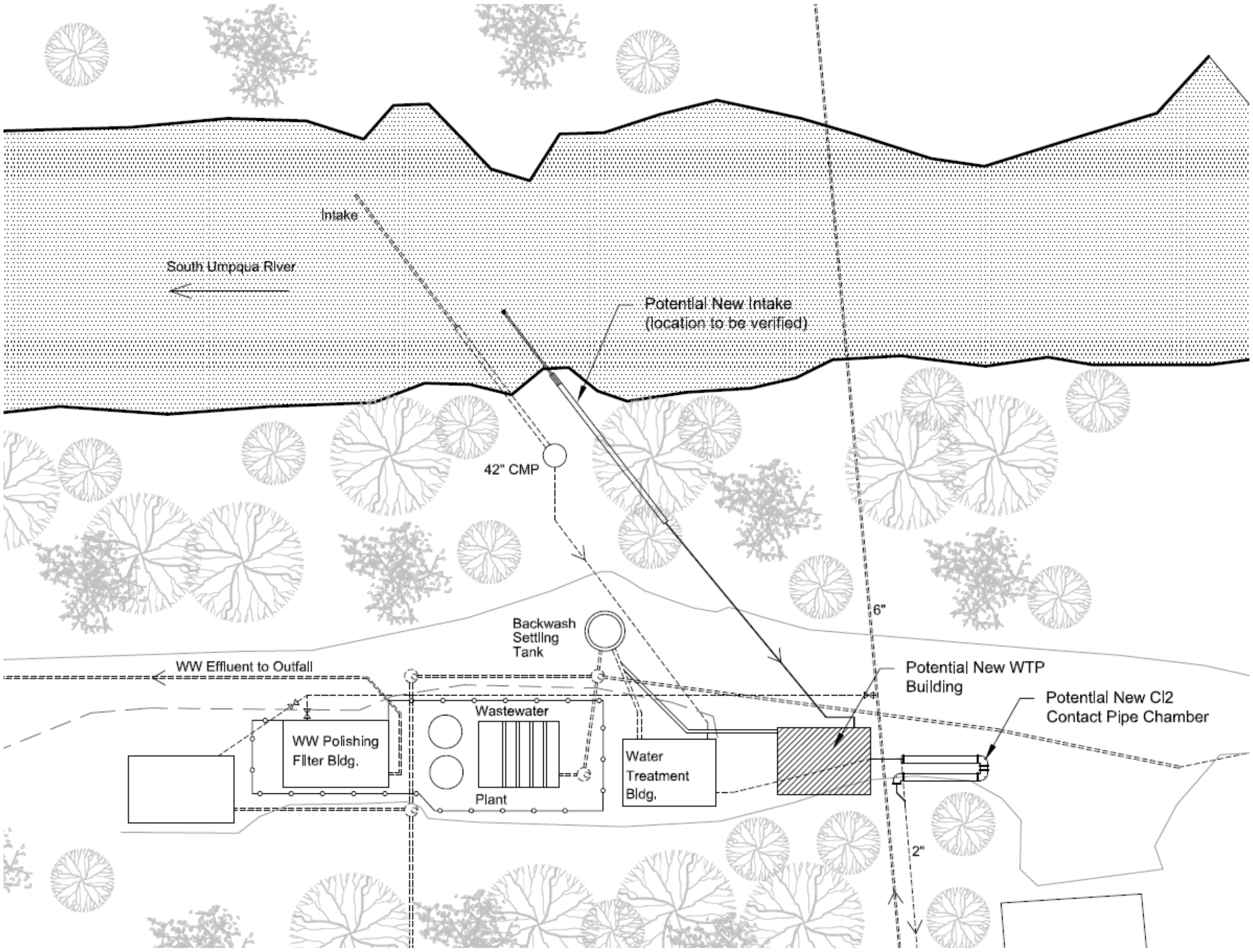
Even though the plant shows its age, it is well operated and has received no water quality violations in recent years. Given the small margin by which the plant currently meets turbidity rules, it is possible that turbidity violations could occur once the turbidimeter sample point is corrected.

The existing raw water intake is a simple streambed infiltration gallery with a single pump. Sand accumulation in the inclined pump tube (and presumably in the perforated piping) has become problematic. Deficiencies notes at the intake include:

- Sand intrusion through filter pack
- Corrosion of 44-year-old buried galvanized components
- Top of pump access pit below flood elevation
- Poor condition of electrical wiring
- No redundant pumping equipment
- Pump oversized delivering excessive flow to plant
- Difficult removal of pumping equipment for maintenance
- Lack of backwash provisions

1.3 Recommended Alternatives

Refurbishment of the existing equipment is not recommended due to the age, condition, and capabilities of the current process equipment. New, small skid-mounted package plant equipment is recommended for treatment improvements. The lowest cost alternative from a life-cycle analysis is a new low-pressure membrane filter package skid. A new intake with conventional submerged screen and inclined pump tube is recommended for intake improvements. A new building is recommended to house the new package equipment so that the existing WTP can continue to function during several months of construction. A new electrical service shared by both the water and wastewater facilities with a single standby generator is also recommended. Following completion of construction, the existing equipment can be removed from the existing building and the building used for storage or office space. A section of enlarged discharge piping is recommended to provide sufficient chlorine contact time without requiring the addition of chlorine into the unfiltered raw water.



Site Plan – Water Supply and Treatment Recommended Improvements

1.4 Recommended Budget and Potential Schedule

The improvement recommendations for the WTP and the intake have a total planning level budget of $1.17 million. Either project (WTP or intake) can be undertaken independently if a phased approach is desired.

Alternative	Construction Cost	Contingency	Engineering Budget	Permitting	Administrative Costs	Total Project Budget	Annual O&M Cost*
Low-Pressure Membrane Plant	$632,400	$126,480	$126,480	$1,000	$31,620	$916,980	$54,100
Conventional Screen	$189,000	$37,800	$37,800	$15,000	$9,450	$289,050	$7,300
Demolition of Existing Equipment, Building Maintenance	$25,000	$5,000	$5,000	$0	$0	$35,000	~
Totals	**$846,400**	**$169,280**	**$169,280**	**$16,000**	**$41,070**	**$1,242,030**	**$61,400**

A potential scheduling scenario is presented below assuming a single-phased approach:

1) Secure Funding for All Improvements – WTP + Intake ($1,242,030) – October 2012
2) Contract with Engineering Firm – October 2012
3) Survey and Develop Pre-Design Drawings – October 2012 through December 2012
4) Engineer to prepare Pre-Selection Documents and conduct Solicitation of Proposals from equipment manufacturers for membrane skid – October 2012 through December 2012
5) Joint Permit Application – January 2013 through April 2013
6) Design WTP Improvements – December 2012 through April 2013
7) Design Intake – January 2013 through April 2013
8) Bid Phase for WTP and Intake – May 2013
9) Construction for WTP and Intake – June 2013 through December 2013 (In-Water Work during July and August)

Section 2

2.0 Introduction

2.1 Authorization

On November 4, 2011, the USDA – Forest Service issued a Notice to Proceed to Civil West Engineering Services, Inc. (Contract Number: AG-046W-C-11-0020, Order Number: AG-05K3-D-11-0045). The scope is outlined in the Task Order – R6 Water/Waste Water A/E Services IDIQ. A concurrent evaluation of the wastewater treatment operations is being prepared under a separate cover.

2.2 Purpose

The primary purpose of this study is to evaluate options to replace or repair the water treatment system for the Ranger Station compound. This study was requested by the Forest Service to provide recommendations on treatment plant and operations upgrades needed to provide reliable and efficient acquisition, treatment and pumping of the water to the existing storage tank.

2.3 Scope of Services

- Determine water demands
- Document water quality and treatability of the South Umpqua River
- Define treatment requirements and goals and monitoring requirements
- Evaluate the existing equipment in regards to capability to treat sufficient water while meeting existing and pending State and Federal treated water quality requirements
- Inspect all major plant electrical and control systems to determine suitability
- Identify and document any required permits and review procedures
- Identify plant modification/replacement alternatives as necessary to meet treatment goals

2.4 Acknowledgements

Many people have provided information, input, feedback, and other contributions to the completion of this Study. While certainly not a complete list, the following individuals deserve recognition for their contributions and assistance provided in this effort:

US Forest Service
- Justin Holder, Contract Specialist
- Rodney Reid, Western Oregon Zone Engineer
- John Beagle, Assistant Forest Engineer
- Steve Sichau, Regional Electrical Engineer
- Kayli Barber, Facilities Engineer
- Michelle Bernard, Facilities Engineer

Environmental Contracting Services, Inc.
- Dan Tiedke, Principal
- Gary Newman, Operator

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3.0 Project Location

Section
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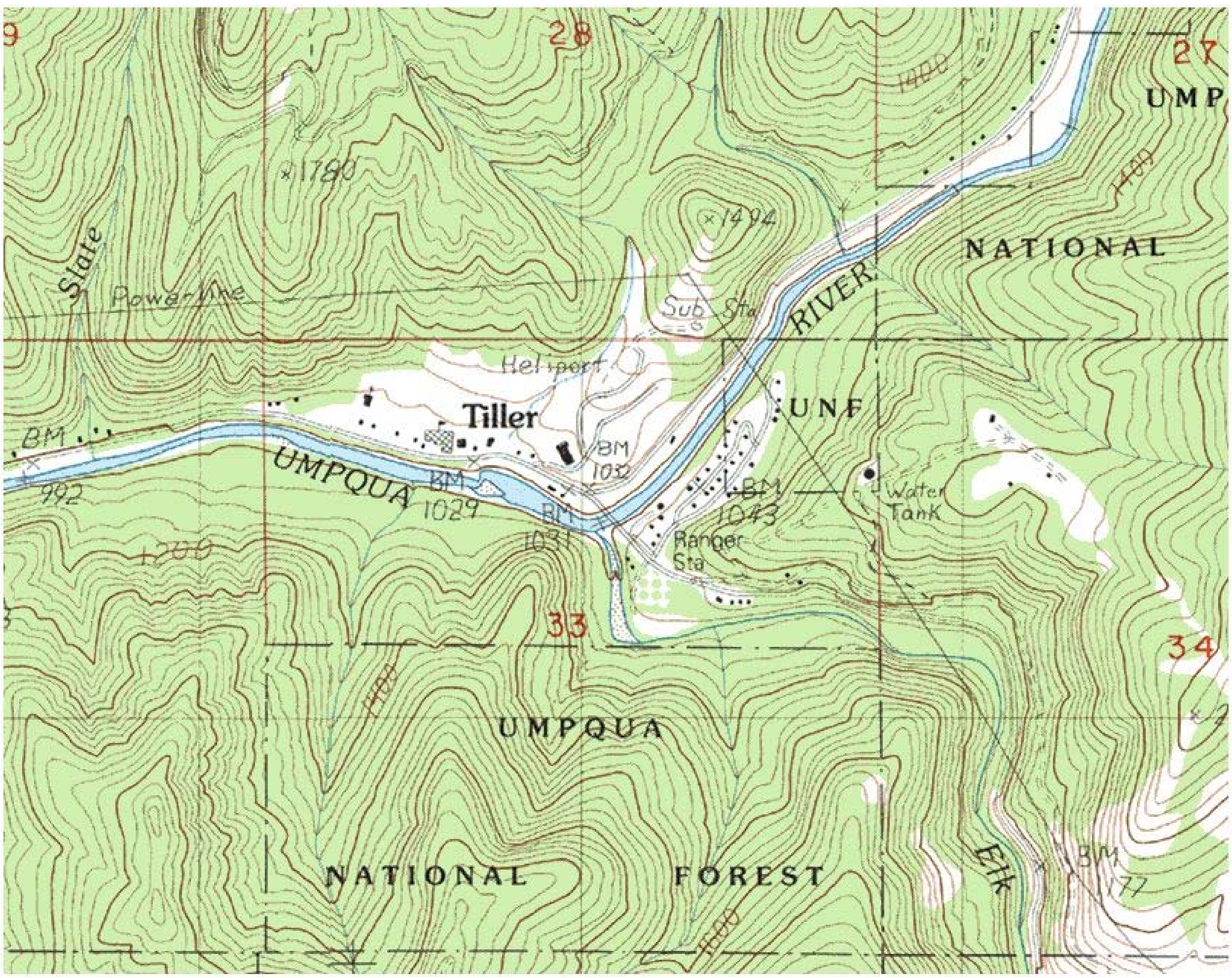
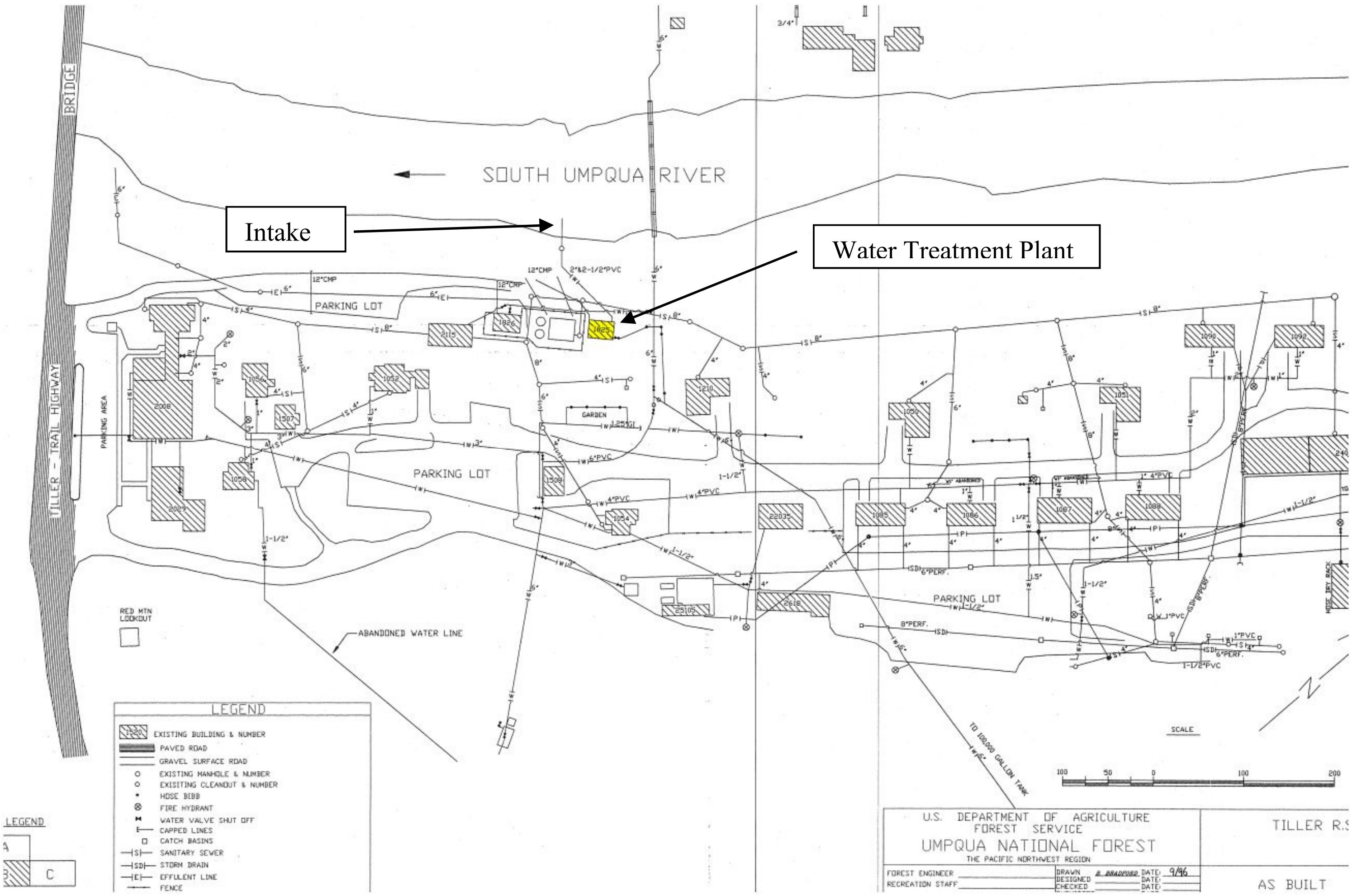
3.1 Project Location

The project site is located at headquarters of the Tiller Ranger District of the Umpqua National Forest. The Tiller Ranger District headquarters are in the unincorporated community of Tiller, Douglas County, Oregon, approximately 23 miles west of Canyonville, Oregon on County Road No. 1 (Oregon State Highway 227). Tiller is located at the confluence of the South Umpqua River and Elk Creek and the intersection of Highway 227 (also known as the Tiller Trail Hwy) and the South Umpqua Road (County Road 46). The district offices are on the south side of the South Umpqua River and are east of the highway.

Latitude & Longitude: 42° 55’ 39” N, 122° 56’ 58” W
Northwest ¼, Section 33, Township 30 S, Range 2 W, Willamette Meridian
USGS Tiller Quadrangle Map, 7.5-Minute Series



3.2 Site Map


BRIDGE
SOUTH UMPQUA RIVER
Intake
Water Treatment Plant
PARKING LOT
PARKING LOT
PARKING LOT
TILLER - TRAIL HIGHWAY
PARKING AREA
GARDEN
RED MTN LOOKOUT
ABANDONED WATER LINE
TO 100,000 GALLON TANK
LEGEND
EXISTING BUILDING & NUMBER
PAVED ROAD
GRAVEL SURFACE ROAD
EXISTING MANHOLE & NUMBER
EXISITING CLEANOUT & NUMBER
HOSE BIBB
FIRE HYDRANT
WATER VALVE SHUT OFF
CAPPED LINES
CATCH BASINS
SANITARY SEWER
STORM DRAIN
EFFLUENT LINE
FENCE
SCALE
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
UMPQUA NATIONAL FOREST
THE PACIFIC NORTHWEST REGION
FOREST ENGINEER
RECREATION STAFF
DRAWN
DESIGNED
CHECKED
AS BUILT

4.0 Site Description/Existing Facilities

Section

4

4.1 Site Usage/Type of Site

The Tiller Ranger Station consists of administrative buildings, residential structures, and operational facilities such as the ranger station water and wastewater treatment plants. Site occupants include permanent and seasonal employees and their families. The water system is classified in Oregon as a community water system with public water system ID No. 41-01092.

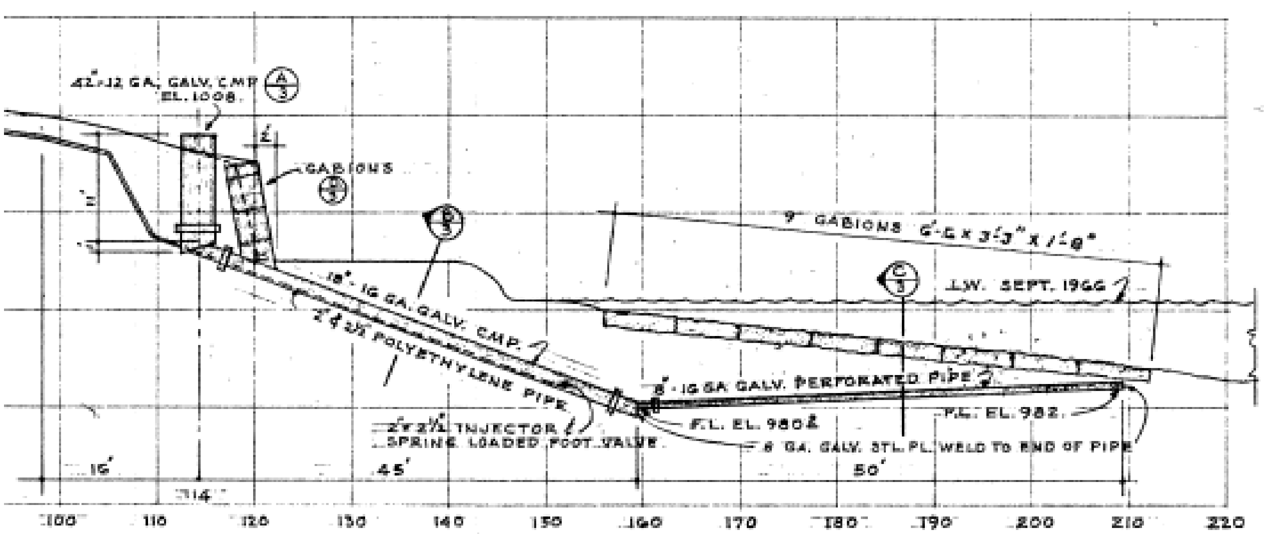
4.2 Size of Site/Layout

The Tiller Ranger Station sits on approximately 18 acres on the southeast side of the South Umpqua River. The total property compromises approximately 58 acres on the south side of the river. North of the river, the Forest Service owns another 30.5 acres on which an apartment building is located as well as a field used for helicopter landing pads. Between the two sites is the South Umpqua River, a few thin parcels of land, and County Road No. 46. The Forest Service owns two of the small thin parcels between the road right of way and the South Umpqua River, one of which is directly across from the water and wastewater treatment site.

4.3 Existing Water Treatment Facilities

4.3.1 Raw Water Intake

The existing raw water intake is an infiltration gallery type constructed in 1968 under the stream channel in the South Umpqua River. According to the old plans, the intake consists of 50 feet of 8-inch diameter perforated galvanized steel pipe buried under the streambed and protected with rock gabions. The gravel filter pack around the perforated pipe is 1- to 2-inch rock, with 6-inches of cover at top and bottom of pipe and 15-inches of cover at sides of pipe, capped with larger 4- to 12-inch rock. A section of 42-inch diameter galvanized corrugated metal pipe (CMP) installed vertically and a section of 18-inch CMP buried at an angle function as the pump wetwell and connection to the perforated pipe as shown in the figure below. An access port exists on the 18-inch pipe approximately half way along its length (not shown in drawing).



At some point in the past, the failing original equipment was replaced with a submersible well pump (2 Hp, 240 volt, single phase) installed at an angle within the 18-inch pipe section. Access to the pump is very limited and ropes are used to slide the pump out for replacement or maintenance. The existing pump provides a flow of approximately 60 gpm to the plant (even though throttled significantly with a half closed ball valve), which is excessive for the plant capabilities. The electrical supply system for the intake pump has several code violations and is hazardous to personnel. Some corrosion is visible at the bottom of the 42-inch CMP. The installation also lacks redundant pumping equipment.

Over time, the intake virtually ceased to function due to sand accumulation in the buried piping. It is possible that corrosion and failure of the buried perforated CMP has created local high velocity spots exacerbating sedimentation accumulation in the gravel surrounding the infiltration pipe. No provisions for easily jetting or backwashing, or removing sediment exist. Using temporary piping, efforts to flush and vacuum sand from the buried piping have been made numerous times. These cleaning efforts have helped temporarily, however sand is still a significant problem.


View of Intake – Top of 42” CMP Vertical Pit Cover


View into 42” CMP Vertical Pump Access Pit

Overall, the 43-year-old intake is in relatively poor condition and past its design life. Uncoupling the pump within the 18-inch CMP section for cleaning sand is a labor-intensive task that requires temporary rewiring for a temporary pump. Additionally, the access port in the 18-inch CMP section is often submerged and inaccessible even during summer water levels, and plant operators report that even the 42-inch access can become submerged during high wintertime water levels completely preventing access to all portions of the intake facility.

4.3.2 Packaged Treatment Plant

The existing package water treatment plant is a RotoFlow Model 40 as manufactured by Northwest Filter Company (no longer in business) housed in a 28’x20’ wood framed building. The package is a conventional treatment unit with hydraulic flocculation, sedimentation, dual-media gravity filtration, and a small clearwell housed in a single steel tank. A Class 2 certified operator is required to run the plant. The plant is in fair to poor condition and exhibits significant corrosion around the base and other locations.


Water Treatment Plant Building

Performance of the plant is relatively poor with most finish water turbidity measurements being above the EPA goal of 0.1 NTU and numerous measurements above the MCL of 0.3 NTU. Turbidity is sampled after the clearwell rather than immediately after filtration as required by OAR 333-061-0030(3)(b)(A)(i), potentially masking temporary high turbidity events such as may occur following a backwash cycle. Additional information on water quality is presented in Section 6.2.3.

Polyaluminum Chloride (PACl) is used as the primary coagulant and a cationic polymer (573C) is added at times, generally during winter raw water turbidity spikes. Chemicals are stored in 50-gallon plastic tanks and fed using standard LMI metering pumps. Jar testing equipment is used to optimize coagulant dosages.

Sodium hypochlorite is added at the front of the plant (flocculation chamber) for disinfection. Chlorination upstream from filtration (pre-chlorination) can increase levels of harmful disinfection byproducts; however, no violations for HAA5 or TTHM have occurred at the plant.

Water Treatment Plant Interior

Raw water enters the plant at a flow of approximately 60 gpm from the submersible raw water pump at the intake. The finish water booster pump in the plant discharges at a rate of approximately 28 gpm. This unmatched flow causes a rise and fall in the package tank water level (69 inches to 79.5 inches depth) as the raw water pump starts and stops based on the water level high/low setpoints. The plant is filtering water at 28 gpm when the finish water pump is running and the raw water pump is off. However, the plant effectively experiences flows of 60 gpm through the flocculation, sedimentation processes when the raw water pump runs as the tank chambers fill back up. A flow control valve exists to limit flows through the filter but the rate of flow allowed to travel from the sedimentation basin through the filter it is not known. Presumably this filter control valve limits the flow to near the original design flow of the package equipment or functions to maintain a constant water level in the filter bay (which would limit flow through the filter to 28 gpm to match the discharge pump).

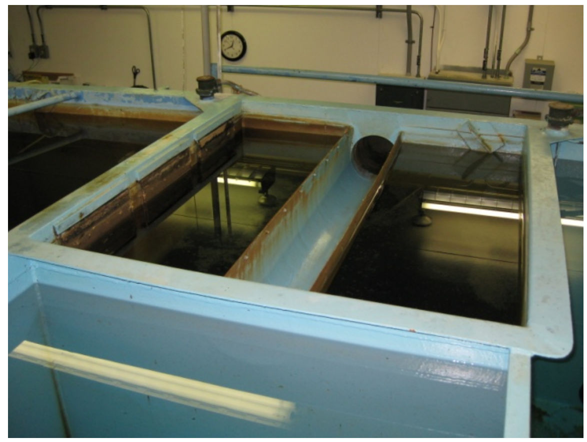
Rotoflow – Corrosion at Flocculator

Raw water enters a 26-inch diameter mixing chamber in the center of the flocculation area where chemicals are added and coagulation occurs. Following the mixing chamber, water enters a multi-stage flocculation chamber with wooden baffles. The flocculator area has a volume of approximately 78.9 ft^3 or 590 gallons. The EPA suggests that 30 minutes of detention time be provided when water temperatures drop below 5°C. The often cited "10-State Recommended Standards for Waterworks" also requires at least 30 minutes for flocculation. The existing flocculation volume is sufficient to adequately treat a design flow of 20 gpm while providing 30 minutes of theoretical detention time. At a flow of 28 gpm, the detention time drops to 21 minutes, which we consider to be near the minimum acceptable time for the conditions at Tiller. When the raw water pump is running, sending 60 gpm through the flocculator, the theoretical detention time drops to an undesirably low 10 minutes. The flocculation process is not optimal under current conditions with inadequate detention time when raw water pump is running.

Sedimentation basin design criteria according to EPA (Optimizing Water Treatment Plant Performance Using the Composite Correction Program, 1998, EPA/625/6-91/027) suggests a surface overflow rate

(SOR) of 0.6 gpm/ft^2 for turbidity removal and 0.4 gpm/ft^2 for color removal for conventional rectangular basins with depth between 12 and 14 feet. AWWA/ASCE recommends (Water Treatment Plant Design, Third Edition) a SOR of 0.55 to 0.83 for turbidity removal with reduction to 0.35 to 0.55 gpm/ft^2 for water with high algae content. The 10-State Recommended Standards for Waterworks, requires 4 hours of detention time as well as a maximum horizontal through velocity of 0.5 fpm. Detention time may be reduced when the SOR is less than 0.5 gpm/ft^2. The sedimentation basin at the Tiller Ranger Station Plant has a surface area of approximately 49 ft^2 and a minimum volume of 2,120 gallons. To achieve a SOR of 0.5 gpm/ft^2, the maximum allowable flow through the sedimentation basin should be 25 gpm.

After sedimentation, the water flows into a single high-rate, dual-media filter measuring approximately 4.5 feet by 3.8 feet providing a surface area of 17.25 ft^2. At a reasonably conservative filter loading rate of 2.0 gpm/ft^2, the capacity of the filter is 35 gpm. A Hach 1720E turbidimeter continuously monitors finish water turbidity but sampling is done after the clearwell rather than immediately after the filter as required. With the clearwell volume functioning to dilute or attenuate turbidity spikes, it is possible that filtrate turbidity is at times higher than currently recorded by the 1720E.



Rotoflow – View of Filter

The filter is backwashed once for every 30,000 gallons of water produced (average of twice per week per operator). Backwash is initiated manually. Backwashing is accomplished with water only as the filter design does not accommodate air scour. The plant operator indicates that approximately 600 gallons of water is used per backwash. No flowmeter exists to verify backwash rate however a typical requirement for this type of filter would be at least 15 gpm/ft^2 (as needed to achieve 25% bed expansion) or 260 gpm for 5 to 10 minutes. With only 600 gallons reportedly used per backwash, either the backwash duration or the backwash rate appears to be inadequate for proper filter cleaning.

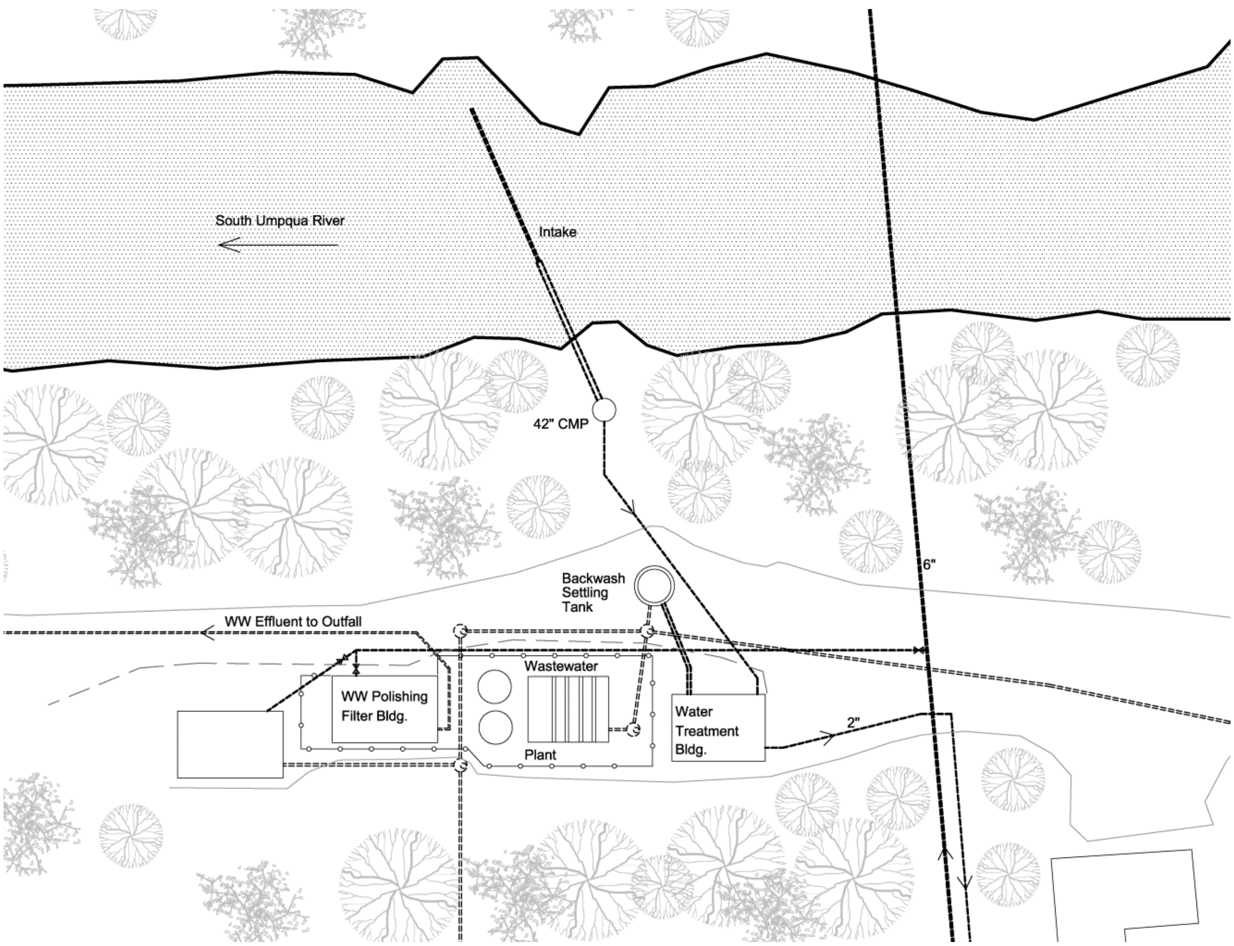
The filter bed has not been rebuilt to the operator's knowledge; however, the anthracite layer was replaced approximately 5 years ago and is topped off as needed. Filters of this type should have all media (sand and anthracite) replaced once every 15 to 20 years or so. It appears the filter media is past its expected design life.

Backwash waste flows by gravity to a buried concrete settling tank constructed in 1975. Supernatant from the tank flows to the sewer treatment facility. A pump at the settling tank can also be used to pump settled water to the sewer treatment facility. The settling tank is a 10-foot diameter tank with a hopper bottom and a volume of approximately 5,500 gallons to overflow. A volume of 1,470 gallons is pumped out of the tank beween the pump on/off level setpoints according to the original plans.

The plant lacks functioning filter-to-waste provisions. Typically, a period of high turbidity water results immediately after a backwash and this water is sent to waste for a few minutes and normal filtration is resumed when turbidity returns to low levels. The lack of turbidity sampling on the filter effluent line at the Tiller plant prevents recording of such events.

Rotoflow – Corrosion at Base

The clearwell has a volume of 2,385 to 2,745 gallons depending on the water level in the tank. Two interior baffle walls in the tank help prevent short-circuiting but the inlet and outlet are unbaffled. Assuming an efficiency of 30% due to the baffles, the worst case theoretical contact time at 28 gpm is 25 minutes in the clearwell alone. A Hach CL-17 on-line chlorine residual analyzer continuously monitors the free chlorine residual from water leaving the clearwell. Free chlorine residual leaving the plant is around 1.0 to 1.5 mg/L which is a proper and common range. Chlorine contact time required is dependent on pH, water temperature, and chlorine residual. Approximate worst case conditions for the Tiller plant would be when the water temperature is 5°C, the pH is around 7.5 and the chlorine residual is around 1.0 mg/L. At these conditions, a CT value of 30 is required for 0.5-log disinfection. The clearwell alone appears inadequate to provide the necessary contact time, and additional contact time is being provided by pre-chlorinating the raw water and utilizing the entire Rotoflow tankage (including flocculator, sedimentation chamber, filter, and clearwell) to provide contact time. A tracer study conducted in 2007 by the State (with pre-chlorination active) showed that at 32 gpm an adequate 86 minutes of contact time was measured by the time the treated water reaches the first water user outside the plant with pre-chlorination practiced. In general, pre-chlorination is discouraged by the State since the chlorination of organic matter prior to filtration leads to an increased formation of disinfection byproducts (TTHM, HAA5) however the Tiller plant has had no violations for disinfection byproducts (DBP). Even though DBP violations have not occurred due to the practice of pre-chlorination, it is recommended that any significant plant improvements include sufficient post-filtration contact time such that pre-chlorination is not required.



Site Plan – Existing Water and Wastewater Treatment Facilities

4.3.3 Existing Controls and Electrical Facilities

The water treatment facility contains limited functional controls including a combination of old and newer control panels. Currently in use, there is the original Rotoflow control panel, an old pump control panel for the intake and finish water pumps, an old control panel for the settling tank decant pump, and the newer control panel receiving signals from the chlorine analyzer, the turbidimeters, and the storage tank level device. The plant controls are based upon floats, timers, switches and relays. Many of these components are old and include parts which are no longer manufactured or difficult to obtain. Operation of the Rotoflow plant is simple and the process is reliable, however the plant lacks functions and automation that are typical today which would improve performance and consistency in water quality. If the existing plant is replaced, the current controls should also be replaced.

The new control panel installed in 2011 corrected deficiencies noted by the State including proper turbidity monitoring with alarm in addition to adding chlorine monitoring and alarm and automated plant start/stop. This new equipment performs such functions as:

- Automatically starts/stops the plant based upon tank level sensors in the new steel storage tank
- Records chlorine residual in the clearwell for regulatory compliance
- Records plant finish water turbidity for regulatory compliance
- Sends telephone alarms through an automatic dialer when key chlorine, tank level, turbidity or general alarm failures are detected.

Chlorine Residual Analyzer

2011 Control Panel

Deficient Wiring to Intake Raw Water Pump

Existing Pump Control Panel

The original indoor electrical panels are old and have limited expansion space remaining. Panel wires are haphazardly arranged and include many splices. Panels constructed with the recent telemetry upgrades are neatly arranged and built to modern code.

The newer control panel performs the functions it was designed for well and solved several problems but does not facilitate future expansion or provide control capability for a modern plant. If the treatment equipment is replaced with new package treatment equipment, the new and old control panels will not be necessary. In such case, the old panels should be discarded but the new panel can be salvaged and potentially used beneficially at another USFS installation elsewhere. Alternatively, during design of any significant plant upgrades, the option of retaining the newer panel and using it in combination with manufacturer supplied control panels can be explored. All new package treatment equipment suitable for use at this installation will come standard with integral control panels designed and tested by the specific equipment manufacturer. Such new control panels will have programmable logic controllers (PLC) with user-friendly operator interfaces. Existing equipment and instrumentation such as the storage tank level sensors, the chlorine analyzer, and the turbidimeter can be reconnected to a new PLC control panel. A PLC control panel will provide all the functions provided in the existing panels while allowing for additional automation and control flexibility as well as the potential to easily add functions in the future as needs change.

Power is provided to the Water Treatment Plant as a three-phase, hi-leg, 120/240 Volt, 100-Amp service from three 10KVA pole mounted transformers. The hi-leg configuration is outdated and no longer used when a neutral high voltage line is available. Fortunately, Pacificorp, the utility provider, has already installed a neutral wire to the Tiller station that will allow a future upgrade to a modern wye configuration power service without excessive cost. The 100-Amp service is small for comparable modern facilities and is currently near the 80 amp load maximum for the panel. It is recommended to maintain spare electrical capacity in treatment plants to facilitate new instruments and processes that may be needed due to growth or regulatory changes.

Outdoor wiring to pumps and outlets is both poorly and dangerously spliced. Missing junction box covers and improper splices in electrical wiring were observed. Even if the current building and facilities are kept in service, the majority of the electrical system should be replaced.

Wiring to the intake pump must be a flexible jacketed cable for submersible applications. Operators have noted the need to use an emergency pump when the primary pump fails or when it is removed to allow sand to be cleaned from the intake structure. A waterproof junction box with a twist-lock receptacle will provide a safe way for operators to change out pumps. If necessary, the box can be provided with both 3-phase and single phase connectors. The dangerous situation in the intake wetwell should be addressed immediately.

In summary, the state of the control and electrical system is:

- Original controls are dated and require replacement
- Recent telemetry upgrades are well constructed but of limited use in a facility upgrade
- Power to site is outdated and marginally sized (only 100-amp)
- Electrical system contains deteriorated components or parts out of compliance with modern building codes
- Some wiring shows evidence of substandard work and dangerous conditions for operators

Table of Current and Needed Electrical System

Item	Existing	Required
Electrical Service	100 Amp 120/240 Delta Hi-Leg	200 Amp 120/208 Wye. New facility should be 100 Amp 277/480 Volt Wye, or 200 Amps if combined with wastewater plant.
Standby Generator	None	30-35 kW, Nema 3R or 4X transfer switch. 50kW if combined with wastewater plant
Main Panels	One panel with 100 Amp main	New 200 Amp panel, 120/208 Volt, or 100 Amp 277/480 Volt
Conduit and wiring	Mixture of EMT, rigid and more modern liquidtight connection. Original conduit experiencing corrosion	New EMT indoors with watertight connections, PVC or Epoxy protected rigid conduit outdoors, liquidtight flexible conduit to equipment
Panels and Junction Boxes	Mixture of Nema 1 to 4X panels. Outdoor and Rotoflow unit junction boxes have significant corrosion.	Use all sealed junction boxes and access point outdoors, and indoors where exposed to water. All outdoor panels should be Nema 4 or 4X, indoor 4X where exposed to water, Nema 12 where protected from water.
Intake Pump	Uncovered and dangerously spliced wiring	Flexible pump cord with twist-lock receptacle to facilitate changeouts to a temporary pump. Sealed Nema 4X junction box
Heating	Resistance Unit Heater	Modern resistance heater or small heat pump with Programmable Thermostat
Lighting	Indoor Fluorescent T-12 and Outdoor Halogen Motion Sensing	Energy Efficient Fluorescent T8 or T5 fixture, vaportight fixtures where outdoors or over exposed liquid. Forest Service has new high efficiency fixtures on hand.

4.3.4 Summary

Based upon the limiting flocculation and sedimentation processes, a maximum flow of 25 gpm is recommended for the existing plant. A design flow of 35 gpm is recommended to size or select future equipment and improvements as discussed in Section 6.2.2. Due to the condition of the steel tankage, the need to rebuild the filter, the need to replace and improve the backwash system, the lack of automated filter-to-waste provisions, the lack of capability and expandability of the control system, the slightly deficient volumes for flocculation and sedimentation, the fact that the manufacturer is no longer in business, and the relatively poor turbidity removal performance records, it is recommended that the package plant be replaced in the near future.

During construction of any major plant improvements, the existing plant will need to remain in service or temporary treatment equipment brought in for a few months. The lack of a separate clearwell may make the use of temporary treatment equipment during construction unattractive since provisions for temporary chlorine contact time would also have to be implemented prior to dismantling of the existing equipment package.

As an interim measure it is recommended that the raw water flow be throttled back to match the 28 gpm finish water flow as closely as possible. It is also recommended that the filtrate turbidity sample point be relocated to the pipe between the filter and the clearwell. Alternatives for plant improvements are discussed in Section 7.

4.4 Distribution Facilities

The distribution system consists of various small diameter piping as necessary to provide water service to the various buildings and water fixtures. The largest piping is a 6-inch diameter transmission main running from the storage tank, down through the compound and across the river, supplying facilities on the west side of the river including fire hydrants near the helipads. A pressure reducing station exists to reduce incoming pressure of 130 psi from the storage tank to a downstream pressure of 65 psi. Some of the piping is old galvanized pipe which will continue to deteriorate and leak over time requiring repairs and replacements as needed.

4.5 Treated Water Storage

The District has a single treated water storage tank with a volume of approximately 43,000 gallons. The bolted steel tank was installed in 2011 and is in new condition. Based on experience and industry standards, emergency storage volume is recommended to be 1 to 1.25 times the MDD or approximately equal to 3 times the ADD. The tank provides a total storage volume equal to approximately three average days demand (or one peak day demand) and is properly sized when significant fire storage is excluded. If significant fire storage were provided, the Oregon Fire Code would suggest 120,000 gallons of fire storage (1,000 gpm for 2 hours) as a minimum for residential structures however this volume could possibly result in water quality problems due to water age because of the transient nature of the use of the facility season by season. The tank should be inspected and cleaned every 3 to 5 years. Divers (such as employed by Liquivision Technology) can be utilized to clean and inspect the tank interior without draining the tank. The tank will likely need repainting around the year 2030.

4.6 Existing Utilities at or Near Site

Other utilities at or near the site include existing electrical power and existing sanitary sewer facilities.

Land-line phone service is available for emergency alarm dialers. Cell-phone service is not available near the sites. The Forest Service contracts for a T-1 internet line to the site with VOIP (Voice over Internet Protocol) phone service. High speed internet service could be extended from the network equipment location to the WTP.

4.7 Existing Access Routes/Right-of-Way Issues

The water treatment plant and associated distribution system piping and storage tank are located on USFS property. Portions of the access route to the storage tank are located on private property and the USFS is currently working on obtaining the necessary easement. The raw water intake located in the South Umpqua River is partially within waters of the State and instream work for upgrades will require a Joint Army Corps of Engineers and Oregon Department of State Lands Permit.

4.8 Summary of Existing Operating Costs

Based on the most recent data available from the Forest Service, annual operating cost for the water treatment plant is $82,093. The majority of existing operating costs (88%) are contract labor costs for plant operators. Electrical costs more than double in winter months, presumably due to heating costs. Electricity averages $0.09 per kWH.

Year	Labor*	Chemicals, Repairs, etc.	Electrical Power**	Total
08/09	$61,242	$3,451	$4,891	$69,584
09/10	$62,928	$4,483	$4,891	$72,302
10/11	$68,015	$4,158	$4,891	$77,063
11/12	$72,204	$4,999	$4,891	$82,093

* Half of total labor cost with Wastewater Plant having equal cost to this value

** Actual cost from 2010/2011 provided and used for each year

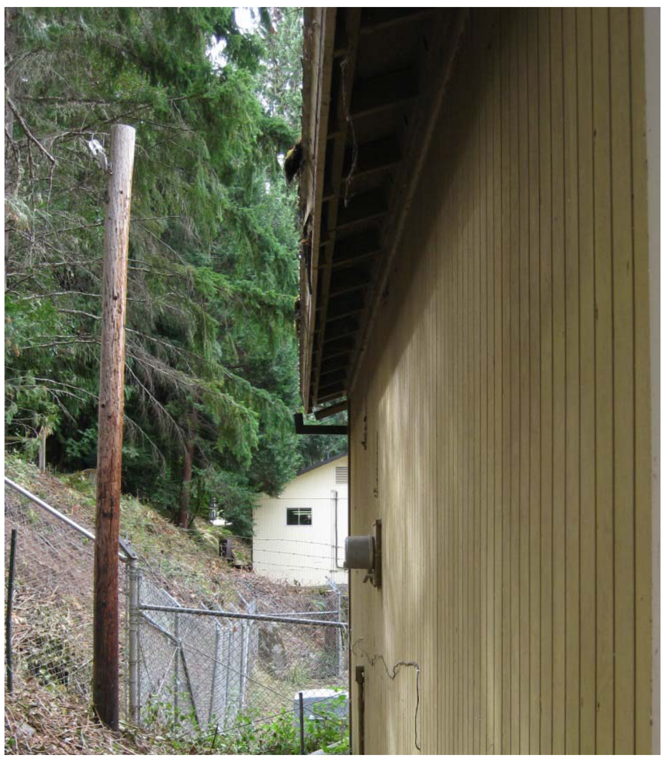
4.9 Deferred Maintenance Items

- Rotoflow Steel Tank – recoating past due
- Filter Media – full filter rebuild (anthracite, sand, and support gravel) past due
- Building Exterior Painting
- Building Fascia – Some evidence of potential deterioration
- Building Gutter – missing gutter on east side
- Various pump controls and wiring systems

As stated previously, refurbishment of the existing process equipment is not recommended since full replacement is now due. It is our opinion that it would not be prudent to spend money on some deferred items such as re-coating the steel package tank, rebuilding the filter, modifying the mechanical piping, valving, and controls to provide filter-to-waste, and other improvements with significant cost.

If the recommended improvements are implemented along with a new building for the new WTP equipment, the existing building may remain for office or storage space. In this case, replacing any defective fascia or trim, and then repainting the building exterior would be recommended.

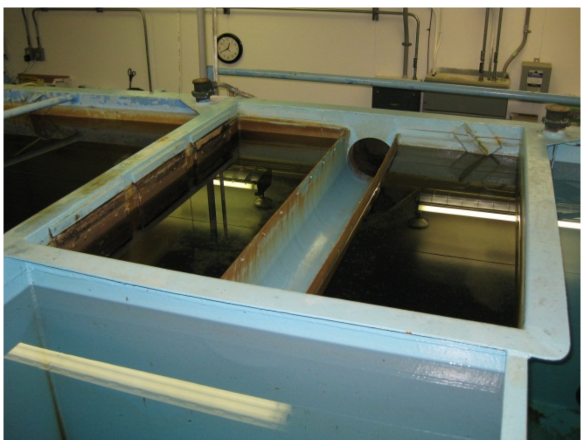
Rotoflow Package Equipment



Missing Gutter at East Side of Building

Backwash Pump and Control Valve

Non-Functioning and Improper Filter-To-Waste Components (white PVC, black valve)



Top of Filter

Finish Water Pump

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5.0 Regulatory Issues

Section 5

5.1 Water Rights Summary – Water Resources Department

There are three water rights certificates associated with the Tiller Ranger Station allowing for withdrawals from the South Umpqua River of up to 71.8 gpm for domestic use plus an additional 4.9 gpm for fire protection only. The water rights are sufficient for the foreseeable future.

Certificate Number	Use	Rate (cfs)	Rate (gpm)	Priority Date
7752	Domestic	0.10	44.9	1/17/1928
41848	Domestic	0.05	22.4	7/7/1967
64583	Domestic	0.01	4.9	12/5/1984
64583	Fire	0.01	4.9	12/5/1984

5.2 Summary of Recent Sanitary Survey

The most recent sanitary survey by the State was conducted in June 2009. The report listed the lack of a high turbidity alarm as the only deficiency. Other recommended improvements included adding a low chlorine residual alarm, replacement of the old 100,000-gallon redwood tank, and fencing of tank site. It was also recommended that distribution system chlorine levels be recorded twice per week. All of these recommendations have been implemented with the exception of fencing at the tank site.

5.3 Water Quality Requirements

Water providers should always be informed of current standards, which can change over time, and should also be aware of pending future regulations. As of this writing, OAR Chapter 333, Division 61 covering Public Water Systems is over 375 pages in length and the latest effective version is dated 8-12-2010. This Section is not meant to be a comprehensive list of all requirements but a general overview of the requirements.

Specific information on the regulations concerning public water systems may be found in the Oregon Administrative Rules (OAR), Chapter 333, Division 61. The rules can be found on the Internet at http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/Rules/Documents/pwsrules.pdf where copies of all the rules and regulations can be printed out or downloaded for reference.

Drinking water regulations were established in 1974 with the signing of the Safe Drinking Water Act (SDWA). This act and subsequent regulations were the first to apply to all public water systems in the United States. The Environmental Protection Agency (EPA) was authorized to set standards and implement the Act. With the enactment of the Oregon Drinking Water Quality Act in 1981, the State of Oregon accepted primary enforcement responsibility for all drinking water regulations within the State. Requirements are detailed in OAR Chapter 333, Division 61. The SDWA and associated regulations have been amended several times since inception with the goal of further protection of public health.

SDWA requires the EPA to regulate contaminants which present health risks and are known, or are likely, to occur in public drinking water supplies. For each contaminant requiring federal regulation, EPA sets a non-enforceable health goal, or maximum contaminant level goal (MCLG). This is the level of a contaminant in drinking water below which there is no known or expected health risk. The EPA is then required to establish an enforceable limit, or maximum contaminant level (MCL), which is as close to the MCLG as is technologically feasible, taking cost into consideration. Where analytical methods are not sufficiently developed to measure the concentrations of certain contaminants in drinking water, the EPA specifies a treatment technique instead of an MCL to protect against these contaminants.

Water systems are required to collect water samples at designated intervals and locations. The samples must be tested in State approved laboratories. The test results are then reported to the State, which determines whether the water system is in compliance or violation of the regulations. There are three main types of violations:

> (1) MCL violation — occurs when tests indicate that the level of a contaminant in treated water is above the EPA or State's legal limit (states may set standards equal to, or more protective than, EPA's). These violations indicate a potential health risk, which may be immediate or long-term.
>
> (2) Treatment technique (TT) violation — occurs when a water system fails to treat its water in the way prescribed by EPA (for example, by not disinfecting). Similar to MCL violations, treatment technique violations indicate a potential health risk to consumers.
>
> (3) Monitoring and reporting violation — occurs when a system fails to test its water for certain contaminants or fails to report test results in a timely fashion. If a water system does not monitor its water properly, no one can know whether or not its water poses a health risk to consumers.

If a water system violates EPA/State rules, it is required to notify the State and the public. States are primarily responsible for taking appropriate enforcement actions if systems with violations do not return to compliance. States are also responsible for reporting violation and enforcement information to the EPA quarterly.

To comply with the regulations, water systems must provide adequate treatment techniques, operate treatment processes to meet performance standards, and properly protect treated water to prevent subsequent contamination after treatment.

There are now EPA-established drinking water quality standards for 91 contaminants, including 7 microbials and turbidity, 7 disinfectants and disinfection byproducts, 16 inorganic chemicals (including lead and copper), 56 organic chemicals (including pesticides and herbicides), and 5 radiologic contaminants. These standards either have established MCLs or treatment techniques. In addition, there are secondary contaminant levels for 16 contaminants that represent desired goals, and in the case of fluoride, may require special public notice.

Total Coliform Rule

The total coliform rule was established by the EPA in 1989 to reduce the risk of waterborne illness resulting from disease-causing organisms associated with animal or human waste. Routine samples collected by Oregon public water suppliers are analyzed for total coliform bacteria. The number of monthly samples required varies based on population served. For the Tiller Ranger Station, a minimum of 1 sample per month is required.

Compliance is based on the presence or absence of total coliforms in any calendar month. Sample results are reported as "coliform-absent" or "coliform-present". If any routine sample is coliform-present, a set of at least three repeat samples must be collected within 24 hours. If any repeat sample is total coliform-present, the system must analyze that culture for fecal coliforms or *E. coli*, and must then collect another set of repeat samples, unless the MCL has been violated and the system has notified the State. Following a positive routine or repeat total coliform result, the system must collect a minimum of five routine samples the following month.

Systems which collect fewer than 40 samples per month are allowed no more than one coliform-present sample per month including any repeat sample results. Larger systems (40 or more samples per month) are allowed no more than five percent coliform-present samples in any month including any repeat sample results. Confirmed presence of fecal coliform or *E. coli* presents a potential acute health risk and requires immediate notification of the public to take protective actions such as boiling or using bottled water. Any fecal coliform-positive repeat sample or *E. coli*-positive repeat sample, or any total coliform-positive repeat sample following a fecal or *E. coli*-positive routine sample is a violation of the MCL.

Community and Non-transient Non-community water systems that use chlorine or chloramines must measure the residual disinfectant level at the same points in the distribution system and at the same time when total coliforms are sampled.

Surface Water Treatment Rules

All water systems using surface water must provide a total level of filtration and disinfection treatment to remove/inactivate 99.9 percent (3-log) of *Giardia lamblia*, and to remove/inactivate 99.99 percent (4-log) of viruses. In addition, filtered water systems must physically remove 99 percent (2-log) of *Cryptosporidium.* Systems with source water *Cryptosporidium* levels exceeding specified limits must install and operate additional treatment processes.

Filtered water systems must meet specified performance standards for combined filter effluent turbidity levels, and water systems using conventional and direct filtration must also record individual filter effluent turbidity and take action if specified action levels are exceeded. When more than 1 filter exists, each filter's effluent turbidity must be monitored continuously and recorded at least every 15 minutes. The combined flow from all filters must have a turbidity measurement at least every four hours by grab sampling or continuous monitoring. Turbidity monitoring must occur prior to any storage such as a clearwell or contact tank. Turbidity monitoring equipment must be calibrated using an approved method at least once per quarter. General requirements for systems utilizing conventional or direct filtration are:

- Individual filter turbidity monitored continuously and recorded every 15 minutes or less
- Combined filter turbidity monitored continuously or grab sample taken at least every 4 hours
- Combined filter turbidity less than 1 NTU in 100% of measurements
- Combined filter turbidity less than or equal to 0.3 NTU in 95% of measurements in a month
- Specific follow-up actions if individual filter turbidity exceeds 1.0 NTU twice

General requirements for systems utilizing slow sand, and alternative filtration (membrane filtration and cartridge filtration) are:

- Combined filter turbidity monitored continuously or grab sample taken at least every 4 hours Department may reduce to once per day if determined to be sufficient
- Combined filter turbidity less than 5 NTU in 100% of measurements
- Combined filter turbidity less than or equal to 1 NTU in 95% of measurements in a month
- Department may require lower turbidity values if the above levels cannot provide the required level of treatment

All water systems must meet specified CxT [concentration x time] requirements for disinfection, and meet required removal/inactivation levels. In addition, a disinfectant residual must be maintained in the distribution system.

- Continuous recording of disinfectant residual at entry point to the distribution system. Small system may be allowed to substitute 1-4 daily grab samples.
- Daily calculation of CxT at highest flow (peak hourly flow)
- Provide adequate CxT to meet needed removal/inactivation levels
- Maintain a continuous minimum 0.2 mg/L disinfectant residual at entry point to the distribution system

- Maintain a minimum detectable disinfectant residual in 95% of the distribution system samples (collected at coliform bacteria monitoring points)

Filtered water systems that recycle spent filter backwash water or other waste flows must return those flows through all treatment processes in the filtration plant. Systems wishing to recycle filter backwash water must provide notice to the State including a plant schematic showing the origin, conveyance, and return location of recycled flows. Design flows, observed flows, and typical recycle flows are also required along with a state-approved plant operating capacity.

Disinfectants and Disinfection Byproducts

Disinfection treatment chemicals used to kill microorganisms in drinking water can react with naturally occurring organic and inorganic matter in source water, called DBP precursors, to form disinfection byproducts (DBPs). Some disinfection byproducts have been shown to cause cancer and reproductive effects in lab animals and suggested bladder cancer and reproductive effects in humans. The challenge is to apply levels of disinfection treatment needed to kill disease-causing microorganisms while limiting the levels of disinfection byproducts produced. The primary disinfection byproducts of concern in Oregon are the total trihalomethanes (TTHM) and the haloacetic acids (HAA5).

Disinfection byproducts must be monitored throughout the distribution system at frequencies of daily, monthly, quarterly, or annually, depending on the population served, type of water source, and the specific disinfectant applied, and in accordance with an approved monitoring plan. Disinfectant residuals must be monitored at the same locations and frequency as coliform bacteria.

Total organic carbon (TOC) is an indicator of the levels of DBP precursor compounds in the source water. Systems using surface water sources and conventional filtration treatment must monitor source water for TOC and alkalinity monthly and practice enhanced coagulation to remove TOC if it exceeds 2.0 mg/L as a running annual average.

Compliance is determined based on meeting maximum contaminant levels (MCLs) for disinfection byproducts and maximum levels for disinfectant residual (MRDLs) over a running annual average of the sample results, computed quarterly.

- TTHM/HAA5 monitoring required in distribution system. One sample per quarter for systems serving 500-9,999 persons. One sample per year in warmest month required for systems serving less than 500.
- MCL for TTHM is 0.080 mg/L. MCL for HAA5 is 0.060 mg/L.
- Any system having TTHM > 0.064 mg/L or HAA5 > 0.048 based on a running annual average must conduct disinfection profiling.
- TOC and alkalinity monitoring in source water monthly. TOC in finish water monthly. Enhanced coagulation if TOC greater than 2.0 mg/L
- Comply with MRDLs. Limit for chlorine (free Cl_2 residual) is 4.0 mg/L. Limit for chloramines is 4.0 mg/L (as total Cl_2 residual). Limit for chlorine dioxide is 0.8 mg/L (as ClO_2)
- Bromate MCL of 0.010 mg/L
- Chlorite MCL of 1.0 mg/L

Data for the Tiller system shows running annual average TOC concentrations of less than 2.0 mg/L so enhanced coagulation is not required. The latest 2011 test results showed finish water HAA5 of 0.041 mg/L and TTHM of 0.056 mg/L.

Long-Term 2 Enhanced Surface Water Treatment Rule

LT2ESWTR was published by the U.S. EPA on January 5, 2006. The rule requires source water monitoring for public water systems that use surface water or ground water under the influence of surface water. Based on the system size and filtration type, in 2008 through 2010, systems were required to monitor for *Cryptosporidium*, *E. coli*, and turbidity. Source water monitoring data was used to categorize the source water *Crypto* concentration into four "bin" classifications that have associated treatment requirements. Systems serving 10,000 or more people were required to conduct 24 months of *Crypto* monitoring. Systems serving fewer than 10,000 people were required to conduct 12 months of *E. coli* monitoring and 12-24 months of *Crypto* monitoring if *E. coli* trigger levels were exceeded. The rule provided other options to comply with the initial source water monitoring that included either submitting previous *Crypto* data meeting (grandfathered data) the requirements or committing to provide a total of at least 5.5-log treatment for *Cryptosporidium*. A second round of source water monitoring will follow 6 years after the system makes its initial bin determination.

Critical Deadlines for LT2ESWTR for systems serving less than 10,000 persons include:
Submit Bin Classification:______________________________September 2012
Comply with Rule:__________________________________October 1, 2014
Begin second round of source water monitoring: ______________Oct. 1, 2017 (April 1, 2019*)
** Cryptosporidium monitoring - applies to filtered systems that exceed E. coli trigger*

The Tiller Ranger Station has completed the initial *E. coli* source water monitoring with an average result of 3.5 *E. coli*/100 mL – much less than the 50 *E. coli*/100 mL limit that would trigger C*rypto* monitoring and/or additional levels of treatment. In a letter from the U.S. EPA dated November 3, 2009 the Tiller Ranger Station was given "**Bin 1**" classification requiring the least stringent levels of treatment. A second round of E. coli source water monitoring will be required beginning no later than October 2017.

Bin Classification	Type of SWTR Filtration Treatment and *Cryptosporidium* Treatment Requirement			
	Conventional Filtration	Direct Filtration	Slow Sand or DE Filtration	Alternative Technologies
1	No additional treatment	No additional treatment	No additional treatment	No additional treatment ←
2	1-log treatment	1.5-log treatment	1-log treatment	Total must be 4.0 log
3	2-log treatment	2.5-log treatment	2-log treatment	Total must be 5.0 log
4	2.5-log treatment	3-log treatment	2.5-log treatment	Total must be 5.5 log

Stage 2 Disinfectants and Disinfection Byproducts Rule
The Stage 2 DBPR was published by the U.S. EPA on January 4, 2006. The Oregon rule is expected to be finalized on January 4, 2010. The rule builds on existing regulations by requiring water systems to meet disinfection byproduct (DBP) MCLs at each monitoring site in the distribution system. Whereas the Stage 1 Rule controls average DBP levels across distribution systems, the Stage 2 Rule controls the occurrence of peak DBP levels within distribution systems.

The rule requires all community water systems to conduct an Initial Distribution System Evaluation (IDSE). The goal of the IDSE is to characterize the distribution system and identify monitoring sites where customers may be exposed to high levels of TTHM and HAA5. There are four ways to comply with the IDSE requirements: Standard Monitoring, System Specific Study, 40/30 Certification, and Very Small System (VSS) Waiver.

Standard monitoring (SM) is one year of increased monitoring for TTHM and HAA5 in addition to the data being collected under Stage 1 DBPR. These data will be used with the Stage 1 data to select Stage 2 DBPR TTHM and HAA5 compliance monitoring locations. Any system may conduct standard monitoring to meet the Initial Distribution System Evaluation (IDSE) requirements of the Stage 2 DBPR. The number of monitoring sites, the monitoring periods, and monitoring frequency vary depending on population served.

Systems that have extensive TTHM and HAA5 data (including Stage 1 DBPR compliance data) or technical expertise to prepare a hydraulic model may choose to conduct a system specific study (SSS) to select the Stage 2 DBPR compliance monitoring locations.

The term "40/30" refers to a system that during a specific time period has all individual Stage 1 DBPR compliance samples less than or equal to 0.040 mg/L for TTHM and 0.030 mg/L for HAA5 and no monitoring violations during the same period. These systems have no IDSE monitoring requirements, but will still need to conduct Stage 2 DBPR compliance monitoring.

The Very Small System (VSS) Waiver applies to systems that serve fewer than 500 people and have eligible TTHM and HAA5 data. The Tiller Ranger Station received a VSS Waiver. The VSS eligibility does not depend on the actual TTHM and HAA5 sample results. These systems also have no IDSE monitoring requirements, but will still need to conduct Stage 2 DBPR compliance monitoring.

Critical Deadlines for Stage 2 DBPR for systems serving less than 10,000 persons include:

Submit SM Plan or SSS Plan:______________________________April 1, 2008
Complete SM:____March 31, 2010
Submit IDSE Report:_____________________________________July 1, 2010
Begin Compliance Monitoring:_____________________________October 1, 2013

Lead and Copper
Excessive levels of lead and copper are harmful and rules exist to limit exposure through drinking water. Lead and copper enter drinking water mainly from corrosion of plumbing materials containing lead and copper. Lead comes from solder and brass fixtures. Copper comes from copper tubing and brass fixtures. Protection is provided by limiting the corrosivity of water sent to the distribution system. Treatment alternatives include pH adjustment, alkalinity adjustment, or both, or adding passivating agents such as orthophosphates.

Samples from community systems are collected from homes built prior to the 1985 prohibition of lead solder in Oregon. One-liter samples of standing water (first drawn after 6 hours of non-use) are collected at homes identified in the water system sampling plan. Two rounds of initial sampling are required, collected at 6-month intervals. Subsequent annual sampling from a reduced number of sites is required after demonstration that lead and copper action levels are met. After three rounds of annual sampling, samples are required every 3 years. The number of initial and reduced samples required is dependent on the population served by the water system.

In each sampling round, 90% of samples from homes must have lead levels less than or equal to the Action Level of 0.015 mg/L and copper levels less than or equal to 1.3 mg/L. Water systems with lead above the Action Level must conduct periodic public education, and either install corrosion control treatment, change water sources, or replace plumbing.

- Have Sampling Plan for applicable homes
- Collect required samples
- Meet Action Levels for Lead and Copper (0.015 mg/L for Lead and 1.3 mg/L for Copper)
- Rule out source water as a source of significant lead levels
- If Action Levels not met, provide corrosion control treatment and other steps

Inorganic Contaminants
The level of many inorganic contaminants is regulated for public health protection. These contaminants are both naturally occurring and can result from agriculture or industrial operations. Inorganic contaminants most often come from the source of water supply, but can also enter water from contact

with materials used for pipes and storage tanks. Regulated inorganic contaminants include arsenic, asbestos, fluoride, mercury, nitrate, nitrite, and others. A possible future MCL for Nickel is currently being evaluated by EPA.

Compliance is achieved by meeting the established MCLs for each contaminant. Systems that cannot meet one or more MCL must either install treatment systems (such as ion exchange or reverse osmosis) or develop alternate sources of water.

- Sample quarterly for Nitrate (reduction to annual may be available)
- Communities with Asbestos Cement (AC) pipe must sample every 9 years for Asbestos
- Sample annually for Arsenic. New MCL of 0.010 mg/L effective January 2006
- Sample annually for all other inorganics. Waivers are available based on monitoring records showing three samples below MCLs. MCLs vary based on contaminant

Organic Chemicals

Organic contaminants are regulated to reduce exposure to harmful chemicals through drinking water. Examples include acrylamide, benzene, 2,4-D, styrene, toluene, and vinyl chloride. Major types of organic contaminants are Volatile Organic Chemicals (VOCs) and Synthetic Organic Chemicals (SOCs). Organic contaminants are usually associated with industrial or agricultural activities that affect sources of drinking water supply, including industrial and commercial solvents and chemicals, and pesticides. These contaminants can also enter from materials in contact with the water such as pipes, valves and paints and coatings used inside water storage tanks.

At least one test for each contaminant from each water source is required during every 3-year compliance period. Public water systems serving more than 3,300 people must test twice during each 3-year compliance period for SOCs. Public water systems using surface water sources must test for VOCs annually.

Compliance is achieved by meeting the established MCL for each contaminant. Quarterly follow up testing is required for any contaminants that are detected above the specified MCL. Only those systems determined by the State to be at risk must monitor for dioxin. Water systems using polymers containing acrylamide or epichlorohydrin in their water treatment process must keep their dosages below specified levels. Systems that cannot meet one or more MCL must either install or modify water treatment systems (such as activated carbon and aeration) or develop alternate sources of water.

- At least one test for each contaminant (for each water source) every 3-year compliance period
- Sample twice each compliance period for each SOCs when system over 3,300 people
- Test VOCs annually
- Quarterly follow up testing required for any detects above MCL
- Maintain polymer dosages in treatment process below specified levels
- MCLs vary based on contaminant

Radiologic Contaminants

Radioactive contaminants, both natural and man-made, can result in an increased risk of cancer from long-term exposure and are regulated to reduce exposure through drinking water. Rules were recently revised to include a new MCL for uranium (30 µg/L), and to clarify and modify monitoring requirements. Initial monitoring tests, quarterly for one year at the entry point from each source, were to be completed by December 31, 2007 for gross alpha, radium-226, radium-228 and uranium. A single analysis for all four contaminants collected between June 2000 and December 2003 will substitute for the four initial samples. Gross alpha may substitute for radium-226 if the gross alpha result does not exceed 5 pCi/L and may substitute for uranium monitoring if the gross alpha result does not exceed 15 pCi/L. Subsequent monitoring is required every three, six, or nine years depending on the initial results, with a return to quarterly monitoring if the MCL is exceeded. Compliance with MCLs is based on the average of the four initial test results, or subsequent quarterly tests. Community water systems than cannot meet MCLs must install treatment (such as ion exchange or reverse osmosis) or develop alternate water sources.

5.4 Responsibilities of a Water Purveyor

Per OAR 333-061-0025, water suppliers are responsible for taking all reasonable precautions to assure that the water delivered to water users does not exceed maximum contaminant levels, to assure that water system facilities are free of public health hazards, and to assure that water system operation and maintenance are performed as required by these rules. This includes, but is not limited to, the following:

- Routinely collect and submit water samples for laboratory analyses at the frequencies and sampling points prescribed by OAR 333-061-0036 "Sampling and Analytical Requirements";
- Take immediate corrective action when the results of analyses or measurements indicate that maximum contaminant levels have been exceeded and report the results of these analyses as prescribed by OAR 333-061-0040 "Reporting and Record Keeping";
- Continue to report as prescribed by OAR 333-061-0040, the results of analyses or measurements which indicate that maximum contaminant levels (MCLs) have not been exceeded;
- Notify all customers of the system, as well as the general public in the service area, when the maximum contaminant levels have been exceeded;
- Notify all customers served by the system when the reporting requirements are not being met, or when public health hazards are found to exist in the system, or when the operation of the system is subject to a permit or a variance;
- Maintain monitoring and operating records and make these records available for review when the system is inspected;
- Maintain a pressure of at least 20 pounds per square inch (psi) at all service connections at all times (at the property line);
- Follow-up on complaints relating to water quality from users and maintain records and reports on actions undertaken;
- Conduct an active program for systematically identifying and controlling cross connections;
- Submit, to the DWP, plans prepared by a professional engineer registered in Oregon for review and approval before undertaking the construction of new water systems or major modifications to existing water systems, unless exempted from this requirement;
- Assure that the water system is in compliance with OAR 333-061-0205 "Water Personnel Certification Rules - Purpose" relating to certification of water system operators.
- Assure that Transient Non-Community water systems utilizing surface water sources or sources under the influence of surface water are in compliance with OAR 333-061-0065 "Operation and Maintenance" (2)(c) relating to required special training.

6.0 Salient Design Data

Section 6

6.1 Population Summary

6.1.1 Current Population

The population of the Tiller Ranger District has wide and inconsistent seasonal variations. Per the 2010 Tiller Ranger Station Water Tank Replacement Engineering Report prepared by the USFS, the population served by the water system varies from a low of 10 persons in the winter to a high of 91 persons during full-occupancy in peak season. The current population is assumed to be the same.

The Tiller Ranger District population is dependent on many factors, but most noticeably the summer and fall fire season. During times with high local fire activity, the population swells when firefighters are brought in to help fight the seasonal fires. Conversely, if fire activity is elsewhere, local permanent and seasonal residents can be asked to go to other areas, thereby decreasing the local population for short periods.

6.1.2 Population Projections for the Planning Period

According to USFS staff, no future expansions will occur. Since no expansions or significant changes in use are anticipated, no population changes are expected over the planning period.

6.2 Water Quantity and Quality Analysis

6.2.1 Past Water Demand

Water demand at the Tiller Ranger Station has been determined from Water Treatment Plant daily production records from January 1, 2008 to August 31, 2011. These values include filter backwash water, leakage from the old redwood storage tank, and leakage from the distribution piping. Average Annual Demand (AAD) ranged from 4.8 to 5.8 million gallons per year with an average of 5.4 million gallons. Average Daily Demand (ADD) ranged from 13,208 gallons per day (gpd) to 15,830 gpd with an average of 14,760 gpd. Months with the highest demand have occurred from May to October. The Maximum Month Demand (MMD) for the period of record, expressed as an average, is 28,674 gpd. The average recorded Maximum Day Demand (MDD) for the period was 53,100 gpd; however, this value is misleading according to plant personnel. For the last two years, the plant discharge pump has been throttled to 28 gpm resulting in a maximum possible MDD of 40,320 gpd. Peak day values in the data greater than 40,320 gpd are suspected to be incorrect. Some of the excessive MDD values may be a result of variations in the time of day the flowmeter totalizer is read. For example, a Friday reading may occur at 8:00 AM but the Saturday value may not be recorded by the weekend operations staff until much later in the day leading to a value with more than 24 hours of runtime in the data. Another reason for high MDD values in the production records is the fact that the plant lacked start/stop automation in the past thereby requiring the operator to, at times, have dramatic “make-up” days to catch up on low tank level.

The redwood storage tank was replaced in June 2011 eliminating leakage estimated at 8,000 gpd (Kennedy/Jenks, 2005, 8.2). In addition, other pipeline leakage repairs were completed in 2011 and new controls were installed automating the start/stop of the plant based on storage tank levels.

The raw data with uncorrected MDD values is shown in the following tables and figures.

Table 6.2-1 – Tiller Ranger Station Water Treatment Plant Production Data (uncorrected MDD values)

Month	2008	2009	2010	2011
Jan	300,000	452,100	366,800	412,500
Feb	235,300	451,200	351,400	365,400
Mar	257,400	308,900	417,600	419,600
Apr	245,100	290,200	433,200	399,400
May	322,700	378,700	440,900	888,900
Jun	458,300	490,600	390,700	516,400
Jul	585,000	884,800	394,500	451,800
Aug	566,500	630,800	512,600	467,000
Sep	484,300	512,800	568,700	
Oct	513,900	405,700	743,500	
Nov	438,900	369,900	658,700	
Dec	426,600	388,200	499,200	
AAD	4,834,000	5,563,900	5,777,800	
ADD	13,208	15,244	15,830	
MMD	18,871	28,542	23,984	28,674
MDD	50,200	56,200	52,900	

Table 6.2-2 – Tiller Ranger Station Past Water Demand Summary (corrected MDD values)

Water Demand	2008	2009	2010	2011
AAD (gallons per year)	4,834,000	5,563,900	5,777,800	*
ADD (gpd)	13,208	15,244	15,830	*
MMD (gpd)	18,871	28,542	23,984	28,674
MDD (gpd)**	40,300	40,300	40,300	*
MMD/ADD Peaking Factor	1.43	1.87	1.52	*
MDD/ADD Peaking Factor	3.05	2.64	2.55	*
* insufficient data for accurate values.				
** Estimate of corrected MDD values				

Water system design literature suggests typical MDD/ADD peaking factors ranging from 1.5 to 3.0 and PHD/ADD peaking factors ranging from 2.5 to 5.0. For most communities in Oregon the MDD is 2.0 to 3.0 times the ADD with smaller communities having peaking factors near the higher end. The corrected MDD/ADD peaking factors at the Tiller Ranger Station plant of 2.6 to 3.0 are within the range of those considered typical.

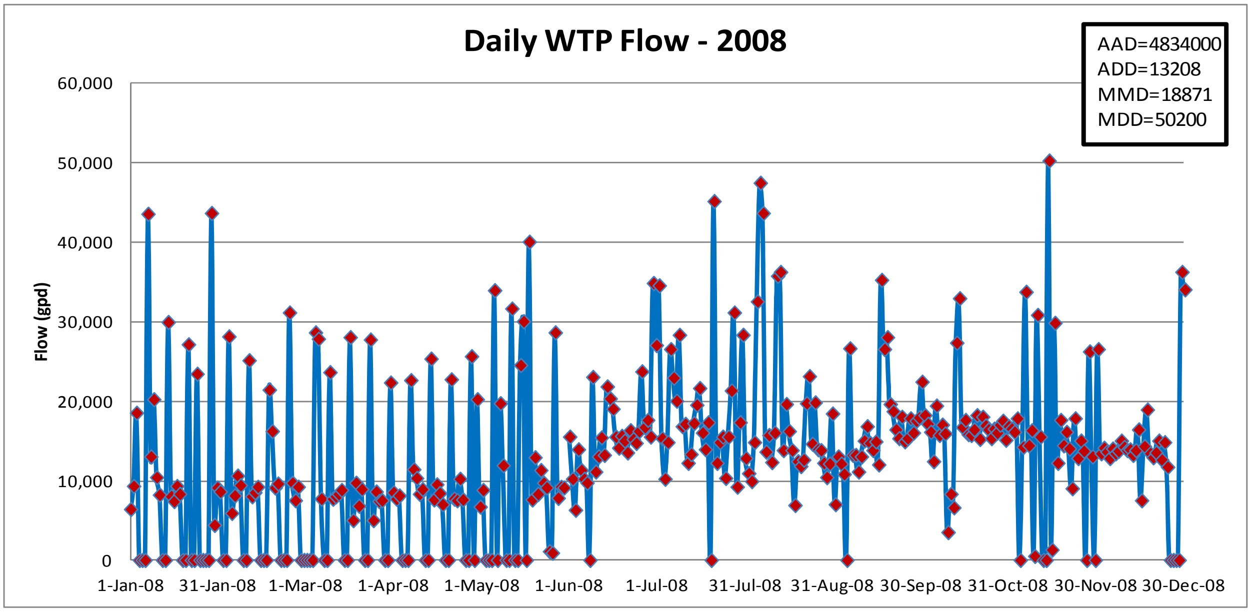


Figure 6.2-1 – Daily Water Production 2008, Tiller Ranger Station Water Treatment Plant

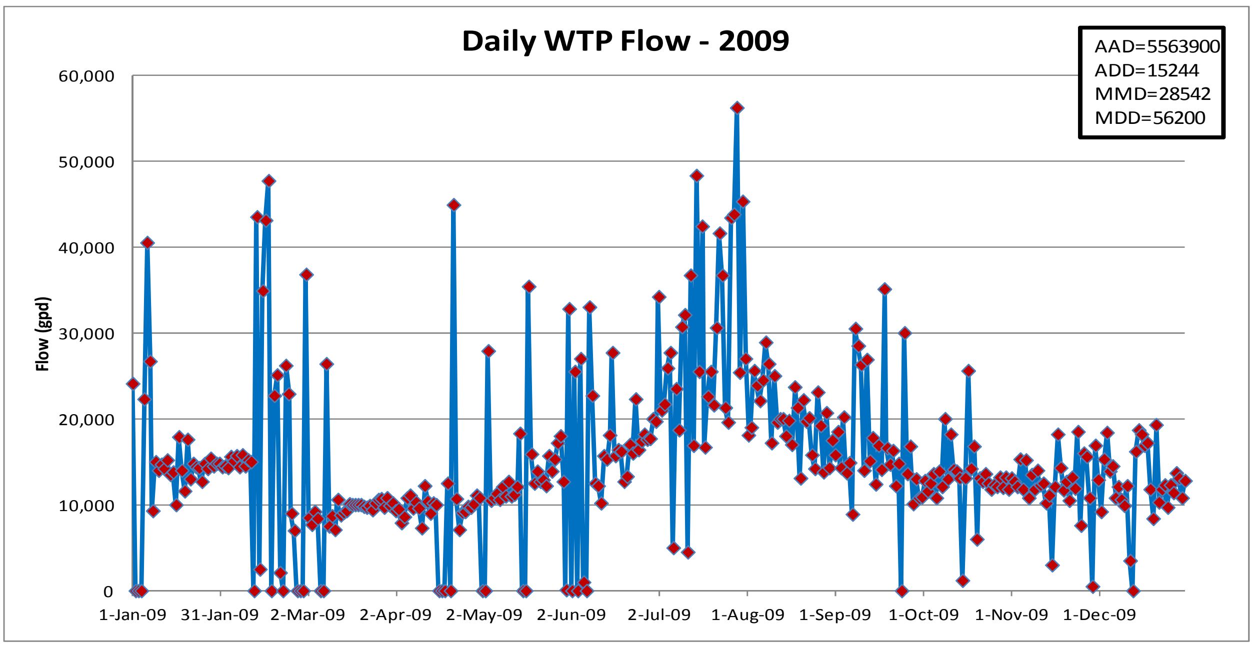


Figure 6.2-2 – Daily Water Production 2009, Tiller Ranger Station Water Treatment Plant

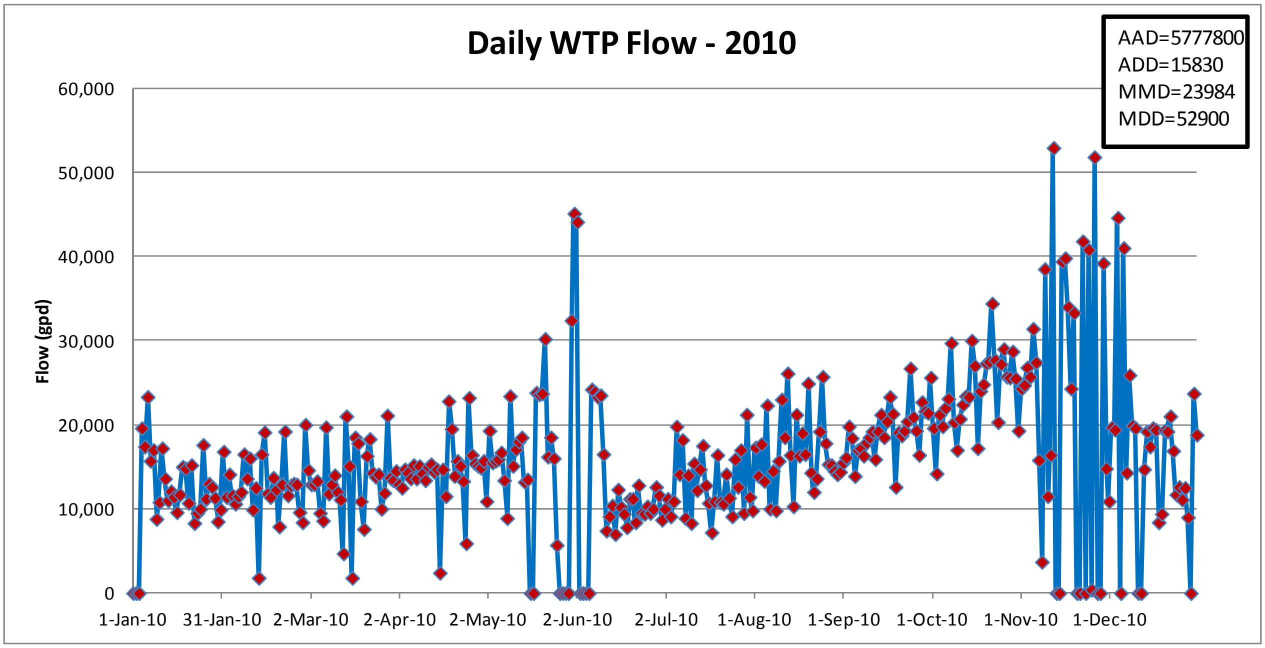


Figure 6.2-3 – Daily Water Production 2010, Tiller Ranger Station Water Treatment Plant

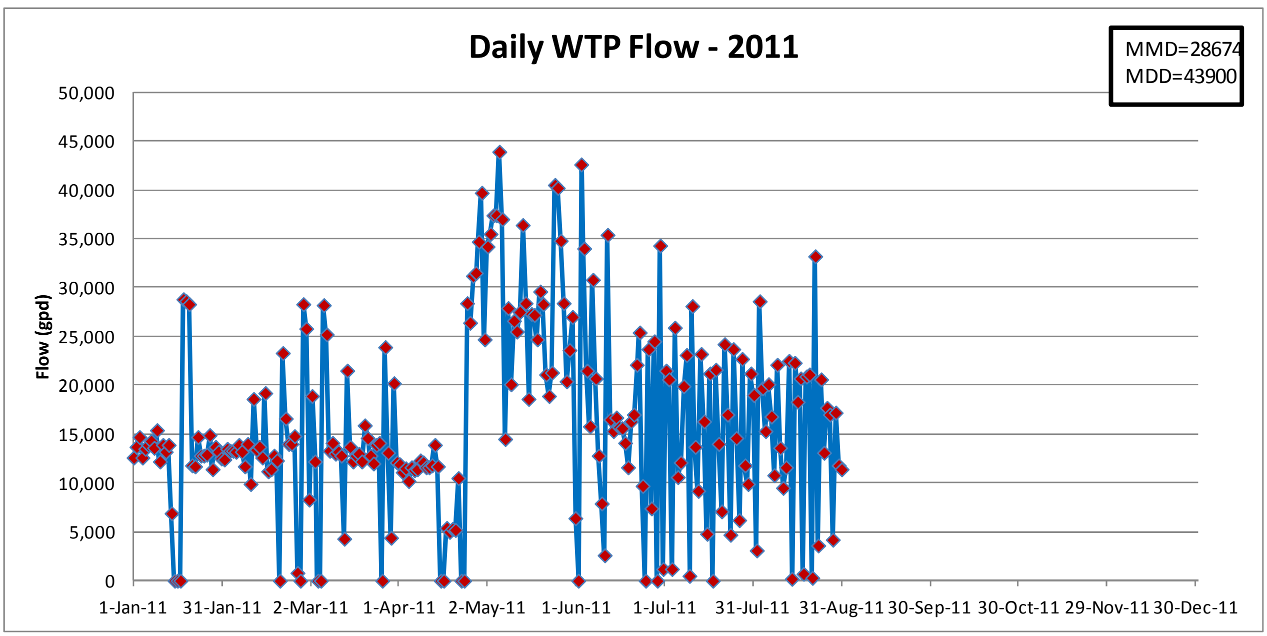
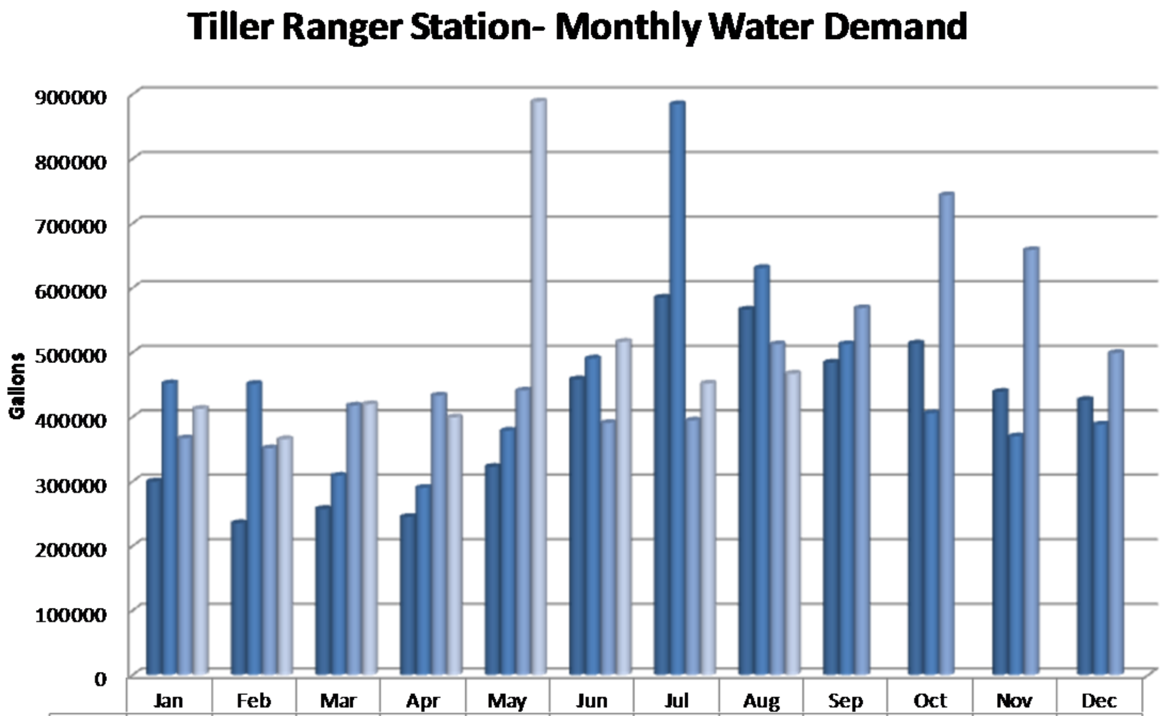


Figure 6.2-4 – Daily Water Production 2011, Tiller Ranger Station Water Treatment Plant



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	300000	235300	257400	245100	322700	458300	585000	566500	484300	513900	438900	426600
2009	452100	451200	308900	290200	378700	490600	884800	630800	512800	405700	369900	388200
2010	366800	351400	417600	433200	440900	390700	394500	512600	568700	743500	658700	499200
2011	412500	365400	419600	399400	888900	516400	451800	467000				

Figure 6.2-5 – Monthly Water Demand, Tiller Ranger Station Water Treatment Plant

6.2.2 Projected Design Water Demand

Since no significant changes in population are anticipated, no significant changes in water demand are expected. For Supply and Treatment, the water demand unit of primary concern is the Maximum Day Demand (MDD). The supply of raw water from the river and the capacity of the treatment plant must be sufficient to meet the MDD. Demands greater than the MDD, such as the Peak Hour Demand (PHD), occur diurnally or temporarily however these demands are typically met through treated water storage. The MDD value for the Tiller water plant is 40,300 gpd. The ADD is 15,000 gpd.

Per capita water use for Oregon is documented by the U.S. Department of the Interior in the 2000 U.S. Geological Survey - Circular 1268. According to the study, the average per capita water use for Oregon is 207 gallons per capita day (gpcd) including domestic, commercial, industrial, public use and loss. Of the total 207 gpcd, 63% is residential, commercial and public use/loss; 34% is industrial; and 3% is related to thermoelectric power generation. For small community water systems with no commercial or industrial use, the average demand becomes approximately 130 gpcd. For a very small system, peak day demands would then typically be around 3 times this average or around 390 gpcd. With an estimated peak population of 91 persons, the approximate "typical" MDD would then be 35,500 gpd. This compares fairly well with the estimated 40,300 gpd from the previous paragraph.

As a conservative basis for planning, it is recommended that new equipment options and alternatives be sized for a peak flow rate of 35 gpm. This will allow MDD peak days to be met without requiring 24 straight hours of production. This design flowrate will allow a high demand day of 35,000 gpd to be met with a little over 16 hours of plant runtime.

6.2.3 Water Quality

Raw water is drawn from an infiltration gallery intake in the South Umpqua River and is pumped to a packaged filter system for treatment. As recorded at the water treatment plant, raw water turbidity ranged from 0.19 NTU to 22 NTU as shown in Figure 6.2-6 with an average of 2.2 NTU. Turbidity spikes of over 100 NTU are suspected immediately after storm events, however the plant is shut-down and these spikes are not recorded. Prior to raw water sampling, some natural filtration occurs due to the infiltration gallery type intake therefore natural stream turbidities are expected to be higher than measured at the plant.

Based on raw water measurements from 2005 through the end of 2011, total organic carbon (TOC) ranges from 0.7 to 2.9 with an average of 1.5 mg/L. Raw water total alkalinity ranges from 26 to 50 with an average of 38 mg/L. Finish water TOC ranged from 0.56 to 1.89 with an average of 1.0 mg/L. Over the last 3 years, TOC reduction through the plant has averaged a low 22% however disinfection byproduct violations have not occurred – likely due to the low raw water TOC.

No significant water quality concerns exist with the source. Minor traces of organic chemicals including chloroform and xylenes were detected in 2006 but all subsequent tests showed non-detectable levels. Mercury was measured at the MCL level of 0.002 mg/L in the year 2000 but subsequent tests showed non-detectable levels. No other alerts have occurred.

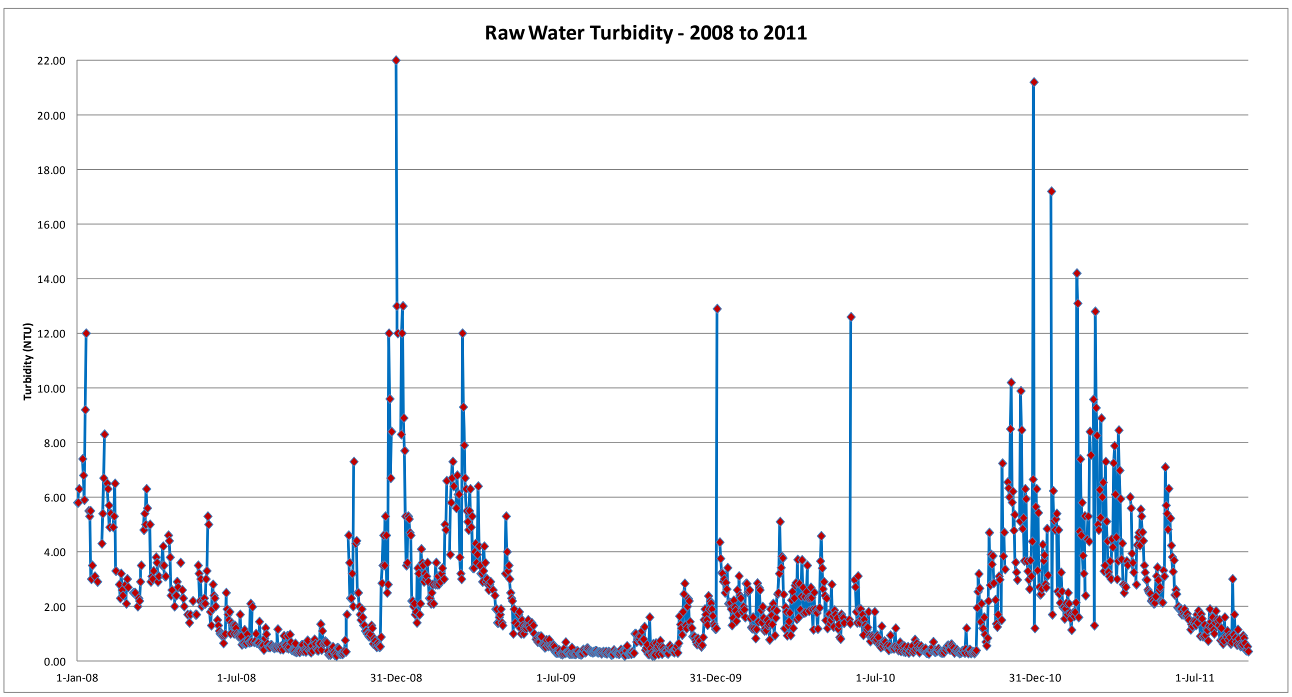


Figure 6.2-6 – Raw Water Turbidity 2008 to 2011, Tiller Ranger Station Water Treatment Plant

Based on the plant bench sheets for the last three years, finish water (treated) turbidity from the Water Treatment Plant averages 0.15 NTU but spikes up to 1.13 NTU have occurred in the recent past as shown in Figure 6.2-7. Treatment rules require that 95% of the samples each month must be less than or equal to 0.3 NTU and never over 1 NTU. The AWWA, the State of Oregon, and the EPA treatment goal for filtrate turbidity is 0.10 NTU. Plants unable to meet the 0.1 NTU goal are considered to not be optimized. It is possible that at some point in the future the 0.1 NTU goal will become the new federal standard.

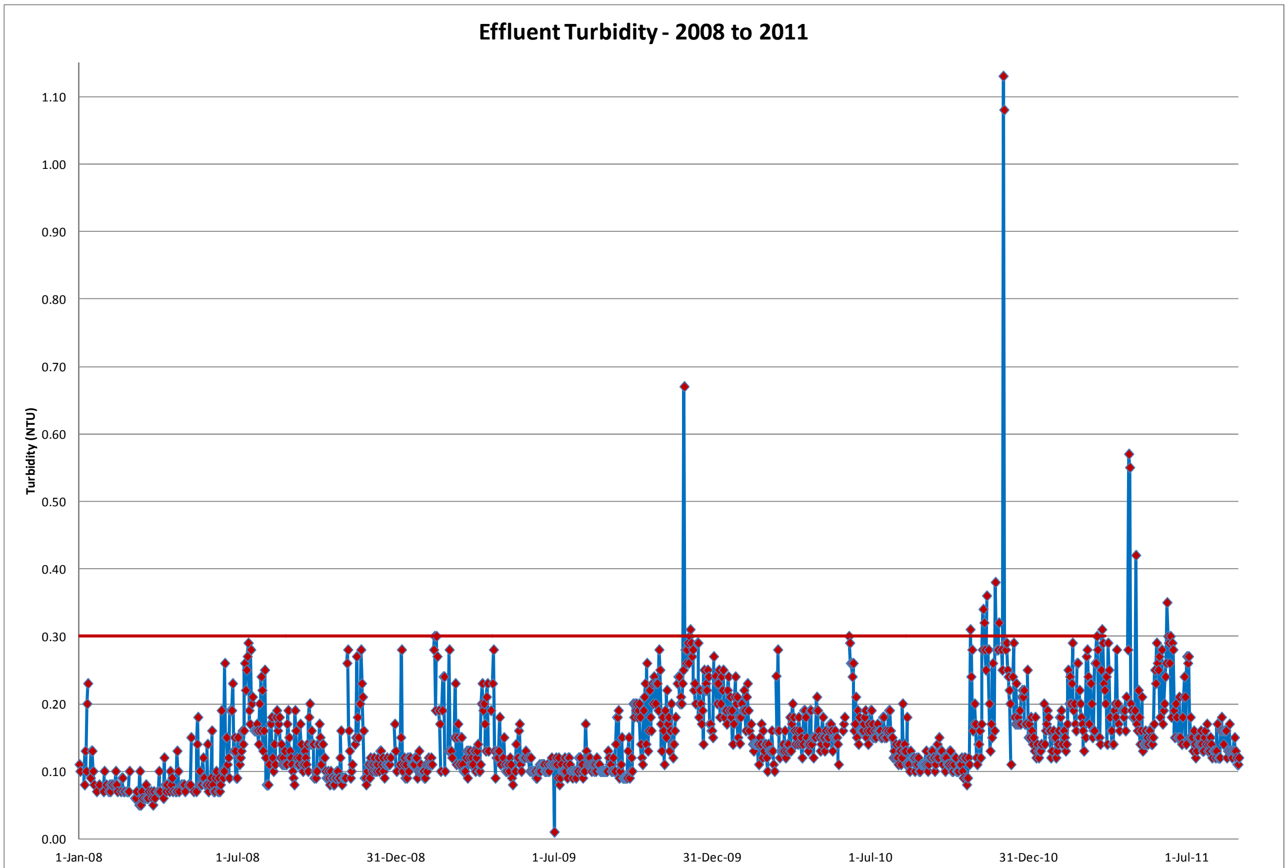


Figure 6.2-7 Effluent Turbidity 2008 to 2011, Tiller Ranger Station Water Treatment Plant

The existing plant is unable to meet the treatment goal of 0.1 NTU and often barely meets the 0.3 NTU maximum contaminant level (MCL). Modern treatment equipment when properly sized and operated should have no trouble meeting 0.3 NTU 100% of the time and meeting 0.1 NTU most of the time. It is suspected that the existing equipment (that was designed to meet a standard of 1.0 NTU) struggles due to excessive raw water flow rates, a deteriorated filter, and lack of modern automation.

6.3 Domestic Water Requirements

Virtually all water demand at the facility is domestic. A typical value for average domestic water need is 130 gpcd and this appears to match the plant records with the seasonally varying number of persons at the facility. Average use can vary from 7,000 gpd in the winter to 15,000 gpd in the summer. Peak summer day demand is estimated to be 48,000 gpd assuming 8,000 gpd in leakage has been recently removed (insufficient data to verify). These values come from actual plant use records and thus include any irrigation water actually used. See also Section 6.2.1.

6.4 Fire Protection Requirements

Forest Service Handbook, FSH 7409.11 45.3 (Figure 7) Section 2 applies since trained structural fire fighting personnel are not available. Two 1.5-inch hose streams simultaneously at 40 gpm each, 40-50 psi at the hydrant, ½-inch nozzles, with 200 foot maximum hose length is recommended. An additional hose stream may be warranted depending on the configuration of buildings and barriers. At flow capability in the piping system of at least 120 gpm is needed to feed 3 hose streams based on this criteria. This flow comes from the storage tank rather than plant capacity.

6.5 Irrigation Requirements

Irrigation need estimates were calculated recently by the Forest Service in the "Tiller Ranger Station Water Tank Replacement Engineering Report, 2010". Irrigation needs of between 6,000 and 12,000 gpd were estimated for the summer season.

6.6 Commercial Requirements

There are no commercial water needs at the Tiller Ranger Station.

6.7 Pressure Requirements

A minimum pressure of 40 psi is desirable at all plumbing fixtures. Pressures above 80 psi should be avoided in domestic plumbing. Pressures above 100 psi should be avoided in water mains to minimize leakage. Oregon rules require that a minimum pressure of 20 psi be maintained at all service connections at all times.

The existing distribution pipe network is downstream of a pressure reducing valve (PRV) which limits the pressure to 65 psi. Some areas within the Ranger Station will receive slightly higher or lower pressures based on the elevation difference, but all will be above 40 and below 80 psi as is currently the case. No changes to the PRV are proposed.

6.8 Quality Requirements – Treatment Goals

The long standing goal of the EPA and the State of Oregon is to have finish water turbidity less than 0.1 NTU 95% of the time. The current rule requires a finish water turbidity of 0.3 NTU or less in 95% of the readings each month and at no time greater than 1 NTU.

Treatment requirements include 99.9% (3-log) removal and/or inactivation of *Giardia lamblia*, 99.99% (4-log) removal and/or inactivation of viruses, and at least 99% (2-log) removal and/or inactivation of *Cryptosporidium*. By meeting the turbidity standards and disinfection CT requirements (free chlorine residual concentration x time), the system is assumed to meet the various log removal requirements. Based on the performance and design of the existing plant, it should be credited with 2-log removal for *Giardia* with filtration, and the remaining 1-log inactivation must be provided through disinfection. A newer properly operating plant would typically be credited with 2.5-log through filtration with only 0.5-log required through disinfection.

The system must meet all other MCLs for inorganic chemicals (arsenic, lead, etc.), organic chemicals (atrazine, dioxin, etc.), disinfection byproducts (TTHM, HAA5, Bromate, Chlorite), volatile organic chemicals (benzene, styrene, etc.), microbiological contaminants (coliform), and radionuclides.

The system must not exceed the maximum residual disinfectant level for chlorine of 4.0 mg/L. At no time shall the free chlorine residual leaving the plant be less than 0.2 mg/L. There also must be a detectable residual at all points in the distribution system at all times.

6.9 Basis for Cost Estimates

The cost estimates presented in this report will typically include four components: construction cost, engineering cost, contingency, and legal and administrative costs. Each of the cost components is discussed in this section. The estimates presented herein are preliminary and are based on the level and detail of planning presented in this report. The goal of these planning level cost estimates is to establish a reasonably conservative budget and to allow fair cost-comparisons of alternatives. As projects proceed and more detailed, site-specific information becomes available, the estimates will require updating.

6.9.1 Construction Costs

Construction costs are based on competitive bidding as public works projects with Davis-Bacon prevailing wage rates. The estimated construction costs in this report are based on actual construction bidding results from similar work, published cost guides, budget quotes obtained from equipment suppliers, and other construction cost experience. Construction costs are preliminary budget level estimates prepared without design plans and details.

6.9.2 Contingencies

A contingency factor equal to approximately twenty percent (20%) of the estimated construction cost has been added to the budgetary costs estimated in this report. In recognition that the cost estimates presented are based on conceptual planning, allowances must be made for variations in final quantities, bidding market conditions, adverse construction conditions, unanticipated specialized investigation and studies, and other difficulties which cannot be foreseen at this time but may tend to increase final costs. Upon final design completion of any project, the contingency can be reduced to 10%. A contingency of at least 10% should always be maintained going into a construction project to allow for variances in quantities of materials and unforeseen conditions.

6.9.3 Engineering

Engineering services for major projects typically include surveying, preliminary and final design, preparation of contract/construction drawings and specifications, bidding services, construction management, inspection, construction staking, start-up services, and the preparation of operation and maintenance manuals. Depending on the size and type of project, engineering costs may range from 18 to 25% of the contract cost when all of the above services are provided. The lower percentage applies to large projects without complicated mechanical systems. The higher percentage applies to small or complicated projects.

Engineering costs for basic design and construction services presented in this report are estimated at 20% of the estimated total construction cost. Other engineering costs such as specialized geotechnical explorations, hydrogeologic studies, easement research and preparation, pre-design reports, and other services outside the normal basic services will typically be in addition to the basic engineering fees charged by firms. When it was suspected that a specific project in this Plan may need any special engineering services, an effort has been made to include additional budget costs for such needs. Specific efforts required for individual basic engineering tasks such as surveying, design, construction management, etc. vary widely depending on the type of project, scheduling and timeframes, level of service desired during construction, and other project/site-specific conditions however an approximate breakdown of the 20% engineering budget is as follows:

Surveying and Data Collection – 1%
Civil/Mechanical Design – 14%
Electrical/Controls Design – 3%
Bid Phase Services – 2%

6.9.4 Legal and Management

An allowance of five percent (5%) of construction cost has been added for legal and other project management services. This allowance is intended to include internal project planning and budgeting, funding program management, interest on interim loan financing, legal review fees, advertising costs, wage rate monitoring, and other related expenses associated with the project that could be incurred by the owner of the facility.

6.9.5 Land Acquisition

Some projects may require the acquisition of additional right-of-way, property, or easements for construction of a specific improvement. The need and cost for such expenditures is difficult to predict and must be reviewed as a project is developed. Effort was made to include costs for land acquisition, where expected, within the cost estimates included in this report. For this project, no land acquisition costs are anticipated.

6.9.6 Cost Estimate Updates

Future changes in the cost of labor, equipment, and materials may justify comparable changes in the cost estimates presented herein. For this reason, common engineering practices usually tie the cost estimates to a particular index that varies in proportion to long-term changes in the national economy. The Engineering News Record (ENR) construction cost index (CCI) is most commonly used. This index is based on the value of 100 for the year 1913. Average yearly values for the past 11 years are summarized in Table 6.9.1-1.

Table 6.9.6-1 – ENR Construction Cost Index History

YEAR	INDEX	% CHANGE/YR
2000	6221	2.67
2001	6343	1.96
2002	6538	3.07
2003	6694	2.39
2004	7115	6.29
2005	7446	4.65
2006	7751	4.10
2007	7967	2.78
2008	8310	4.31
2009	8570	3.13
2010	8801	2.69
2011	9070	3.06
	Average since 2000	3.5%

Cost estimates presented in this report are based on average 2011 dollars with an ENR CCI of 9070. For construction performed in later years, estimated costs should be projected based on the then current year ENR Index using the following method:

Updated Cost = Plan Cost Estimate x (current ENR CCI / 9070)

7.0 Alternatives Considered

Section

7

As stated in Section 4.3.4, it is recommended that the water treatment plant be replaced with new equipment. Alternatives for new equipment are presented in this section along with alternatives for improvements to the intake.

7.1 Managerial Alternatives

The Tiller Ranger Station water treatment plant is currently operated by Environmental Contracting Services, Inc. who is contracted by the USFS to provide both water and wastewater treatment operation services.

7.1.1 Elimination of Facility

Elimination of the water treatment facility is not feasible unless the Ranger Station were to have no residents or other buildings with domestic plumbing. Safe drinking water must be provided and therefore the treatment facility must be maintained.

7.1.2 Change or Control Use of Facility

No change or controlled use of the facility would result in elimination of the need for water treatment unless such changes resulted in no potable water available at the entire Station.

7.1.3 Cooperate or Combine with Local Utility District, Local Agency, etc.

No other local agencies exist that can provide water for the Ranger Station. The Tiller Store and RV Park are on wells with limited capacity.

7.2 Technical Alternative A – New Water Treatment Plant, Membrane Filtration

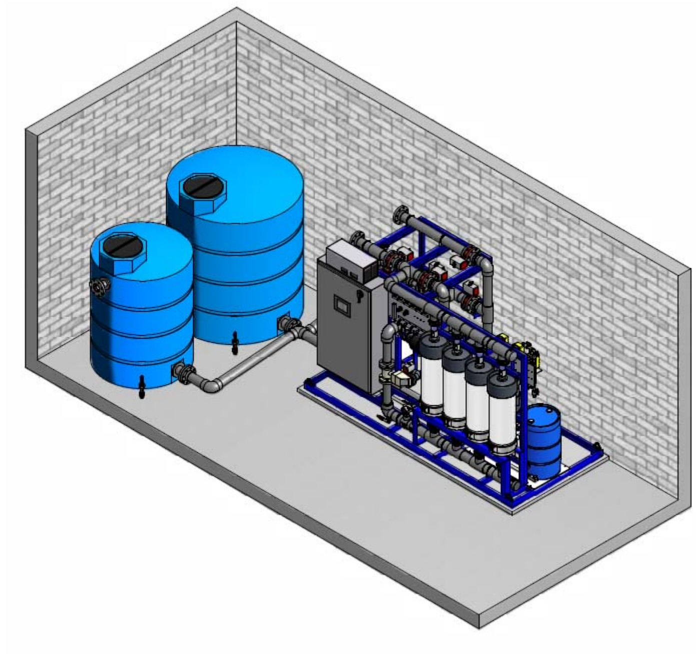
One possible option is to construct a new small building, adjacent to the existing WTP building, housing new package membrane filtration equipment and modern controls. This option would provide the highest finish water quality (due to membrane filtration) and would allow the existing plant to continue to provide water during construction. Following project completion, the existing equipment can be removed from the existing building and the building utilized for operator office space, storage, etc.

7.2.1 Source and Development of Raw Water Supplies

The facility has adequate certificated water rights on the South Umpqua River and water quality and quantity in the River is suitable for the facility. No wells with sufficient yield have resulted from any of the wells drilled over the years in the area (see Section 7.4). Therefore, no additional source development or new raw water supplies are needed. However, the existing intake is deteriorated and should be reconstructed to allow continued supply for the facility. The electrical code violations at the intake pump electrical power supply must also be corrected. Alternatives for a new intake facility are shown in Sections 7.6 and 7.7.

7.2.2 Treatment Processes and Components

Membrane filtration represents the best available technology today for turbidity removal from surface water with such quality as exists in the South Umpqua River at the location of this facility. Membrane filtration provides a physical barrier to pathogens and turbidity and technically does not require chemical coagulation; however, small doses of a coagulant can help extend filter runs and are needed for TOC reduction. Hollow fiber, pressurized membrane filter modules are used for small treatment packages such as needed for this application. Manufacturers of such equipment with successful installations in Oregon include Pall Corporation, Siemens, and Westech Inc. Appropriate equipment packages include the Pall Aria AP-2 unit, the Siemens Memcor XP sr 9, and the WesTech AltaPac APIV 3.



Common Membrane Package Plant Layout

Raw water is pumped from the intake to the plant as done now but additional pressure (45 psi ±) is required to push the feed water through the membranes. Most manufacturers will utilize a second feed pump (in addition to the intake pump) on the membrane package skid to control the feed flow and pressure. Typically, raw water enters a small feed tank (70 to 500 gallons – filled by the intake pump) located in the building or on the skid itself, and the feed pump boosts pressure in a controlled manner utilizing a variable frequency drive (VFD). A pre-membrane strainer located in the building with 130 to 500 micron openings is used to filter out larger particulate matter. Chemical feed connections are installed in the raw water line ahead of the membrane skid. After being pumped through the membrane modules, the clean filtrate then enters a clearwell or other finish-water holding tank. Chlorine is injected into the filtered water prior to the clearwell. Water from the clearwell is then pumped into the distribution system as done now at the existing plant. The membrane backwash process is similar to a sand filter with reverse flow however they backwash more frequently but with a much lower rate and volume of water. An air scour typically accompanies the water backwash to increase cleaning effectiveness while reducing water consumption. The air system is then also used to actuate the automated valves in the plant. The backwash pump is normally part of the package membrane skid.

Processes unique to membrane filtration include an occasional clean-in-place (CIP) cycle, and a periodic chlorine rinse. A CIP involves soaking the membranes with heated chemicals such as chlorine or citric acid for a period of time to remove scale and other build-up on the membrane surface. A CIP is normally initiated manually by the operator based on the transmembrane pressure (differential pressure across the membrane) value displayed at the control panel. When the transmembrane pressure approaches the pre-determine value recommended by the manufacturer the operator starts the CIP at the next convenient opportunity by pushing a button. The CIP then runs automatically until complete and the skid then resumes normal production mode. Typically, a CIP is needed once per month although some installations only need a CIP once every 3 to 6 months. A full CIP takes 2 to 4 hours to complete. The chlorine rinse occurs automatically, normally once daily to weekly, and last just a minute or two.

To ensure membrane integrity, a pressure-decay test is conducted daily using low-pressure air. This test occurs automatically based on PLC controls. This “Direct Integrity Test” is required by the State and will indicate whether any pinholes or fiber breaks have occurred thus potentially compromising the filtration effectiveness. All membrane package manufacturers have a built-in integrity test procedure.

Minor controls integration and a telemetry dialer will be necessary as part of a membrane plant installation in addition to the standard manufacturer provided PLC. Depending on the manufacturer selected and factory control options available, integration with the existing control panel installed in 2011 should be explored during design to determine the most cost effective integration method.

Treated water from the membrane will easily meet the State and EPA goal of 0.1 NTU and will typically be consistently less than 0.05 NTU. Backwash waste volumes and coagulant dosages are generally less than conventional treatment options. During much of the year, it is likely that no coagulant addition would be required. Soda ash may be required for final pH adjustment.

Since the existing clearwell is not separate from the deteriorated package equipment that is recommended for replacement, a new clearwell would be required. A new plant will be credited with 2.5-log removal of *Giardia* with an additional 0.5-log inactivation required through disinfection per OAR 333-061-0032. Further, OAR 333-061-0050(4)(c)(D) requires at least 0.5-log inactivation of *Giardia* through disinfection alone regardless of the filtration method. The clearwell therefore must be sized to provide at least 30 minutes of contact time at the design flow such that a CT value of 30 results at a free chlorine residual of 1.0 mg/L (assuming worst case conditions of 5.0°C water and pH of 7.5). With a peak design flow of 35 gpm, a clearwell volume of 1,050 gallons is required in a 100% efficient configuration such as would occur in plug-flow pipe conditions. Less efficient configurations such as a baffled tank with some short-circuiting would require large volumes. In this small size, the most cost effective clearwell solution is to provide a section of enlarged diameter buried piping outside the building. Approximately 80 feet of 18-inch diameter piping or 45 feet of 24-inch piping will suffice to provide 30 minutes of contact time.

7.2.3 Waste Disposal Method (Backwash)

Originally, backwash waste was discharged directly to the river. In 1975, a concrete settling basin was constructed to accept the filter backwash water. Supernatant from the settling basin now returns back to the wastewater treatment plant through either pumping or overflow. The settling basin should remain in use for filter backwash water settling as done now. Since the facility does not have an NPDES permit allowing direct discharge of the settled backwash water into the river, the practice of sending this settled water to the wastewater treatment plant will need to continue. No changes in the waste disposal method are recommended however a new pump and controls for the settling basin are needed.

7.2.4 Storage Facilities and Distribution System

Existing storage and distribution facilities to remain unchanged.

7.2.5 Pumping Facilities

Pumping facilities for the membrane plant option include the raw water pump(s) at the intake, the feed booster pump, the backwash pump, and the finish water discharge pump. It is recommended that two pumps be provided for the intake in a redundant duty/standby configuration. A similar redundant duty/standby installation should be considered for the finish water pumping equipment as well.

7.2.6 Design Life of System

Since growth and corresponding increases in water demand are not anticipated to occur, design life of the systems is a function of mechanical life expectancy of the various components rather than capacity. Pumps, valves, and other basic mechanical components have a normal design life of 20 years. Mechanical and site piping has a design life of at least 40 years. The short-lived asset in membrane plants are the membrane modules themselves. The membrane modules typically have a design life of 10 years after which time new ones are installed easily in place. This is similar to sand and anthracite in regular media filters where the granular filter materials should be replaced at the 12 to 15 year mark. Depending on the quality (and initial cost), chemical feed pumps can sometimes require replacement in 10 years (less expensive models) to 20 years (more expensive models).

7.2.7 Electrical Requirements

The membrane plant options come standard in a three-phase 480 volt configuration. At a minimum, a 100 amp 480 volt three phase service is required. The most cost effective solution is to supply the plant with a 200 amp 277/480 volt three phase wye service shared with the wastewater plant. A combined service will minimize base billing rates and efficiently share service entrance equipment.

The existing building service can be left alone or removed. Forest service personnel expressed the desire to provide backup power for the water treatment plant. While this is not a state requirement, membrane skid modeling with Cummins Power Suite generator sizing tool and Generac's Power Design tool recommends a 30-35kW backup generator for the plant. A combined wastewater/water treatment electrical service requires 50kW of backup power according to the sizing tools.

Generator run time is estimated at 100 hours per year. This allows for 2 days of power loss and 1 hour per week of generator self-testing. During a self-test, the automatic transfer switch will simulate a power outage and switch the power supply over to the backup generator. The tests are scheduled to occur automatically with no operator interaction. Generator O&M costs are listed at $1-2 per hour of run time per year. To be conservative, $3 an hour was chosen for run time and $5 an hour for diesel fuel consumption at ¼ power for a 50kW generator. This allows for 3 hours of operator time per year for maintenance and $500 for fuel. Total O&M costs were split between the water and sewer facilities equally in this analysis.

7.2.8 Operational Considerations

Operation Requirements

Operation of a membrane plant is relatively straightforward since turbidity removal is guaranteed with the physical barrier of intact membranes. In comparison, a conventional plant, as exists now, only functions when proper chemical feed, mixing, and detention times are provided through plant design and operator expertise. A membrane plant will require daily integrity testing, which is programmed to automatically occur at a pre-set time or production gallons and the results will be recorded by the PLC. The plant will stop and an alarm will sound if the integrity test fails. A failing integrity test means that one or more of the individual fibers in a membrane module has failed. A procedure called "pinning" is used to repair the membrane module by blocking off the individual fiber. Pinning can be required a few times per year and normally takes an hour or two. Additionally, the CIP cycle will need to be initiated by the operator once every one to three months. Other duties will include normal maintenance of wearable items and preparation of chemical batches such as chlorine and potentially a coagulant.

Training Required

A training period of one or two days should suffice to train operations personnel on the plant function and the process for integrity testing, pinning, PLC operation, and CIP processes.

Duties and Man Hours Required

Duties remain similar to those required now with the existing plant, but a new facility will be much more automated. Jar testing and careful chemical feed adjustments will no longer be required however monitoring of integrity test results, occasional pinning, and monthly CIP will be required. Also, each day of operation the operator must record flow, turbidity, chlorine contact, etc. as done now. An operator on-site for 2 hours per day should suffice to record all daily values and make visual checks of the systems. An additional 4 hours per month will be needed for CIP cycles. Approximately 2 hours per week should suffice for chemical batch make-ups. Turbidimeters must be calibrated quarterly according to State rules.

Emergency or Malfunction Impacts to Users

A major malfunction of a plant component will generate an alarm and shut down the treatment process. Most malfunctions can be corrected within a short period of time and users will see no impact as water supply continues from the existing 43,000-gallon tank.

The needs for alarm telemetry and remote plant troubleshooting mandates a phone line for plant operation. Further, it is recommended to use a high speed internet connection beyond the dial-up speeds of a land line modem. The existence of a T-1 internet connection on site is fortunate, and would be very beneficial for the Forest Service to make this connection available to the treatment plant as well. There is no high speed cell phone or land DSL availability in the Tiller area, which means that the only other viable communication option would be to install another expensive T-1 line to the plant. Having a high speed connection opens up the possibility of remote operator SCADA controls and will reduce travel costs charged by package equipment plant manufacturers when control system maintenance is required.

7.2.9 Maintenance Considerations

Routine Maintenance

Routine maintenance consists of general cleaning, inspection of air inlet filter on any air compressor (monthly), cleaning of pre-filter or basket strainer (weekly – 1 hour), and the various infrequent maintenance items such as replacing minor wear items on chemical feed pumps.

Man Hours Required

Routine maintenance should require approximately 8 hours per month or less.

7.2.10 Testing and Monitoring Considerations

Facilities, Tests, and Equipment Required and Available

No special facilities or equipment is required. Integrity testing is built into the membrane skid. Turbidimeters will continuously monitor both raw and finish water NTUs. A chlorine residual analyzer will continuously monitor the free chlorine residual leaving the filter. In addition, a membrane plant may have an automatic pH meter and temperature sensor to record these parameters automatically. The parameters will be recorded automatically in the plant PLC. At any time, the operator may query the data in order to manually record a value for daily plant records.

Skills Required

No special skills beyond normal level 2 operator certification are required.

Man Hours Required

Normal routine monitoring will occur through continuously recording instruments such as exists for chlorine residual and turbidity.

7.2.11 Reporting Considerations

Reporting requirements will be identical to those required now except integrity testing results.

7.2.12 Economic Considerations

Initial Capital Cost Estimates

Membrane Package Plant (Micro/Ultra filtration) Option					
No.	***Item Description***	***Unit***	***Quantity***	***Unit Cost***	***Item Cost***
1	Mobilization, Overhead, Bonds (10%)	ls	1	$59,000	$59,000
2	Treatment Equipment and Controls	ls	1	$230,000	$230,000
3	Pumping Equipment (2 booster)	ls	1	$8,000	$8,000
4	Settling Tank Pump and Controls	ls	1	$7,000	$7,000
5	Clearwell (45' of 24" Pipe)	ls	1	$15,000	$15,000
6	Mechanical Piping, Flowmeter, Valves	ls	1	$17,000	$17,000
7	Building	sf	600	$160	$96,000
8	Chemical Feed Systems	ls	1	$8,000	$8,000
9	Electrical Service Upgrade	ls	1	$20,800	$20,800
10	Electrical System, HVAC	ls	1	$60,000	$60,000
11	Backup Generator	ls	1	$41,600	$41,600
12	Additional Controls and Telemetry	ls	1	$25,000	$25,000
13	Exterior Site Piping, Sitework	ls	1	$25,000	$25,000
14	Air Compressor/Air System	ls	1	$10,000	$10,000
15	Start-Up, Training	ls	1	$10,000	$10,000
		Initial Capital Cost Estimates			$632,400
		Contingency (20%)			$126,480
		Engineering (20%)			$126,480
		Administrative and Other Costs (5%)			$31,620
		Total Budget Estimate			**$916,980**

A new building has been assumed to house new treatment equipment. The existing building could be converted to office/storage/lab space for the water and wastewater treatment operators once the new plant is complete. Alternatively, temporary treatment equipment could be rented and set-up outside for a few months while the old equipment is removed from the existing building and new equipment is installed. Temporary tanks large enough to provide 30 minutes of chlorine contact time would also be required if a new building is not included in the project. It is estimated that 3 months rental would be required at approximately $15,000 per month for a small portable treatment unit. All together with temporary treatment equipment, temporary tanks and pumps, temporary piping, temporary wiring and instrumentation it is expected that temporary treatment would have a capital cost of approximately $65,000 for three months ($31,000 less than new building but loss of new building as asset). A flaw with this approach is the lack of capacity in the existing 100-amp service preventing the installation and set-up of temporary equipment while maintaining operation of the existing plant. The outdated hi-leg 120/240 volt service poses challenges since the temporary equipment typically available does not function at this voltage. At this stage of planning it is recommended that a new building be included in the budget as shown.

Operation and Maintenance Costs

Membrane Package Plant (Micro/Ultra filtration) Option					
No.	***Item Description***	***Unit***	***Quantity***	***Unit Cost***	***Item Cost***
1	Energy Consumption, Annual	kWh	36000	$0.10	$3,600.00
2	Half of Montly Base Power Charge	mo	12	$50.00	$600.00
3	Dedicated Phone Line	mo	12	$50.00	$600.00
4	Half of Generator Run time	hr	100	$4.00	$400.00
5	Data logging, normal operations	hr	730	$50.00	$36,500.00
6	CIP Operations	hr	48	$50.00	$2,400.00
7	Chemical Feed Systems	hr	104	$50.00	$5,200.00
8	Routine Maintenance	hr	96	$50.00	$4,800.00
	Total Annual Operation and Maintenance Costs				$54,100.00

Amortized Costs

Membrane Package Plant (Micro/Ultra filtration) Option					
No.	***Item Description***	***Life Span***	***Replacement Cost***	***Bond Rate***	***Amortized Annual Cost***
1	Treatment Equipment and Controls	20	$230,000.00	2%	$14,066.05
2	Pumping Equipment (2 booster)	20	$8,000.00	2%	$489.25
3	Clearwell (45' of 24" Pipe)	40	$15,000.00	2%	$548.34
4	Mechanical Piping, Flowmeter, Valves	20	$17,000.00	2%	$1,039.66
5	Building	40	$96,000.00	2%	$3,509.35
6	Chemical Feed Systems	20	$8,000	2%	$489.25
7	50% of Electrical Service Upgrade	40	$8,000	2%	$292.45
8	Electrical System, HVAC	25	$60,000	2%	$3,073.23
9	50% of Backup Generator	25	$16,000	2%	$819.53
10	Additional Controls and Telemetry	20	$25,000	2%	$1,528.92
11	Exterior Site Piping, Sitework	40	$25,000	2%	$913.89
12	Air Compressor/Air System	20	$10,000	2%	$611.57
13	Membrane Module Replacements	10	$7,000.00	2%	$779.29
	Total Annual Amortized Costs				$28,160.77

Total Annual Cost

Membrane Package Plant (Micro/Ultra filtration) Option		
No.	***Item Description***	***Item Cost***
1	Annual Operations & Maintenance Costs	$54,100.00
2	Annual Amortized Costs	$28,160.77
	Total Annual Costs	**$82,260.77**

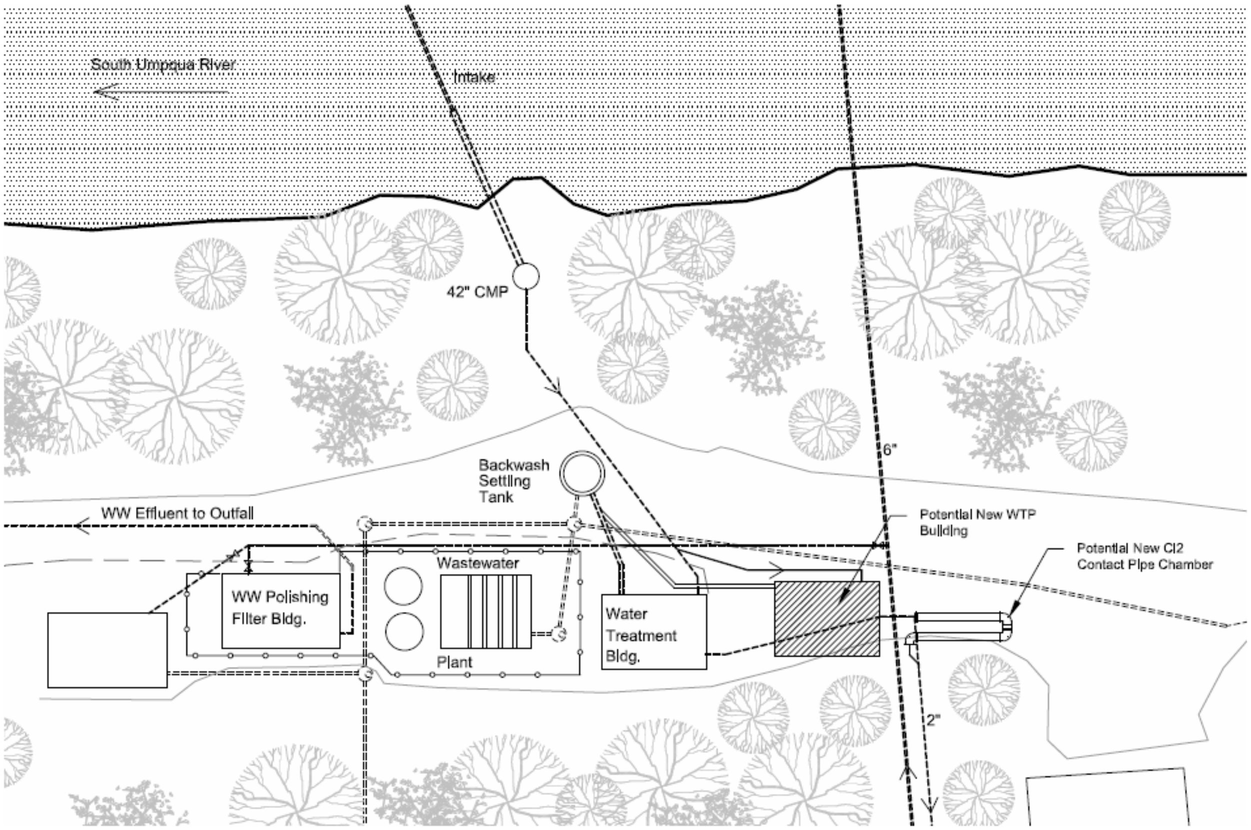


Figure 7.2-1 – New Plant Potential Site Plan

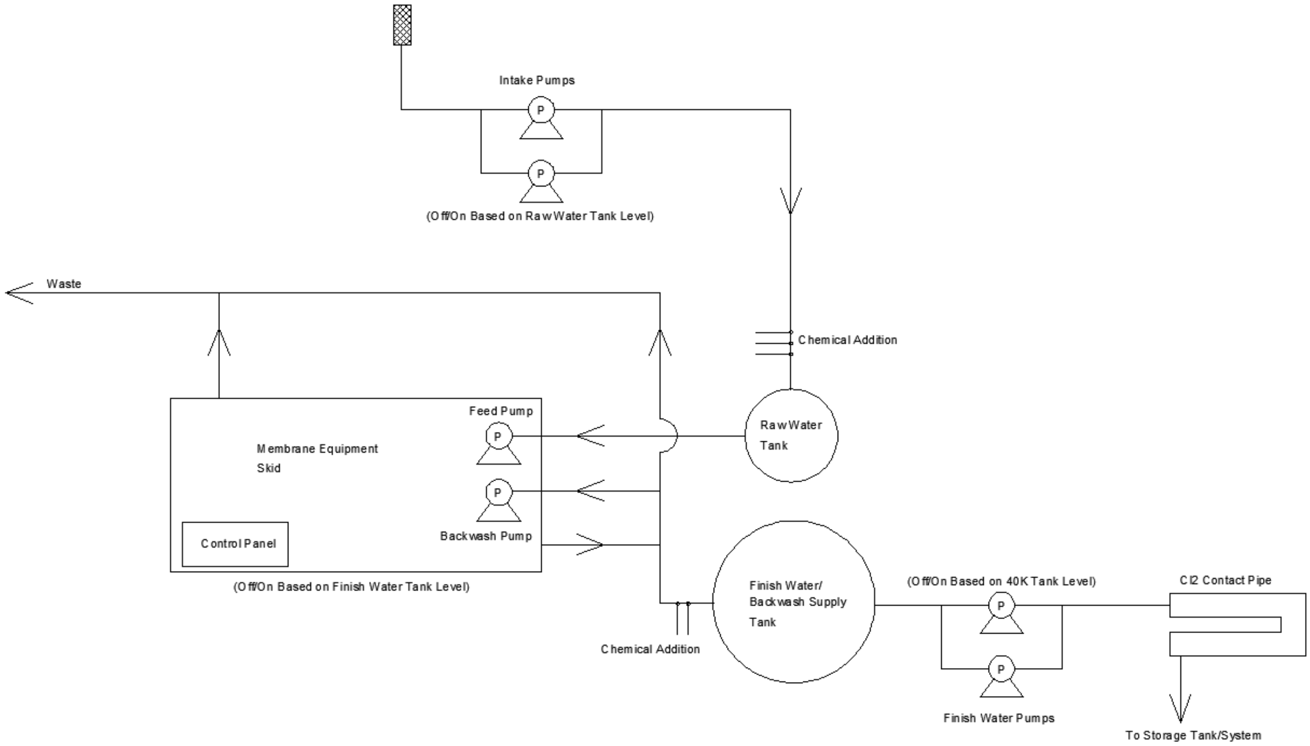


Figure 7.2-2 – Membrane Plant Alternative Process Schematic

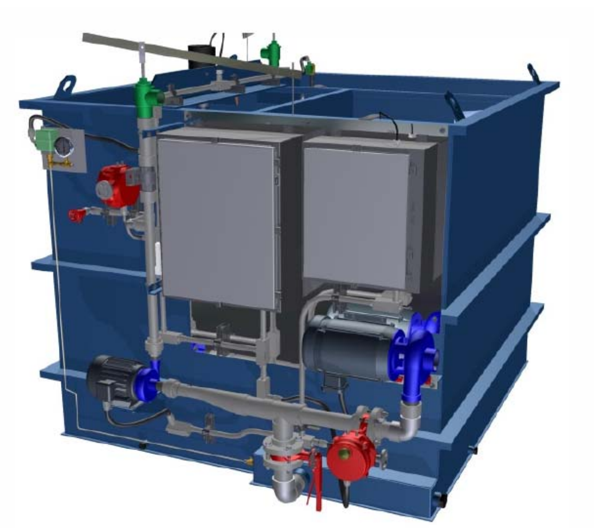
7.3 Technical Alternative B – New Water Treatment Plant, Conventional Filtration

Another viable alternative is to replace the existing treatment plant with new package equipment based on conventional treatment similar to the existing processes. The new equipment would be housed in a new building (see Figure 7.2-1) just as would be required for the membrane plant alternative, keeping the existing equipment in service during construction. Following project completion, the existing equipment can be removed from the existing building and the building utilized for operator office space, storage, etc. Appropriate equipment packages include the Siemens Microfloc WaterBoy WB-82 unit, the Corix CWS-AC-35 (adsorption clarifier type), and similar designs by WesTech and Tonka Equipment Company.

7.3.1 Source and Development of Raw Water Supplies

See Section 7.2.1

7.3.2 Treatment Processes and Components



Microfloc WaterBoy by Siemens

Conventional filtration processes will be familiar to the operator's as identical or similar to the existing equipment processes. The conventional treatment process includes chemical coagulant addition, rapid mix, flocculation, sedimentation, and granular media filtration. Two basic configurations exist for the flocculation/clarification process prior to filtration with the viable small package equipment – 1) traditional flocculation and sedimentation basins (same as current equipment) with possible addition of tube settlers in clarifier, or 2) adsorption clarifier designs. Both configurations are appropriate for the water quality at this installation and both depend on proper chemical addition and operator expertise for suitable finish water quality. Adsorption clarifier designs provide the flocculation and sedimentation process in a single media-filled chamber reducing the physical footprint size of the tanks required for treatment. The adsorption clarifier type design is best suited when raw water turbidity is less than 40 NTU, which is generally the case in Tiller. The plant can be shutdown automatically during the occasional turbidity spike over 40 NTU which likely occurs in the stream for a day or two following significant storm events (which plant could see if infiltration gallery type intake not utilized).

Most conventional package plants available today include air scour assisted filter backwash to improve filter cleaning while using less water for the backwash process, including equipment packages from Corix, WesTech, and Tonka. The Siemens WaterBoy is available without air scour. The use of air scour necessitates the inclusion of a small blower or air compressor at the plant. Generally, in addition to water savings, the energy consumption of the air supply equipment is offset by the reduced pumping energy required during the hydraulic backwash cycle portion.

Minor controls integration and a telemetry dialer panel will be necessary as part of a packaged conventional plant installation in addition to the manufacturer provided controller. A high speed internet connection as discussed in the previous alternative would be highly beneficial to streamlining plant operation by reducing personnel on site time.

7.3.3 Waste Disposal Method (Backwash)

See Section 7.2.3

7.3.4 Storage Facilities and Distribution System

Existing storage and distribution facilities to remain unchanged.

7.3.5 Pumping Facilities

Pumping facilities for the conventional plant option include the raw water pump(s) at the intake, the backwash pump, and the finish water discharge pumps. It is recommended that two pumps be provided for the intake in a redundant duty/standby configuration. A similar redundant duty/standby installation should be considered for the finish water pumping equipment as well.

7.3.6 Design Life of System

Since growth and corresponding increases in water demand are not anticipated to occur, design life of the systems is a function of mechanical life expectancy of the various components rather than capacity. Pumps, valves, and other basic mechanical components have a normal design life of 20 years. Mechanical and site piping has a design life of at least 40 years. The sand and anthracite in rapid sand dual media filters should be replaced at the 12 to 15 year mark. Depending on the quality (and initial cost), chemical feed pumps can sometimes require replacement in 10 years (less expensive models) to 20 years (more expensive models).

7.3.7 Electrical Requirements

The conventional plants come in a variety of configurations permitting both single and multiphase connections. Since a new electrical service will be part of construction of the new plant, a 480 Volt three phase service is recommended due to its commonality of use between manufacturers. The most cost effective solution is to supply the plant with a 200 amp 277/480 volt three phase wye service shared with the wastewater plant. A combined service will minimize base billing rates and efficiently share service entrance equipment.

The existing building service can be left alone or removed. Forest service personnel expressed the desire to provide backup power for water treatment. Sizing for conventional plants is similar to the 30-35kW modeled under Alternative “A”. A combined wastewater/water treatment electrical service modeled at approximately 50kW of backup power.

Electrical generator run time and costs are the same as for Alternative “A”.

7.3.8 Operational Considerations

Operation Requirements

Operations will be similar to existing plant however automation and monitoring equipment should reduce time required. Other duties will include normal maintenance of wearable items and preparation of chemical batches such as chlorine and coagulant.

Training Required

A training period of one or two days should suffice to train operations personnel on the plant function and the process for setpoint adjustments and PLC operation.

Duties and Man Hours Required

Duties remain similar to those required now with the existing plant, but a new facility will be much more automated. Jar testing and careful chemical feed adjustments will continue to be required however a streaming current monitor can be added for about $5,000 that would automate and optimize chemical feed with changing raw water conditions. Each day of operation the operator must record flow, turbidity, chlorine contact, etc. as done now. In addition, each day the turbidity of the settled water (prior to filter) must be recorded and each quarter a filter turbidity profile must be developed. An operator on-site for 3 hours per day should suffice to record all daily values and make visual checks of the systems.

Approximately 3 hours per week should suffice for chemical batch make-ups. Turbidimeters must be calibrated quarterly according to State rules.

Emergency or Malfunction Impacts to Users
A major malfunction of a plant component will generate an alarm and shut down the process. Most malfunctions can be corrected within a short period of time and users will see no impact as water supply continues from the existing 43,000-gallon tank.

7.3.9 Maintenance Considerations

Routine Maintenance
Routine maintenance consists of general cleaning, inspection of air inlet filter on any air compressor (monthly), and the various infrequent maintenance items such as replacing minor wear items on chemical feed pumps.

Man Hours Required
Routine maintenance should require approximately 8 hours per month or less.

7.3.10 Testing and Monitoring Considerations

Facilities, Tests, and Equipment Required and Available
No special facilities or equipment is required. Turbidimeters will continuously monitor both raw and finish water NTUs. A chlorine residual analyzer will continuously monitor the free chlorine residual leaving the filter. The parameters will be recorded automatically in the plant PLC. At any time, the operator may query the data in order to manually record a value for daily plant records.

Skills Required
No special skills beyond normal level 2 operator certification are required.

Man Hours Required
Normal routine monitoring will occur through continuously recording instruments such as exists for chlorine residual and turbidity.

7.3.11 Reporting Considerations

Reporting requirements will be identical to those required now except integrity testing results.

7.3.12 Economic Considerations

Initial Capital Cost Estimates

Conventional Package Plant Option					
No.	***Item Description***	***Unit***	***Quantity***	***Unit Cost***	***Item Cost***
1	Mobilization, Overhead, Bonds (10%)	ls	1	$54,000	$54,000
2	Treatment Equipment and Controls	ls	1	$180,000	$180,000
3	Pumping Equipment (2 booster)	ls	1	$8,000	$8,000
4	Settling Tank Pump and Controls	ls	1	$7,000	$7,000
5	Clearwell (45' of 24" Pipe)	ls	1	$15,000	$15,000
6	Mechanical Piping, Flowmeter, Valves	ls	1	$15,000	$15,000
7	Building	sf	600	$160	$96,000
8	Chemical Feed Systems	ls	1	$10,000	$10,000
9	50% of Electrical Service Upgrade	ls	1	$8,000	$8,000
10	Electrical System, HVAC	ls	1	$60,000	$60,000
11	50% of Backup Generator	ls	1	$16,000	$16,000
12	Additional Controls and Telemetry	ls	1	$25,000	$25,000
13	Exterior Site Piping, Sitework	ls	1	$25,000	$25,000
14	Air Compressor/Air System	ls	1	$10,000	$10,000
15	Start-Up, Training	ls	1	$10,000	$10,000
		Initial Capital Cost Estimates			$539,000
		Contingency (20%)			$107,800
		Engineering (20%)			$107,800
		Administrative and Other Costs (5%)			$26,950
		Total Budget Estimate			**$781,550**

See also Section 7.2.11 for discussion of new building versus temporary treatment equipment.

Operation and Maintenance Costs

Conventional Package Plant Option					
No.	***Item Description***	***Unit***	***Quantity***	***Unit Cost***	***Item Cost***
1	Energy Consumption, Annual	kWh	30000	$0.10	$3,000.00
2	Half of Montly Base Power Charge	mo	12	$50.00	$600.00
3	Dedicated Phone Line	mo	12	$50.00	$600.00
4	Half of Generator Run time	hr	100	$4.00	$400.00
5	Data logging, normal operations	hr	1095	$50.00	$54,750.00
6	Floc/Sed basin Cleaning	hr	16	$50.00	$800.00
7	Chemical Feed Systems	hr	156	$50.00	$7,800.00
8	Routine Maintenance	hr	96	$50.00	$4,800.00
		Total Annual Operation and Maintenance Costs			$72,750.00

Amortized Costs

Conventional Package Plant Option					
No.	***Item Description***	***Life Span***	***Replacement Cost***	***Bond Rate***	***Amortized Annual Cost***
1	Treatment Equipment and Controls	20	$180,000.00	2%	$11,008.21
2	Pumping Equipment (2 booster)	20	$8,000.00	2%	$489.25
3	Clearwell (45' of 24" Pipe)	40	$15,000.00	2%	$548.34
4	Mechanical Piping, Flowmeter, Valves	20	$15,000.00	2%	$917.35
5	Building	40	$96,000.00	2%	$3,509.35
6	Chemical Feed Systems	20	$10,000	2%	$611.57
7	50% of Electrical Service Upgrade	40	$8,000	2%	$292.45
8	Electrical System, HVAC	25	$60,000	2%	$3,073.23
9	50% of Backup Generator	25	$16,000	2%	$819.53
10	Additional Controls and Telemetry	20	$25,000	2%	$1,528.92
11	Exterior Site Piping, Sitework	40	$25,000	2%	$913.89
12	Air Compressor/Air System	20	$10,000	2%	$611.57
13	Filter Media Replacements	15	$3,500.00	2%	$272.39
	Total Annual Amortized Costs				$24,596.04

Total Annual Cost

Conventional Package Plant Option		
No.	***Item Description***	***Item Cost***
1	Annual Operations & Maintenance Costs	$72,750.00
2	Annual Amortized Costs	$24,596.04
	Total Annual Costs	**$97,346.04**

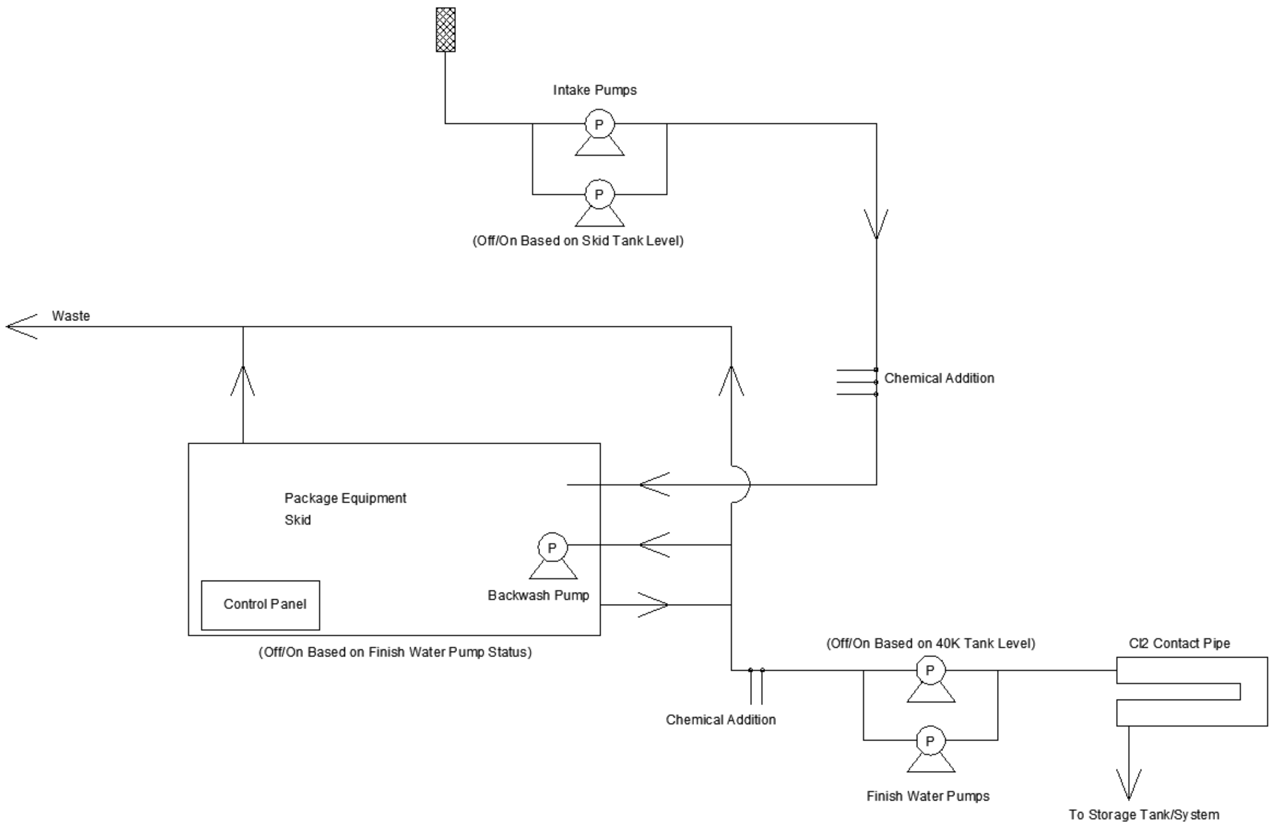


Figure 7.3-2 – Conventional Plant Alternative Process Schematic

7.4 Technical Alternative C – Replace Facility with Wells

7.4.1 Source and Development of Raw Water Supplies

Based on a query of the Oregon Water Resource Department for all wells located within Section 33 and 34 of Township 30S, Range 2W; a total of 7 wells were drilled. Out of the 7 wells, 3 were dry, and the remainder had yields of between 2 and 8 gpm. The largest well yield of 8 gpm belongs to the Tiller School District. Based on this analysis, it does not appear likely that wells of sufficient yield would be possible in the area. Well water supply is not considered a viable option and no further analysis will be made.

7.5 Technical Alternative D – New Water Treatment Plant, Utilize Steamboat Treatment Unit

The Steamboat Treatment Unit was removed from service at another location, cleaned and repainted, and is currently stored at the Tiller location. The unit is a basic conventional water treatment package plant shell and is in good condition. Based on drawings and data provided by the FS, the unit has a flocculation volume of 512 gallons, a sedimentation basin surface area of 48 ft^2 with tube settlers available, a filter area of 10.8ft^2, and a clearwell volume of 1,045 gallons (with 6" freeboard). Based on these areas and volumes available, the recommended maximum design flow through the unit for creating potable water is 25 gpm or approximately 70% of the recommended needed design flow of 35 gpm. Even though undersized, with water conservation measures and longer plant run times each day the unit could potentially meet the needs of the facility.

The unit is an empty shell so all mechanical piping, valves, filter underdrain and media, backwash equipment, level sensors, filter rate control valve, and other instrumentation and controls for the unit would need to be designed and installed in addition to the remainder of the mechanical work in the plant. In addition, custom PLC programming or a custom relay based control panel would need to be designed and built.

All operational and maintenance considerations and testing and monitoring will be equal to that described in Section 7.3 for a new conventional water plant.

Disadvantages to this option include the lower flow capacity, the need for a custom designed control system rather than a factory supplied and tested system, the lack of factory support and training, and no warranty.

The new plant may be designed to operate on any available power configuration. For consistency with modern treatment plants and best efficiency, a three-phase 480 volt wye configuration is recommended. As with the earlier alternatives, a combined electrical service with the wastewater plant is the most cost effective solution.

Based upon the loads of the existing Rotoflow plant and a similar configuration for the Steamboat unit, the recommended backup generator power remains a combined 50kW. Electrical generator run time and costs are the same as for Alternative "A".

7.5.2 Economic Considerations

Initial Capital Cost Estimate

Steamboat Plant Option					
No.	***Item Description***	***Unit***	***Quantity***	***Unit Cost***	***Item Cost***
1	Mobilization, Overhead, Bonds (10%)	ls	1	$50,000	$50,000
2	Treatment Equipment Installation	ls	1	$10,000	$10,000
3	Pumping Equipment (2 booster, 1 backwash)	ls	1	$12,000	$12,000
4	Settling Tank Pump and Controls	ls	1	$7,000	$7,000
5	Clearwell (45' of 24" Pipe)	ls	1	$0	$0
6	Mechanical Piping, Flowmeters, Valves	ls	1	$65,000	$65,000
7	Building	sf	600	$160	$96,000
8	Chemical Feed Systems	ls	1	$10,000	$10,000
9	50% of Electrical Service Upgrade	ls	1	$8,000	$8,000
10	Electrical System, HVAC	ls	1	$95,000	$95,000
11	50% of Backup Generator	ls	1	$16,000	$16,000
12	New Control and Telemetry System	ls	1	$95,000	$95,000
13	Exterior Site Piping, Sitework	ls	1	$25,000	$25,000
14	Air Compressor/Air System	ls	1	$0	$0
15	Start-Up	ls	1	$10,000	$10,000
		Initial Capital Cost Estimates			$499,000
		Contingency (20%)			$99,800
		Engineering (25%)			$124,750
		Administrative and Other Costs (5%)			$24,950
		Total Budget Estimate			**$748,500**

Operation and Maintenance Costs

Steamboat Plant Option					
No.	***Item Description***	***Unit***	***Quantity***	***Unit Cost***	***Item Cost***
1	Energy Consumption, Annual	kWh	30000	$0.10	$3,000.00
2	Half of Montly Base Power Charge	mo	12	$50.00	$600.00
3	Dedicated Phone Line	mo	12	$50.00	$600.00
4	Half of Generator Run time	hr	100	$4.00	$400.00
5	Data logging, normal operations	hr	1095	$50.00	$54,750.00
6	Floc/Sed basin Cleaning	hr	16	$50.00	$800.00
7	Chemical Feed Systems	hr	156	$50.00	$7,800.00
8	Routine Maintenance	hr	96	$50.00	$4,800.00
		Total Annual Operation and Maintenance Costs			$72,750.00

Amortized Costs

Steamboat Plant Option					
No.	**Item Description**	**Life Span**	**Replacement Cost**	**Bond Rate**	**Amortized Annual Cost**
1		20		2%	$0.00
2	Pumping Equipment (2 booster, 1 backwash)	20	$12,000.00	2%	$733.88
3	Clearwell (45' of 24" Pipe)	40	$0.00	2%	$0.00
4	Mechanical Piping, Flowmeters, Valves	20	$65,000.00	2%	$3,975.19
5	Building	40	$96,000.00	2%	$3,509.35
6	Chemical Feed Systems	20	$10,000	2%	$611.57
7	50% of Electrical Service Upgrade	40	$8,000	2%	$292.45
8	Electrical System, HVAC	25	$95,000	2%	$4,865.94
9	50% of Backup Generator	25	$16,000	2%	$819.53
10	New Control and Telemetry System	20	$95,000	2%	$5,809.89
11	Exterior Site Piping, Sitework	40	$25,000	2%	$913.89
12	Air Compressor/Air System	20	$0	2%	$0.00
13	Filter Media Replacements	15	$3,500.00	2%	$272.39
	Total Annual Amortized Costs				$21,804.07

Total Annual Cost

Steamboat Plant Option		
No.	**Item Description**	**Item Cost**
1	Annual Operations & Maintenance Costs	$72,750.00
2	Annual Amortized Costs	$21,804.07
	Total Annual Costs	**$94,554.07**

7.6 Technical Alternative E – New Intake, Rebuild Infiltration Gallery

The existing intake is an infiltration gallery constructed under the streambed. The intake works well to supply the needed water but sand intrusion has become problematic. Based on the amount of exposed rock along the stream, it is suspected that subsurface rock formations would prevent the successful implementation of an infiltration gallery or collector well placed adjacent to but not under the stream. Galleries such as this located under the source have high water yields but the yield will decrease over time as sedimentation of the gravel pack around the perforated pipe reduces the hydraulic conductivity of the filter pack. Ideally, infiltration galleries of this type are located in shallow riffle areas where stream velocity increases thereby minimizing sedimentation around the intake. The existing intake is not in a shallow riffle area but has worked fine for over 40 years. Since the intake has functioned for so many years, rebuilding the intake in the same location with new perforated piping and a new filter pack should allow continued performance.

A deficiency with the existing intake is the fact that the top of the 42-inch CMP section allowing access to the pumping equipment is too low in elevation and becomes submerged in flood conditions. Records for the nearby USGS Gaging Station No. 14308000 list flood stage at 18 feet indicating that the pump access hatch is located almost 2 feet below flood stage and approximately 9 feet below the 100-year flood elevation (approximate 100-year flood assumed to be 1964 flood). Based on these records, the intake access has become submerged around 13 times since construction. To facilitate pump removal for maintenance and to allow for access to the pumping equipment during high water conditions it is recommended that the top of any access hatch or opening to the equipment be located above the 100-year flood elevation.

An inclined pipe shaft similar to the existing 18-inch CMP section of pipe is the most economical method to provide a pump well for submersible pumps with the top access above the 100-year flood elevation at the steep slope of the riverbank in this area. At the top, quick disconnect fittings can be provided for the waterline as well as the electrical power cable. The controls would be located inside the plant building. Significant excavation and streambed disturbance are required, possibly requiring equipment access to the streambed from the opposite side of the river.

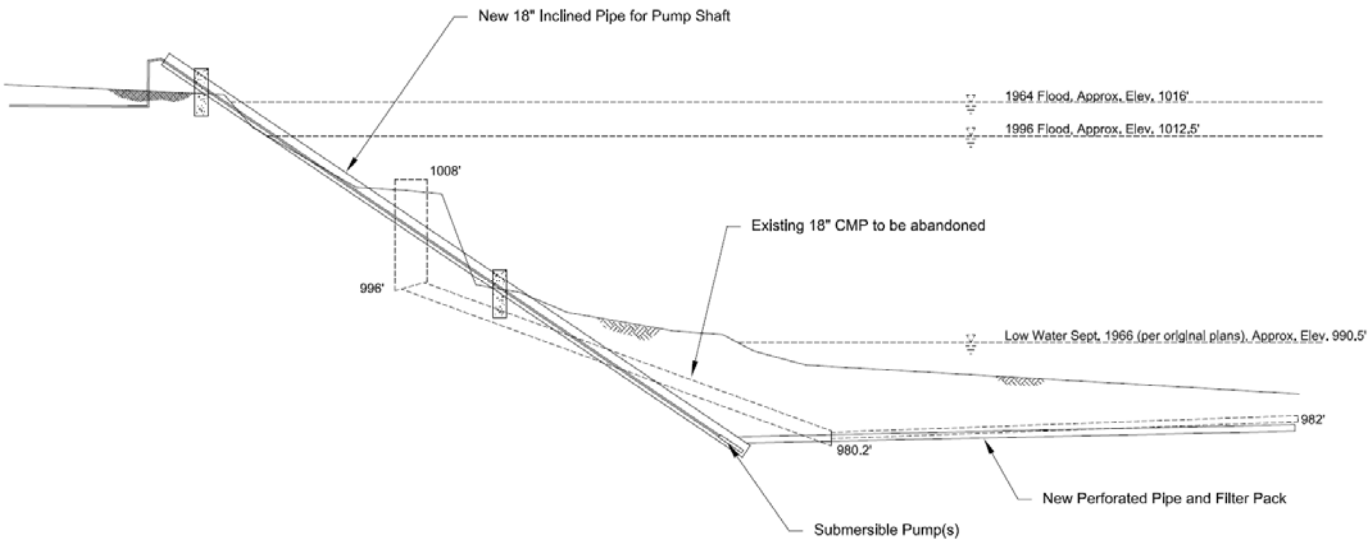


Figure 7.6 – Reconstructed Infiltration Gallery Intake

According to the 2008 *Anadromous Salmonid Passage Facility Design* manual by the National Marine Fisheries Service (NMFS), Northwest Region, infiltration galleries must now be designed to be capable of being backwashed. Backwashing may be accomplished using air, water, or both. In the document, NOAA's NMFS refers to infiltration galleries as experimental and generally discourages their use.

Initial Capital Cost Estimate

Rebuild Existing Intake - New Infiltration Gallery					
No.	**Item Description**	**Unit**	**Quantity**	**Unit Cost**	**Item Cost**
1	Mobilization, Overhead, Bonds (10%)	ls	1	$25,000	$25,000
2	Cofferdam/Water Control	ls	1	$80,000	$80,000
3	Pumping Equipment (2 submersible)	ls	2	$3,000	$6,000
4	Perforated Pipe and Filter Pack	lf	50	$900	$45,000
5	Air/Water Backwash System	ls	1	$15,000	$15,000
6	18" Inclined Pipe Section	lf	75	$400	$30,000
7	Access Excavation, Erosion Control	ls	1	$25,000	$25,000
8	Electrical	ls	1	$10,000	$10,000
9	Additional Gabions, Slope Stabilization	ls	1	$15,000	$15,000
		Initial Capital Cost Estimates			$251,000
		Contingency (20%)			$50,200
		Engineering (20%)			$50,200
		In-Water Work Permitting			$15,000
		Administrative and Other Costs (5%)			$12,550
		Total Budget Estimate			**$378,950**

Operation and Maintenance Costs

Rebuild Existing Intake - New Infiltration Gallery					
No.	**Item Description**	**Unit**	**Quantity**	**Unit Cost**	**Item Cost**
1	Energy Consumption, Annual	kWh	1000	$0.10	$100.00
2	Normal Operation	hr	104	$50.00	$5,200.00
3	Routine Maintenance	hr	40	$50.00	$2,000.00
		Total Annual Operation and Maintenance Costs			$7,300.00

Amortized Costs

Rebuild Existing Intake - New Infiltration Gallery					
No.	**Item Description**	**Life Span**	**Replacement Cost**	**Bond Rate**	**Amortized Annual Cost**
1	Pumping Equipment (2 submersible)	20	$6,000.00	2%	$366.94
2	Perforated Pipe and Filter Pack	30	$45,000.00	2%	$2,009.25
3	Air/Water Backwash System	20	$15,000.00	2%	$917.35
4	18" Inclined Pipe Section	40	$30,000.00	2%	$1,096.67
5	Electrical	25	$10,000.00	2%	$512.20
6	Additional Gabions, Slope Stabilization	40	$15,000	2%	$548.34
		Total Annual Amortized Costs			$5,450.75

Total Annual Cost

Rebuild Existing Intake - New Infiltration Gallery		
No.	***Item Description***	***Item Cost***
1	Annual Operations & Maintenance Costs	$7,300.00
2	Annual Amortized Costs	$5,450.75
	Total Annual Costs	**$12,750.75**

Suitable pumps for this intake option will be standard 4-inch submersible well pumps with 1 Hp or smaller motors. Smooth skids or rollers should be used to facilitate installation and removal of the pump and motor in the inclined pipe tube. A single pump can be installed with a second pump on the shelf for emergency replacement. Alternatively, two 8-inch inclined pipes can be used (with various fittings at the bottom to connect to the single perforated pipe) to allow two pumps to be installed in a duty/standby configuration.

Permitting to allow the instream work will be required with a joint permit application completed and submitted to the Oregon Department of State Lands (DSL) and the Army Corps of Engineers. To protect existing aquatic life, in-water work periods are restricted to times when interference with fish spawning or fry sized fish can be minimized. In the South Umpqua River, the in-water work period is July 1 through August 31 and all work that involves disturbance of the stream must be completed during that time. Species of concern include fall and spring runs of Chinook salmon, coho salmon, winter steelhead, and cutthroat trout. The Joint Permit application process can take four to eight months to complete and approval from both DSL and the ACOE must be received prior to beginning work.

7.7 Technical Alternative F – New Intake, Submerged Screen

Another option for improving the intake is to use a conventional submerged screen that is located in the water just above the streambed. The screen functions to strain debris and to prevent harm to fish. A critical requirement for this type of screen is adequate water depth, specifically at extreme low water conditions. It is estimated that at least 3 feet of water depth at worst case conditions will be required. Based on the contour information in the original plans for the current intake, adequate depth is available however this would need to be verified with survey data of today's stream conditions.

Typically, this type of screen includes an air-burst system to periodically clean accumulated debris from the outside of the screen. An air compressor and air receiver tank would need to be located in the plant building with dedicated use for the intake burst cleaning (in addition to any air compressor needed for filter backwashing and/or valve actuation). Air-burst cycling occurs several times a day, depending on the rate of debris impingement on the screen surface, based on an adjustable timer setting. Alternatively, rotating drum screens which clean with water nozzles from the inside can be used eliminating the need for an air system but requiring higher water pumping rates and adding moving parts to the screen itself.

Design requirements for submerged screens are dictated by the type of aquatic life present. Screen criteria to protect juvenile fish have been developed by the National Marine Fisheries Service (NMFS). Requirements are outlined in the 2008 *Anadromous Salmonid Passage Facility Design* manual by the National Marine Fisheries Service (NMFS), Northwest Region. At the Tiller location, it is assumed that fry-sized salmonid will be present. General requirements include a maximum screen opening of 1.75 mm for wedge wire or 3/32 inch for perforated plate, a maximum approach velocity of 0.4 fps or less, a minimum open area of 27%, and suitable sweeping velocity in the stream.

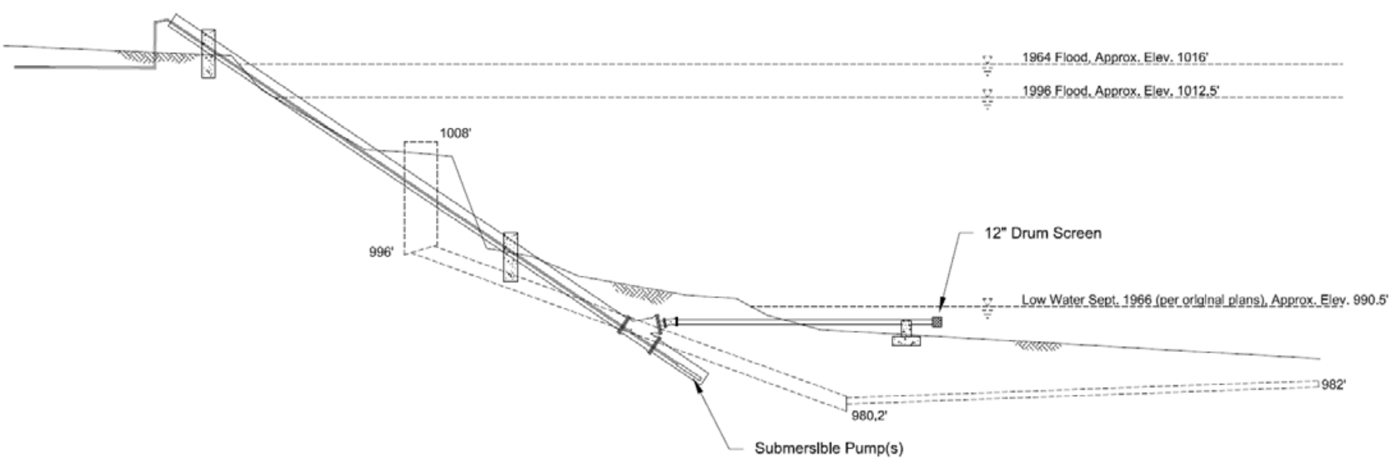


Figure 7.7 – New Submerged Screen Intake

Initial Capital Cost Estimate

New Intake, Submerged Screen					
No.	***Item Description***	***Unit***	***Quantity***	***Unit Cost***	***Item Cost***
1	Mobilization, Overhead, Bonds (10%)	ls	1	$20,000	$20,000
2	Cofferdam/Water Control	ls	1	$60,000	$60,000
3	Pumping Equipment (2 submersible)	ls	2	$3,000	$6,000
4	Screen and 6" Pipe	ls	1	$20,000	$20,000
5	Screen Air-Burst Cleaning System	ls	1	$15,000	$15,000
6	18" Inclined Pipe Section	lf	70	$400	$28,000
7	Access Excavation, Erosion Control	ls	1	$15,000	$15,000
8	Electrical	ls	1	$10,000	$10,000
9	Additional Gabions, Slope Stabilization	ls	1	$15,000	$15,000
		Initial Capital Cost Estimates			$189,000
		Contingency (20%)			$37,800
		Engineering (20%)			$37,800
		In-Water Work Permitting			$15,000
		Administrative and Other Costs (5%)			$9,450
		Total Budget Estimate			**$289,050**

Operation and Maintenance Costs

New Intake, Submerged Screen					
No.	***Item Description***	***Unit***	***Quantity***	***Unit Cost***	***Item Cost***
1	Energy Consumption, Annual	kWh	1000	$0.10	$100.00
2	Normal Operation	hr	104	$50.00	$5,200.00
3	Routine Maintenance	hr	40	$50.00	$2,000.00
		Total Annual Operation and Maintenance Costs			$7,300.00

Amortized Costs

New Intake, Submerged Screen					
No.	***Item Description***	***Life Span***	***Replacement Cost***	***Bond Rate***	***Amortized Annual Cost***
1	Pumping Equipment (2 submersible)	20	$6,000.00	2%	$366.94
2	Screen and 6" Pipe	40	$20,000.00	2%	$731.11
3	Screen Air-Burst Cleaning System	20	$15,000.00	2%	$917.35
4	18" Inclined Pipe Section	40	$28,000.00	2%	$1,023.56
5	Electrical	25	$10,000.00	2%	$512.20
6	Additional Gabions, Slope Stabilization	40	$15,000	2%	$548.34
		Total Annual Amortized Costs			$4,099.51

Total Annual Cost

New Intake, Submerged Screen		
No.	***Item Description***	***Item Cost***
1	Annual Operations & Maintenance Costs	$7,300.00
2	Annual Amortized Costs	$4,099.51
	Total Annual Costs	**$11,399.51**

Suitable pumps for this intake option will be standard 4-inch submersible well pumps with 1 Hp or smaller motors. Smooth skids or rollers should be used to facilitate installation and removal of the pump and motor in the inclined pipe tube. A single pump can be installed with a second pump on the shelf for emergency replacement. Alternatively, two 8-inch inclined pipes can be used (with various fittings at the bottom to connect to the single perforated pipe) to allow two pumps to be installed in a duty/standby configuration.

Inclined vertical turbine pumps were also evaluated however they are not available in such small capacities (35 gpm). A standard vertical wetwell could also be utilized instead of an inclined pipe but the wetwell would need to extend to 35 feet deep and would be significantly more expensive with no appreciable benefit.

Permitting to allow the instream work will be required with a joint permit application completed and submitted to the Oregon Department of State Lands (DSL) and the Army Corps of Engineers. To protect existing aquatic life, in-water work periods are restricted to times when interference with fish spawning or fry sized fish can be minimized. In the South Umpqua River, the in-water work period is July 1 through August 31 and all work that involves disturbance of the stream must be completed during that time. Species of concern include fall and spring runs of Chinook salmon, coho salmon, winter steelhead, and cutthroat trout. The Joint Permit application process can take four to eight months to complete and approval from both DSL and the ACOE must be received prior to beginning work.

8.0 Comparison of Alternatives

Section 8

8.1 Discussion

The existing water treatment facility and the existing intake are in need of replacement. A design flow of 35 gpm is recommended as a basis for sizing components. Section 7 presents various alternatives in more detail whereas this Section 8 summarizes and compares those alternatives.

A total of three alternatives are presented for improvements to the water treatment facility. Two alternatives are presented for the intake improvements.

Electrical power service recommendations are based upon combining the water and wastewater plants to reduce total operating and installation costs. This is feasible because of the close proximity of the plants. If desired, the Forest Service could install separate power services and backup generators. Installing individual services and backup generators increases the combined initial capital costs of the water and wastewater facilities by $40,000.

The membrane and conventional plants benefit from using the locally available T-1 internet connection for remote monitoring, troubleshooting, factory support, and other operations. If the Forest Service cannot share this connection, a separate T-1 line to the plant is advised. A dedicated T-1 line would add approximately $2000 to annual operation costs shared equally between the water and wastewater plants.

8.2 Comparative Factors

8.2.1 Economic Considerations

Treatment Alternatives

Alternative	Construction Cost	Total Project Budget	Annual O&M Cost*	Total Amortized Annual Cost	Cost Ranking
Low-Pressure Membrane Plant	$632,400	$916,980	$59,100	$89,040	1
Conventional Package Plant	$577,400	$837,230	$77,750	$104,125	3
Steamboat Package Plant	$537,400	$806,100	$77,750	$99,554	2

Intake Alternatives

Alternative	Construction Cost	Total Project Budget	Annual O&M Cost*	Total Amortized Annual Cost	Cost Ranking
Infiltration Gallery	$251,000	$378,950	$7,300	$12,751	2
Conventional Screen	$189,000	$289,050	$7,300	$11,400	1

For treatment alternatives, the lowest cost option from a life-cycle cost comparison is a new small package membrane system. The membrane option has a slightly higher initial construction cost but a lower operating cost than the other options. The lower operating cost is due to reduced man-hours needed to run an automatic membrane plant which does not depend on proper chemical coagulation and flocculation in order to produce acceptable finish water quality.

For intake alternatives, the lowest cost option from both an initial capital cost and life-cycle cost comparison is a conventional submerged screen with an inclined pump tube and submersible pump.

8.2.2 Operational Considerations

Both the conventional package plant and steamboat alternatives would require the same operational procedures as required now with the current facility. These alternatives, as with the current facility, depend on proper chemical addition to produce acceptable finish water quality. Changes in source water quality such as turbidity generally require adjustments to chemical feed rates to maintain proper treatment during changing conditions. Operator time must be allotted to monitor raw water conditions, conduct periodic jar testing to determine proper chemical dosages, and to scale-up the jar testing results to the full-scale plant. For about $10,000 in additional equipment cost coagulant feed can be automated with the use of a streaming current monitor/controller with coagulant doses automatically adjusted with changes in raw water quality. Periodic manual checks and jar testing is still recommended. Additionally, turbidity grab samples are needed after sedimentation, but prior to filtration.

The membrane plant alternative requires different operational procedures as compared to a conventional sand filter based plant but generally will be easy to operate and require slightly less operator time to run properly. Since the membrane filter is a physical barrier to contaminants of concern, it is less susceptible to changes in source water quality. For instance, storm events that trigger high turbidity will merely result in more frequent backwashing of the membrane filter rather than a potential high filter turbidity violation. The effluent quality of the membrane filter remains unchanged. Operational procedures unique to a membrane filter include the necessary clean-in-place (CIP) cycle and Direct Integrity Testing. The CIP cycle generally will be needed once every 1 to 3 months and takes about 4 hours to complete. The CIP is initiated manually by the operator and then proceeds semi-automatically with the operator making up the proper chemical batch. Direct Integrity Testing is programmed into the PLC control system for each membrane package manufacturer and the testing occurs automatically once per day with results logged. If an integrity test fails, it likely means that one or more membrane fibers is damaged requiring repair by the operator. To repair a fiber, the operator must take the suspect module offline, apply air to locate the broken fiber by observing the bubble, and then insert a pin to block off the fiber.

8.2.3 Area Required

All three alternatives require approximately the same amount of space. A new building 600 ft^2 in size is adequate to house all three of the equipment options. Approximately 350 ft^2 of space outside the building is required to construct the buried chlorine contact pipe chamber.

8.2.4 Reliability

Modern package plants, both those based on membrane filtration and those based on conventional media filtration, are reliable and easy to operate. The various pumps, valves, valve actuators, and other mechanical items are designed to last 20 years with minor maintenance. Membrane modules have proven to be reliable with a conservative life expectancy of 10 years.

8.2.5 Water Quality

All three treatment alternatives will produce high quality finish water meeting all State and Federal requirements. Due to the greater filtration effectiveness of the membrane option, the membrane plant alternative will produce filtrate with a higher quality (greater contaminant removal) than conventional media filtration based alternatives.

9.0 Recommendations

Section 9

9.1 Recommended Alternatives

The low-pressure membrane package plant alternative is the recommended option for replacing the deteriorated existing plant. The membrane alternative has the lowest present-worth cost, provides the highest quality finish water, and is equal to other options in terms of reliability and space considerations.

The conventional submerged screen alternative for the intake is the recommended option for replacing the existing intake. The submerged screen option has the lowest present-worth cost and is preferred over an infiltration gallery by the National Marine Fisheries Service.

Permitting and environmental reviews for work at the intake could take 3 to 8 months to complete before approval to begin instream work.

9.2 Summary of Recommendations

- Construct new water treatment plant building and install new membrane package plant sized for 35 gpm peak flow. Utilize existing plant during construction.

- Install new electrical service to supply the plant with a 200 amp, 277/480 volt, three-phase wye power service shared with the wastewater plant.

- Remove existing Rotoflow package equipment from existing building. Repair building fascia and gutters. Paint building exterior. Utilize building for office/lab/storage and/or locate standby generator inside building if desired.

- Install a single new standby generator sized to provide emergency power for both the water and wastewater plants. Utilize existing fuel tank. Can install new generator in either the existing water plant building or existing wastewater plant filter building once demolition is complete.

- Construct new Intake. Utilize existing intake during construction. May leave existing intake in place as emergency backup.

- Construct new chlorine contact chamber utilizing large diameter pipe.

9.3 Recommended Project Budget Summary

Alternative	Construction Cost	Contingency	Engineering Budget	Permitting	Administrative Costs	Total Project Budget	Annual O&M Cost*
Low-Pressure Membrane Plant	$632,400	$126,480	$126,480	$1,000	$31,620	$916,980	$59,100
Conventional Screen	$189,000	$37,800	$37,800	$15,000	$9,450	$289,050	$7,300
Demolition of Existing Equipment, Building Maintenance	$25,000	$5,000	$5,000	$0	$0	$35,000	~
Totals	**$846,400**	**$169,280**	**$169,280**	**$16,000**	**$41,070**	**$1,242,030**	**$61,400**

*Annual O&M for WTP and intake only. O&M costs for remainder of water system not included.

9.4 Potential Schedule and Phasing

Both the water treatment plant and the intake facility are now well beyond their expected design life and have immediate needs. If a $1.25 million dollar project cannot be undertaken at one time, it is possible to phase the improvements into multiple years if desired. For instance, the plant can be constructed one year and the intake constructed in a later year or vice versa. Since both projects are recommended immediately, there is no inherent phasing however it can be implemented if needed. It is important to remember that inflation will generally cause the project cost to increase over time and improvements delayed several years must have adjustments made to the budget cost (see Section 6.9.6).

A potential scheduling scenario is presented below assuming a two-phased approach:

1) Secure Funding for Phase 1 – WTP + Demo + Building Maintenance ($951,980) – October 2012
2) Contract with Engineering Firm – October 2012
3) Engineer to prepare Pre-Selection Documents and conduct Solicitation of Proposals from equipment manufacturers for membrane skid – November 2012 through December 2012
4) Design WTP Improvements – December 2012 through April 2013
5) Bid Phase for WTP – May 2013
6) Construction for WTP – June 2013 through October 2013

7) Secure Funding for Phase 2 – Intake ($289,050) – August 2013
8) Survey and Develop Pre-Design Drawings – September 2013
9) Joint Permit Application – October 2013 through March 2014
10) Design Intake – January 2014 through April 2014
11) Bid Phase for Intake – May 2014
12) Construction for Intake – June 2014 through September 2014 (In-Water Work during July and August)

A potential scheduling scenario is presented below assuming a single-phased approach:

1) Secure Funding for All Improvements – WTP + Intake ($1,242,030) – October 2012
2) Contract with Engineering Firm – October 2012
3) Survey and Develop Pre-Design Drawings – October 2012 through December 2012
4) Engineer to prepare Pre-Selection Documents and conduct Solicitation of Proposals from equipment manufacturers for membrane skid – October 2012 through December 2012
5) Joint Permit Application – January 2013 through April 2013
6) Design WTP Improvements – December 2012 through April 2013

7) Design Intake – January 2013 through April 2013
8) Bid Phase for WTP and Intake – May 2013
9) Construction for WTP and Intake – June 2013 through December 2013 (In-Water Work during July and August)