Central Kitsap Treatment Plant

Reclamation and Reuse Project
Volume I: Basis of Design Summary

August 2011

**KITSAP
COUNTY
PUBLIC
WORKS**
WASTEWATER
DIVISION

Brown AND Caldwell

KPG

Central Kitsap Treatment Plant
Reclamation and Reuse Project
Preliminary Design

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EXECUTIVE SUMMARY

ES-1 Introduction

In March 2011 Kitsap County completed a *Central Kitsap County Wastewater Facility Plan* (Facility Plan) that provided an outline for improvements to meet the area's long-term wastewater infrastructure needs and move Kitsap County towards a greener future. The Facility Plan provided an assessment of both the wastewater collection system as well as the Central Kitsap wastewater treatment plant (CKTP). The Facility Plan has been approved by the Department of Ecology and the next project phases for implementation of the identified 6-year capital improvements plan (CIP) have begun.

Figure ES-1 presents a summary of the CKTP CIP that was derived from the Facility Plan. This figure shows the 6-year CIP for the CKTP (the "Reclamation and Reuse Project") project drivers and timing relative to population projections (from the Facility Plan) and other planned improvements.

This Preliminary Design submittal is for the CKTP Reclamation and Reuse project and includes a Basis of Design Summary (Volume I) and Preliminary Drawings (Volume II). Because components of this project have been developed as part of previous designs and the Facility Plan included detailed documentation of project concepts, this Preliminary Design is intended to be only a summary representation of previous decisions. Significant decisions made after the Facility Plan are captured in the Workshop Minutes and Decision Log (both included as part of the Preliminary Design submittal). See the Facility Plan for additional background information.

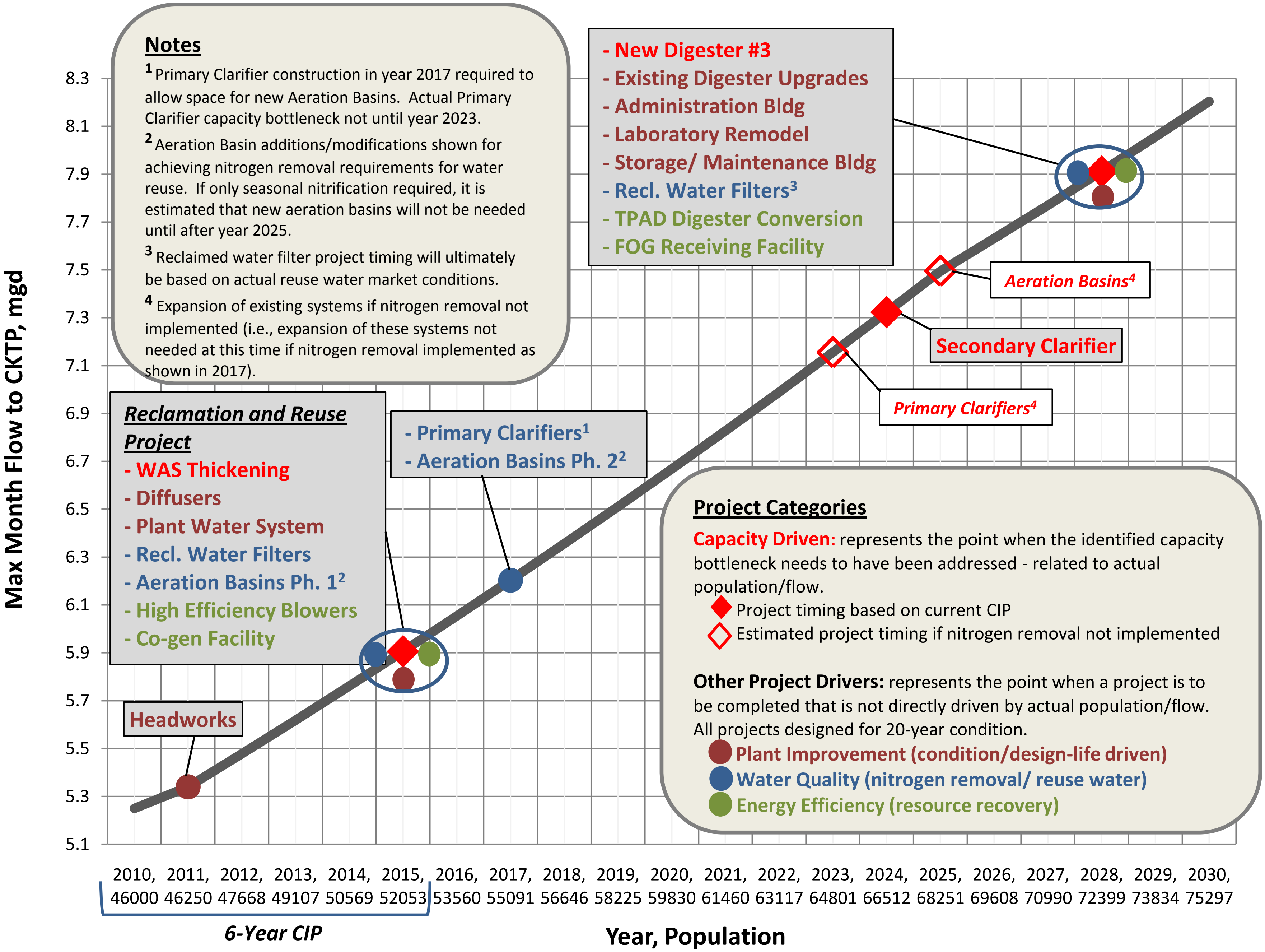
ES-2 Reclamation and Reuse Project

This project will involve improvements related to the following CKTP processes:

- WAS Thickening
- Plant Process Water System
- Reclaimed Water Production
- Aeration Basin Addition/Modifications (nitrogen removal)
- High Efficiency Blowers
- Aeration Diffuser Upgrade

These improvements are illustrated on the Process Flow Diagram included at the end of this Executive Summary.

Central Kitsap County - CKTP Capital Improvements Plan



Notes

[1] Primary Clarifier construction in year 2017 required to allow space for new Aeration Basins. Actual Primary Clarifier capacity bottleneck not until year 2023.

[2] Aeration Basin additions/modifications shown for achieving nitrogen removal requirements for water reuse. If only seasonal nitrification required, it is estimated that new aeration basins will not be needed until after year 2025.

[3] Reclaimed water filter project timing will ultimately be based on actual reuse water market conditions.

[4] Expansion of existing systems if nitrogen removal not implemented (i.e., expansion of these systems not needed at this time if nitrogen removal implemented as shown in 2017).

Project Categories

Capacity Driven: represents the point when the identified capacity bottleneck needs to have been addressed - related to actual population/flow.

- ◆ Project timing based on current CIP
- ◇ Estimated project timing if nitrogen removal not implemented

Other Project Drivers: represents the point when a project is to be completed that is not directly driven by actual population/flow. All projects designed for 20-year condition.

- ● **Plant Improvement (condition/design-life driven)**
- ● **Water Quality (nitrogen removal/ reuse water)**
- ● **Energy Efficiency (resource recovery)**

Figure ES-1

Date Created: October 14, 2010

The Reclamation and Reuse Project improvements are described in further detail below.

WAS Thickening

The CKTP is approaching the hydraulic residence time (HRT) capacity in the existing digestion system to meet Class B biosolids production requirements. The CKTP currently operates two gravity thickeners, which co-thicken primary sludge, secondary sludge, and hauled septage and sludges from Kingston, Manchester, and Suquamish prior to digestion. Because of the relatively thin sludge produced by the gravity thickeners when operated to co-thicken primary and secondary sludges, both digesters will need to be in service at all times to meet the 15-day HRT requirement for Class B sludge production. Consequently, the plant cannot take one of the digesters off-line for maintenance. By improving the sludge thickening performance, which increases the thickened sludge concentrations, the corresponding HRT can be increased. This will allow the County to delay the construction of a third digester.

The sludge thickening system will be upgraded by adding a separate thickening device (rotary drum thickener [RDT]) for waste activated sludge (WAS) thickening and a thickened sludge blending tank, while retaining the existing gravity thickeners for primary sludge thickening. Only one WAS thickening unit will be installed. A new solids thickening building will be sized to house a total of two thickening units to provide room for future expansion. Septage will continue to be thickened in the gravity thickeners, while the thickened WAS from the other plants will be sent directly to the new thickened sludge blending tank. Specific major components of this work are as follows:

- WAS pumps: New WAS pumps will be required to pump WAS to the new thickening device. Pumps will be installed at the RAS box.

- Solids Thickening Building: A new Solids Thickening Building will be required to house RDTs, polymer system and solids transfer pumps.

- Thickened Sludge Blending Tank: A thickened sludge blending tank is required to blend thickened primary and thickened WAS solids prior to pumping to digestion.

- Thickened Sludge Blending Tank Pump: A pump is required to circulate the tank contents to keep them mixed.

- Hauled Sludge Transfer Pump: A pump is required to transfer sludge from trucks hauling WAS from area treatment plants to the thickened sludge blending tank.

- Digester Feed Pumps: The digester feed pumps are required to pump the thickened blended solids from the thickened sludge blend tank to the existing digesters. The digester feed pumps will be located at the thickened sludge blend tank vault.

- Foul Air Treatment: Foul air treatment (carbon canisters) will be provided for the WAS thickening unit and thickened sludge blend tank. The foul air treatment system will be located adjacent to the two structures. Foul air treatment for the building room air is not included in this scope.

- Curb, Gutter, and Pavement Surfacing: Grading and surfacing will be modified in the vicinity of the new Solids Thickening Building and blend tank to accommodate vehicle access for maintenance and operations.

Plant Process Water System Upgrade

A portion of the disinfected secondary effluent is used as process water for the screenings compactor, scum sprays in the primary and secondary clarifiers, grit classifiers, centrifuge flushing and polymer usage, biofilter irrigation, and in the seal water and utility maintenance systems throughout the plant. In the existing system, process water pumping is provided by three pumps located in the existing Utilidor.

It was determined that the existing plant process pumps would be suitable for continued use. Therefore, no new plant process water pumps will be included in this project. These pumps will be reconfigured to use filtered reclaimed water as an additional source.

Reclaimed Water Production

Water reuse is currently limited to in-plant process uses. In order to produce reclaimed water for applications outside of the treatment plant, the liquid-stream treatment will need to be enhanced to meet specific criteria for Class A reclaimed water, plus additional criteria related to applications involving indirect groundwater recharge and stream flow augmentation. These criteria include limits on turbidity, total nitrogen, total coliform, biochemical oxygen demand, and total suspended solids.

To produce Class A reclaimed water at the CKTP, a tertiary effluent filtration system will be installed to treat secondary effluent. Initially, the system will be sized to treat 3.5 million gallons per day (mgd), the annual average plant flow. The system will consist of filters, chemical coagulation equipment, and chlorination. Because this initial project will not included facilities to export reclaimed water off-site (e.g., clearwell, distribution pumps, etc.) due to lack of external user commitments, the water cannot be identified as “Class A” until a future clearwell is installed to provide the disinfection contact time. Initially, this water will be identified as reclaimed water. During peak flow events, disinfected secondary effluent in excess of 3.5 mgd will be discharged through the plant outfall. Specific major components of this work are as follows:

- New Reclaimed Water Building: A new Reclaimed Water Building is required to house the following components of the system:
  - Chemical coagulation equipment
  - Chlorination equipment
  - Blower system for air scouring
  - Hydropneumatic tank (future installation, not part of this project)
  - Reclaimed water distribution pumps (future installation, not part of this project)

- New Reclaimed Water Filters: New filters and ancillary equipment (backwash pumps, etc.) are required to produce reclaimed water.

- New Reclaimed Water Feed Pumps: New pumps are required to pump plant effluent from the ultraviolet (UV) channel to the reclaimed water system. A weir will be added before the outlet of the channel to form a pumping pit for the added pumps.

- Curb, Gutter, and Pavement Surfacing: Grading and surfacing will be modified in the vicinity of the new building, filter structure, and clearwell tank to accommodate vehicle access for maintenance and operations.

Aeration Basin Addition/Modifications

The existing activated sludge secondary treatment system will be expanded and modified to provide the total nitrogen removal required for reclaimed water production. The target maximum effluent total nitrogen level is typically 10 milligrams per liter for groundwater recharge and stream flow augmentation. In order to achieve this level of nitrogen removal, two new aeration basins (Aeration Basins 3 and 4) will be added initially, thus doubling the aeration basin capacity. A supplemental carbon addition system will also be added to achieve the required level of denitrification.

Besides the two new basins and other modifications described above to achieve nitrogen removal, new dissolved oxygen (DO) sensors and air flow control valves will be installed in each existing and new basin to facilitate automatic DO control, which in conjunction with the new blowers described below, will provide a more energy efficient aeration system. The existing activated sludge system occasionally experiences excessive biological foaming that negatively impacts effluent quality. A classifying selector, comprising of a surface skimming system designed for foam and scum removal, will be installed. Other improvements include a new RAS mixing box, mixed liquor recirculation pumps, new WAS pumps, and new coarse bubble diffusers or mixers in the aeration basin inlet and mixed liquor channels for channel air mixing. Specific major components of this work are as follows:

- New Aeration Basins (two): Two new basins and ancillary equipment (mixers, baffles, recirculation pumps, aeration system, channel mixing, etc.) are required. The two new concrete aeration basins will be the same size and general configuration as the existing aeration basins. Because the original basins were designed to use surface aerators, the new basins will have different surface features than the existing basins.

- Scum and foam handling: The aeration basins will be equipped with surface overflow baffles and downward-opening gates to prevent scum and foam accumulation in the basins. The scum and foam will be captured by either the new classifying selector to be installed along the mixed liquor channel or by the existing scum removal system at the secondary clarifiers.

- New RAS Mixing Box: The new RAS mixing box will be a cast-in-place concrete structure located between the existing and new aeration tanks. The structure will be similar to the RAS mixing box designed for Contract IIA, but reconfigured for the proposed location.

- New WAS Pumps: New WAS pumps are required to transfer WAS from the RAS mixing box to the new solids thickening device. WAS pumps will be rotary lobe or progressing cavity type.

- New Carbon Facility: A new structure is required to house the supplemental carbon addition system, which will include metering pumps and a storage tank. The tank and pumps will be located in a secondary containment dike and a tanker truck unload facility with spill containment will be located next to the dike.

  The facility is assumed to be covered with a pre-engineered metal canopy to keep rainwater out of the containment system. If methanol is selected as the carbon source, the canopy will include a dry pipe sprinkler system (performance spec) for fire protection.

- Retrofit of Existing Aeration Basins: New baffle walls and gates will be added to provide a more plug-flow flow path. New mixed liquor recirculation pumps and piping are also required for nitrogen removal. Coarse bubble diffusers or mixers will be added in the aeration inlet and mixed liquor channels to provide adequate mixing. New DO control will be included as well.

- Curb, Gutter, and Pavement Surfacing: Grading and surfacing will be added for pull-through traffic circulation at the new carbon facility that includes a new service road around new Aeration Basins 3 and 4 to accommodate material deliveries and vehicle access for maintenance and operations.

High Efficiency Blowers

The three existing aeration blowers used to supply air to the aeration basins in the activated sludge system are multistage centrifugal blowers installed in 1996 as part of the Contract I upgrade. Although the three existing blowers still function relatively well from a mechanical perspective, they operate with variable volume inlet valve control, which results in low efficiencies at reduced air flow rate operating scenarios. One new blower will be needed to meet the higher aeration requirements associated with year-round total nitrogen removal described above. This project will consist of replacing two of the existing blowers with high efficiency (high speed) turbo blowers. The remaining two multi-stage blowers will be retained.

Aeration Diffuser Upgrade

The existing aeration diffusers were installed in 1996. Over the years, the oxygen transfer efficiency has deteriorated significantly due to the fouled, aging membranes on the diffusers such that the system has at times not been able to maintain adequate DO concentrations in the aeration basins. The system back pressure requirement has also increased, exceeding the original design operating pressures for the aeration blowers. Both the existing basins and the new basins will be outfitted with new grids and high-efficiency Aerostrip diffusers.

Digester Gas Cogeneration System

Currently, all of the biogas generated in the plant's anaerobic digesters is burned and wasted through an existing flare. Fuel oil must be purchased to heat the tanks and to provide for building heat. This project would furnish the plant with an internal combustion engine generator that would use digester gas as the fuel source. This engine generator will generate electricity that would be either used throughout the plant or supplied to the local electrical power grid. The waste heat from the engine generators will be used to heat the digesters and the treatment plant buildings. Specific major components of this work are as follows:

- The cogeneration system will be a vendor-supplied internal combustion engine that is a skid-mounted unit in a container and that no new building will be required to house the new engine generator and associated systems.

- New Engine Generator: A new engine generator is required, complete with jacket water and exhaust heat recovery. The engine-generator will be provided as a complete cogeneration system with all paralleling switchgear, controls, ancillary cooling, lubrication, fuel train, noise abatement and heat recovery equipment from a single Vendor.

- New Digester Gas Treatment System: A new digester gas treatment system will treat the gas prior to being combusted in the engine generator. The digester gas treatment system will consist of compression, water removal, hydrogen sulfide (H2S) removal by sulfatreat and siloxane removal with activated carbon filters. The gas treatment system will be located outside on a slab near the engine-generator. This system will be furnished by one vendor as a combined package.

- Exhaust Gas Treatment: A lean burn internal combustion engine with no post combustion treatment is assumed to meet the Best Available Control Technology (BACT) requirements of the air permitting authority. A BACT analysis will be part of the air permitting assistance scope.

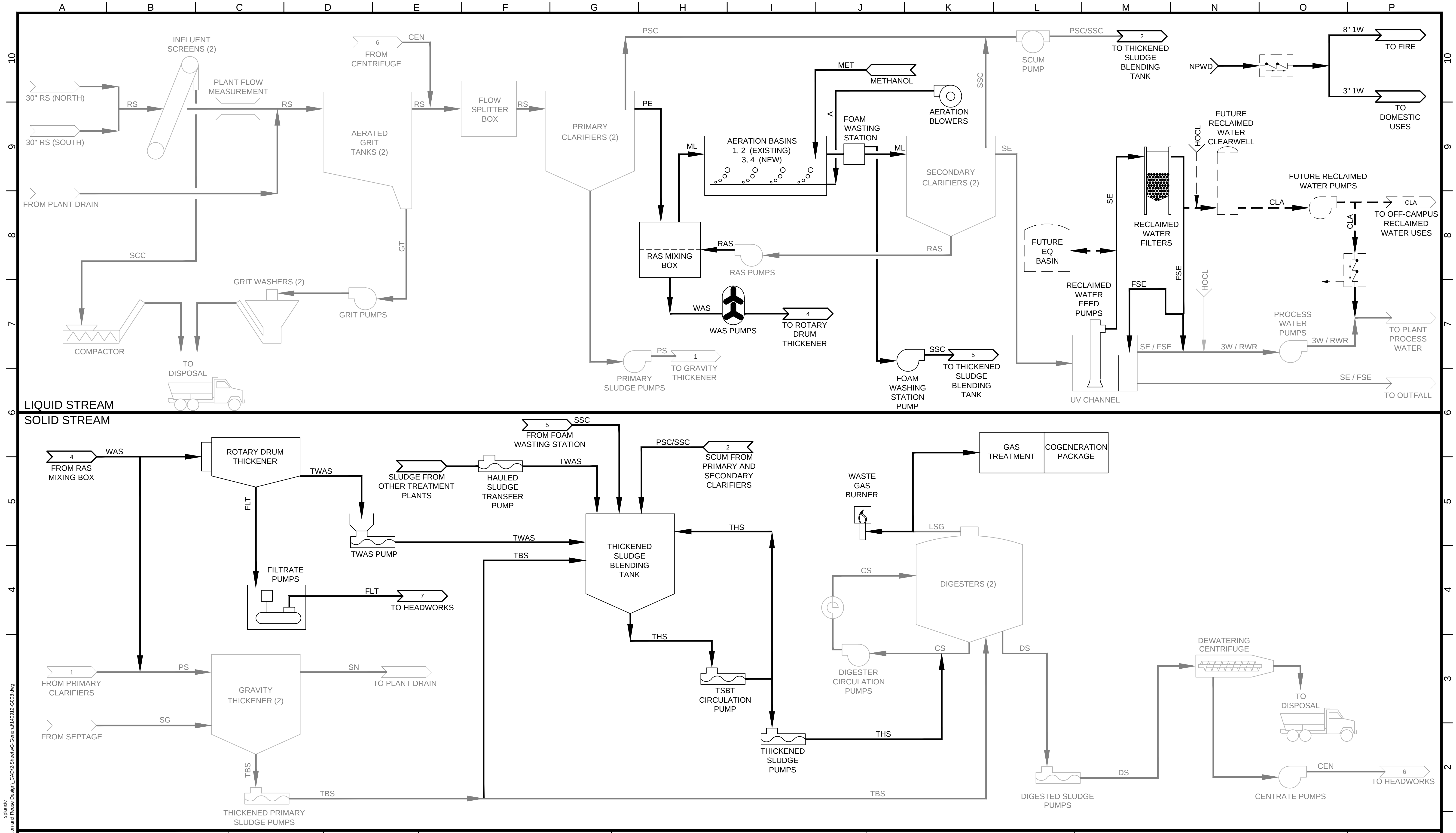
- Hot water system interconnect: A new hot water pump and controls will be required to circulate hot water through the cogeneration heat recovery heat exchanger. The hot water pump will be located outside on a slab near the engine-generator container.

- New Waste Gas Burner: The existing waste gas burner is projected to have 7 to 10 years of remaining life in a continuous mode of operation mode and was considered for reuse as part of this project. However, the expected life is significantly less when operated in intermittent mode, as would be the case as a backup to the engine generator. Therefore, it is recommended that the existing waste gas burner be replaced with a new waste gas burner. Puget Sound Clean Air Agency (PSCAA) will likely require the waste gas burner to be enclosed.

- Piping: Gas piping and appurtenances are required to convey gas from the digesters to the engine generator. Hot water piping is required to take heat from the engine generator back to the existing hot water heat loop near the existing boilers.

- It is assumed that the cogeneration system will not be used for backup power due to its higher maintenance requirements and downtime as well as the availability of methane as a fuel source.

- Site Grading and Retaining Wall: It is assumed that the area in and around the cogeneration system will require regrading to accommodate vehicle access for maintenance and operations. Final site selection and finish floor elevation for the cogeneration facility will be coordinated with site grading to limit the height of structural retaining walls along the service road to the east. This scope includes evaluation of grading revisions and associated options for retaining wall systems.



Brown AND Caldwell
OFFICE CITY, STATE

SUBMITTED: ______________ DATE: ______
PROJECT MANAGER

APPROVED: ______________ DATE: ______
BROWN AND CALDWELL

LINE IS 2 INCHES
AT FULL SIZE
(IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: TCG
DRAWN: TRL
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CHECKED:
APPROVED:

EXTERNAL REFERENCE FILES
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REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

KITSAP COUNTY

CENTRAL KITSAP TREATMENT PLANT

RECLAMATION AND REUSE PROJECT

GENERAL
PROCESS FLOW DIAGRAM

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140912
CLIENT PROJECT NUMBER
DRAWING NUMBER
G-008
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Workshop 1 Agenda

CKTP Reclamation and Reuse Project
Project No.: 140912

Kickoff Meeting and Workshop **Date:** April 18, 2011
Meeting Location: CKTP **Time:** 9:30 a.m.

Invitees:	Barbara Zaroff	Bill Persich
	Stella Vakarcs	Tadd Giesbrecht
	John Gardner	Patricia Tam
	George Radebaugh	Bo Vestergaard-Hansen
	Rich Neil	

1) Intro/Objectives of Preliminary Design (9:30 – 10:00)

a) Introductions

b) Produce Preliminary Design for:

   i) County review of Facility Planning concepts on drawings/model

   ii) Basis for cost estimating

c) Confirm contents of Preliminary Design: See attached Table of Contents

2) Project Communication and Management (10:00 – 10:30)

a) County preferences/requests

b) Communication Protocols

c) Draft Schedule and Workflow

d) Preliminary design evaluations and decision-making process

3) Design Drawing Approach (10:30 – 10:45)

a) 2D for Aeration Basins and Blowers

b) 3D proposed for WAS Thickening, Cogen, Reclaimed Water, Plant Water

4) Preliminary Design Evaluations

a) Site Plan Overview (see attached Site Plan) (10:45 – 11:00)

b) WAS Thickening (see attached Evaluation) (11:00– 12:00)

c) Aeration Basins and Blowers (see attached Evaluation) (12:30 –)

d) Reclaimed Water/Plant Water (see attached drawings) ???

e) Electrical Evaluation (next workshop)

f) Cogen Evaluation (next workshop)

g) Additional Evaluations (next workshop)

5) Next Steps

Workshop #2 meeting with County: Thursday May 12, 2011?

Assignments

Assignment	Person	Date Due
1.		
2.		
3.		
4.		
5.		

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DRAFT Workshop 1 Minutes

Prepared for: Kitsap County
Project Title: CKTP Reclamation and Reuse Project
Project No.: 140912

Purpose of Meeting: Workshop #1
Meeting Location: CKTP
Minutes Prepared by: Tadd Giesbrecht

Date: April 18, 2011
Time: 9:30 a.m.

Attendees:

Barbara Zaroff	Bill Persich
Stella Vakarcs	Tadd Giesbrecht
John Gardner	Patricia Tam
George Radebaugh	Bo Vestergaard-Hansen
Rich Neal	

Summary

The purpose of this meeting was to kick-off the CKTP Reclamation and Reuse Project and discuss a series of Preliminary Design issues. A summary of decisions for general Preliminary Design issues, WAS Thickening and Aeration Basins and Blowers is provided below:

Preliminary Design Issues

- Preliminary Design Content: It was determined that presented Table of Contents for the Preliminary Design would be acceptable.
- Communication: In general, the BC team should directly email the appropriate plant staff for information/guidance and cc: Barbara, John, George and Rich. Bill and Tadd should be cc on all BC-County communications.
- Schedule: The draft schedule presented was acceptable and will be further detailed for work occurring in later phases.
- Evaluations: In general, the preliminary design evaluations will occur in a workshop setting and documented in summary format. In some cases, a more detailed technical memorandum may be required.
- 2D and 3D Designs: The County determined that it would be acceptable to conduct the designs in 3D for process areas that have not yet been designed (such as WAS Thickening and Reclaimed Water). For the Aeration Basin process area, it was determined that

developing the design in 2D would be appropriate to take advantage of existing 2D drawings from past designs.

WAS Thickening

At the Workshop on April 18, 2011, the following decisions were made by the core team:

- **Technology:** RDT was selected based on client preference, smaller footprint, lower cost, improved indoor environment (less moisture and odor as a result of the thickening drum being enclosed), and favorable impression from the plant staff's tour of the Bremerton installation.

- **Number of Units:** One unit will be installed as part of this project, but the design will allocate space for a second unit to be installed in the future. In the anticipated WAS flow range, only one unit is required. In case of RDT downtime for periodic inspection and repair work, WAS can be re-directed to the gravity thickener (GT) minimizing the need for a second, redundant unit.

- **General Design Direction:**
  - Thickening equipment
    - Size based on continuous WAS wasting flow rate
    - Consider sizing for the 10 year load to see if smaller unit can be used; this maybe better suited to handle the required turndown. If turndown exceeds the required range of flows, size must be reduced from preliminary 200 gpm capacity to handle the initial year flow of 84 gpm
    - Progressing cavity pump with open-throated inlet were selected as the TWAS pumps from RDT to TSBT for their ability to handle the expected TWAS concentration and client preference. The design will provide a bypass around the TSBT for direct digester feed in case of tank downtime.
    - Emulsion polymer system was selected over a combined dry/emulsion for client preference and relative small amounts of emulsion polymer needed. Progressing cavity metering pumps were selected for good metering capability and low shear of polymers.
    - Electrical room to provide power to all equipment associated with thickening, storage, and digester feed will be located in the thickening building
    - Single-story building
    - Provide access around the RDT with a catwalk.
    - Use FKC as the basis of design, but open spec up for other competition.
    - CMU building was selected over the pre-cast type because of its reduced corrosion potential and washdown considerations. It is recommended to add sealing for improved washdown (min 4-5 ft up from floor). ***BC to provide a brief summary of the relative cost difference between CMU and pre-engineered metal to confirm this decision.***

  - Thickened sludge blend tank (TSBT)
    - Separate structure for the TSBT and associated pump room were discussed. The final design may combine these with thickening building; final decision will be based on discussions with structural engineers
    - Recessed impeller pump were selected for TSBT mixing. This type has been used in other thickened sludge storage tank applications.
    - Progressing cavity pumps were selected for digester feed. These provide good metering capability and is a client preference.
    - Sizing of tank will be finalized when all information on inflows has been collected.
  - Flows to TSBT and GT
    - TWAS from other plants: up to 3 trucks per day (8 hrs) at about 4,000 gal each. This can be spread out and sequenced to reduced load to TSBT
    - Septage will be sent to the GT. No impact on RDT sizing
    - Primary and secondary scum to be sent directly to the TSBT. No impact on RDT sizing
  - Add line to feed thickened primary from GT to the TSBT and retain the existing digester feed line.

- **Operating Scenario:**
  - WAS is wasted on a continuous basis
  - Thickening operation to match the dewatering operating scenario: 16 hrs/day during the week and 8 hrs/day during the weekend
  - When thickening system is off-line, valves will direct flow to GT

Aeration Basins and Blowers

At the Workshop on April 18, 2011, the following decisions were made by the core team:

- **Mixers:** See mixer evaluation below.
- **Blowers:** Evaluate the option of a hybrid blower system consisting of both multistage centrifugal blowers and high speed turbo blowers. The initial proposal is to replace one of the existing multistage centrifugal blowers with a high speed turbo blower and add one new high speed turbo blower. This approach would result in a total of four blowers: two existing and two new high speed blowers. As the remaining existing blowers approach the end of their service life, they could also be replaced with high speed turbo blowers. Reusing the existing blowers as part of the blower arrangement could ultimately defer the capital expense of two high speed blowers, lowering the capital cost required for this phase of construction while still meeting air flow requirements. ***BC will investigate the range of air flow requirements to determine if different size blowers are needed to cover the range of air flows and propose a control scheme for the blowers.***
- **Mode of Operation:** The plant staff would like to preserve the flexibility to operate in sludge reaeration mode. They currently operate in sludge reaeration mode. This means that the diffusers will be required in all anoxic cells and the original RAS mixing box configu-

ration that allows sludge reaeration operation will remain (with modifications to accommodate new aeration basins).

- **Diffusers:** The option of replacing the existing 7-inch Sanitiare diffuser grids with new diffuser grids was brought up, as the existing diffusers are about 15 years old. This option was evaluated as part of the Phase III pre-design in 2007. At that time, it was concluded from a life cycle cost analysis that replacing the membranes on the existing 7-inch diffusers and retaining the existing diffuser grids would be the most favorable, when compared to the alternatives of replacing them with new 9-inch diffuser grids and with new panel-type diffusers. Inspection by the plant staff at that time indicated that the in-basin air piping was in satisfactory condition. However, that evaluation was conducted assuming that the plant would nitrify in the summer only. For the current plant upgrade, the secondary system will provide year-round TN removal. In addition, there is potentially a large energy-saving incentive from Puget Sound Energy (as high as 70 cents matched for a dollar of cost). To determine the most cost effective option for the diffusers for the current design criteria, the following activities will be performed:
    - *The plant staff will inspect the existing in-basin air piping again to confirm whether the existing diffuser grids can be retained. (At the April 25, 2011 Workshop, plant staff indicated that the existing piping is in working order and can be retained).*
    - ***BC will re-visit the life cycle cost analysis based on the current projected aeration demand for TN removal, both with and without an energy grant from PSE. The latest rate for the grant will be used.***
- **DO Control:** It was decided that the design would proceed with the proposed layout of three automatic control valves and three DO probes in each basin to optimize DO control. There was some discussion on the use of manual valves, but follow-up discussion at the April 25, 2011 Workshop confirmed that automated control was desired. But with multiple cells in multiple basins, this would become very labor-intensive. Operator adjustment of the valves would still be possible. It was also requested that ORP meters be installed in the anoxic cells to assess denitrification in those cells.
- **Internal Mixed Liquor Recycle Pumps:** The plant staff had good luck with submersible pumps so far, and thus do not have any problem with the use of submersible pumps for the new IMLR pumps.
- **Channel Air Blowers:** The existing channel air blowers should remain in the utilidor. New channel air blowers can be installed next to the new supplemental carbon addition facility or possibly by the new RAS mixing box by the new WAS pumps.

WAS Pumps: The new WAS pumps at the RAS mixing box will be sized to provide the required turndown for wasting. The existing WAS pumps do not have adequate turndown; as a result, wasting of mixed liquor often takes place. Wasting of mixed liquor has a negative impact on the performance of the thickening system and is thus not desired. The option of installing different sized WAS pumps will be considered to cover the range of WAS flows. With proper sizing of the WAS pumps, wasting of mixed liquor will longer occur.

Mixers

At the Workshop on April 18, 2011, the following decisions were made by the core team:

- **Technology:** It was decided that submersible mixers (same as the existing mixers) would be used in the second anoxic cells in the existing basins and in the anoxic cells of the new basins. The plant staff has not had any issues with the existing mixers. They have a spare mixer on the shelf. The new units will have 2-hp motors (instead of 3-hp motors as for the existing units).

- **Number of Units:** 12 total (two units in cell 5 in each of aeration basins 1 and 2, and in cells 1 and 5 in new aeration basins 3 and 4)

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Workshop 2 Agenda

CKTP Reclamation and Reuse Project
Project No.: 140912

Kickoff Meeting and Workshop
Meeting Location: CKTP

Date: April 25, 2011
Time: 9:30 a.m.

Invitees:
Barbara Zaroff
Stella Vakarcs
John Gardner
George Radebaugh
Rich Neil
Bill Persich
Tadd Giesbrecht
Eron Jacobson
Kelly Kimball
Greg Kumataka

1) Preliminary Design Evaluations

a) Electrical Evaluation (see Evaluation material)

b) Cogen Evaluation (see Evaluation material)

c) Reclaimed Water/Plant Water (see Evaluation material)

d) Additional Evaluations?

2) Next Steps

Workshop #2 meeting with County: Thursday May 12, 2011?

Assignments

Assignment	Person	Date Due
1.		
2.		

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DRAFT Workshop 2 Minutes

Prepared for: Kitsap County
Project Title: CKTP Reclamation and Reuse Project
Project No.: 140912

Purpose of Meeting: Workshop #2
Meeting Location: CKTP
Minutes Prepared by: Tadd Giesbrecht

Date: April 25, 2011
Time: 9:30 a.m.

Attendees:

Barbara Zaroff	Bill Persich
John Gardner	Tadd Giesbrecht
George Radebaugh	Eron Jacobson
Rich Neal	Kelly Kimball
	Greg Kumataka

Summary

The purpose of this meeting was to discuss Electrical, Cogen, and Reclaimed Water and Plant Water preliminary design issues.

Electrical Evaluation

Two options were discussed for addressing normal power distribution and standby power needs:

- Option A) Consolidated generator system approach with a new building
- Option B) Distributed generator systems without a new building (outside generator, 15kV, and cogen system installation)

It was decided to develop an evaluation to compare these two options in greater detail on a higher level planning cost basis. This evaluation has been started and is expected to be presented to the County next week.

Cogen Evaluation

At the Workshop on April 25, 2011, the following decisions were made by the core team:

- **Technology:** An internal combustion engine was confirmed as the cogeneration technology. The plant personnel have operational and maintenance experience with engine-generators and it is a more efficient technology than microturbines. The County does not want to consider microturbines.

- **Engine-generator Capacity**: The County prefers a smaller engine-generator that would operate more of the time at start-up over a larger engine-generator that would potentially not operate as frequently during the beginning years of operation. The County views this cogeneration project as the first step toward increased biogas usage and desires to start with a smaller unit/system that can be expanded as gas control is optimized and the third digester installed.

  The 330 kW and 350 kW engine-generators were eliminated from further consideration. A second engine-generator could be installed in the future if FOG co-digestion were implemented and the quantity of biogas increased. The 265 kW engine-generator (MAN) was the preferred size unless similar turndown capabilities exist with the 300 kW engine-generator (Guascor). The County expressed a desire to talk to personnel at other plants that have operated the MAN and Guascor engines.

  The County indicated that to get better readings and confirm gas production numbers, the gas meter would need to be fixed or re-positioned. The existing gas meter turbine wheel sometimes sticks and gives erroneously low gas production values. This may account for some of the large variability in gas production. The flow meter position in the pipe downstream of a 90-degree elbow would also provide poor measurement. A fix or replacement of the flow meter may provide better gas flow information in the short term showing that gas variability is less than seen to date. The cogeneration capacity selected above will not increase if variability is seen to be less. If gas production variability is seen to be greater, consideration will be given for decreasing the cogeneration capacity. The cogeneration design will incorporate a new thermal mass flow meter with adequate straight runs for good measurement. If the County installs a new thermal mass flow meter now, it may be used for the cogeneration design.

- **Container/Building:** The container option seemed reasonable to plant personnel. The location of the cogeneration unit will depend on the standby generator alternative location assessment currently underway.

Packaged Digester Gas Treatment: The County agreed the two vessel system with lead-lag capabilities for activated carbon siloxane removal was the better design. The County expressed preference for a longer carbon replacement cycle (i.e. six months to one year). The system will have a two-vessel hydrogen sulfide removal system with regeneration and a long-term replacement cycle (i.e. as close to one year as possible). The County expressed a desire to talk to other wastewater treatment plants regarding the digester gas treatment system.

- **Flare, System Connections, and Backup Power:** An option to move the new flare from the location shown in the Facility Plan to a location closer to the cogeneration building/container was discussed. This location would minimize the length of digester gas piping required. The County agreed that there were no issues with moving the new flare to this location.

  The location for the digester gas connection was reviewed. The County agreed that connecting to the digester gas line outside the digester gas building in the flare vault was acceptable.

  The location for the hot water connection was reviewed. The County agreed that connecting to the hot water boilers at the common return headers was acceptable.

  It was decided that the hot water return pumps would need to be on backup power.

- **Funding:** The County intends to apply for Puget Sound Energy's energy conservation grant program to help fund a portion of the co-generation project.

Action Items:

Brown and Caldwell will assemble a list of names of plants that have digester gas pre-treatment with internal-combustion cogeneration for the County to contact.

Brown and Caldwell will set up a plant visit to see and discuss digester gas pre-treatment system with internal-combustion cogeneration.

Reclaimed Water

At the Workshop on April 25, 2011, the following decisions were made by the core team:

- **Technology:** Options for producing Class A reclaimed water such as sand filtration, cloth filtration and membranes were discussed. Based on the evaluation presented in the Facility Plan, the discussion primarily focused on the details of the sand filtration technology. One of the key advantages of sand filtration that was valued by the team is that the deep sand bed provides a greater depth of barrier than a piece of cloth in the case of cloth filtration.

Sand filtration was selected as the preferred technology and site visits to LOTT Budd Inlet plant and King County South Plant will be scheduled to see similar installations of sand filter systems.

- **Tank Type:** The filter tanks could be of concrete or steel construction. Because the current vision is for the filters to be located on a slab above-grade, steel tanks would be suitable and overall would cost less to design/construct. The design will be advanced based on vendor-supplied steel tanks for the sand filters.

- **Building Type:** A pre-engineered steel building will be used to house pumps and chemical feed equipment. The filters can likely be located outside. Plant staff indicated that the open slab area to the west of the UV channels and south of the control panel could possibly be used for locating some of the reclaimed water equipment.

- **Current and Future Design Capacity:** The design capacity of the first phase of the reclaimed water system is 3.5 mgd in the Facility Plan. This capacity is an estimate of demand from potential off-campus reclaimed water users. The decision was made to size the reclaimed water production system (not the off-site pumping system) for 3.5 mgd initially and provide a layout to accommodate up to 8.2 mgd, which corresponds to year 2030 max month flow estimate for full plant flow reclamation. This will require providing an equalization storage tank in the future to store peak flows above the capacity of the filters at 8.2 mgd.

  The decision was made to not design off-site reclaimed water pumping equipment (pumps or hydropneumatic tank) at this time since off-site customers have yet to be formally identified. System layout should allow for the future installation of these components, but not included in this design phase.

  Provision needs to be made for using Class A reclaimed water as the source for the plant water system. One option may be to gravity overflow from the clearwell to the plant water process pump suction in the UV channel (depending on plant water pump type). Another more likely option would be to install dedicated plant water pumps to pump from the clearwell to pressurize reclaimed water to the required plant water system pressure (90 psig) and in the future add reclaimed water service pumps to deliver reclaimed water to off-campus uses (likely at a larger flow and lower pressure than the plant water pumps).

  Use of the 6,000 gallon Alum tank in the Solids Processing Building for the reclaimed water system was discussed. Plant staff indicated that this tank is currently infrequently used and could be considered for reclaimed water system use. An alum pipe runs from this tank to the secondary clarifiers, making it a short distance to connect to the reclaimed water system if it is located near the UV area.

- **Siting:** Two locations were discussed for siting the reclaimed water system: south of the primary clarifiers (as shown in Facility Plan) and north of secondary clarifier 2. The location north of secondary clarifier 2 was not explored in the Facility Plan because until recent plant flow projection reductions, the entire area north of the existing clarifiers was reserved for 2 future secondary clarifiers. Now that the reduced flow projections result in the need for only 1 future secondary clarifier, the space north of secondary clarifier 2 could be used for the reclaimed water system. This location is ideal in that it is both close to the source water for the reclaimed water system (UV disinfected effluent) and a connection to the outfall (for overflow from the clearwell when reclaimed water production exceeds the demand).

  For these reasons, it was decided to proceed with siting the new reclaimed water system in the area north of secondary clarifer 2. A pipe connection from the reclaimed water system to the reclaimed water pipe south of the primary clarifiers for serving off-campus users will likely need to be routed to the west of the aeration basins to avoid significant utility conflict through the middle of the WWTP.

Plant Water

At the Workshop on April 25, 2011, the following decisions were made by the core team:

- Irrigation is currently accomplished with process water via garden hose with sprinkler. Future irrigation is expected to continue to be with a garden hose.
- The plant water system pressure for on-site uses is confirmed at 90 psig. Off-site uses may not require as high of a pressure. Design pressure for off-site uses to be determined later.
- The plant staff indicated that they have had good success with submersible pumps if that type of plant water pump would be more appropriate than a vertical turbine. Typically submersible pumps are not as efficient as vertical turbine and are use more for wastewater applications.
- The direction of the overall proposed layout for the plant water pumps and the reclaimed water pump was acceptable.
- Contact with North Perry Water District will be made to begin discussions about meeting fire flow demands.

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Item #	Decision/Comment Item	Discipline	Process Area	Originator	Date Originated	Respondent	Date Resolved	Decision
1	Who will have authority for generation delivery and distribution of the reclaimed water?	Process_Mech	Reclaimed Water	George Radebaugh	5/4/2011	Tadd Giesbrecht	5/4/2011	Per Barbara Zaroff, this is a County policy decision that's yet to be determined.
2	Will we charge a fee to end users of this water?	Process_Mech	Reclaimed Water	George Radebaugh	5/4/2011	Tadd Giesbrecht	5/4/2011	Per Barbara Zaroff, this is a County policy decision that's yet to be determined.
3	How will ongoing operation be funded?	Process_Mech	Reclaimed Water	George Radebaugh	5/4/2011	Tadd Giesbrecht	5/4/2011	Per Barbara Zaroff, this is a County policy decision that's yet to be determined.
4	Will we be able to continue overall operation of reclaimed water supply while filters are being changed or cleaned?	Process_Mech	Reclaimed Water	George Radebaugh	5/4/2011	Jon Beer	5/10/2011	Yes, the Dynasand filter is a continuous backwashing filter design (unit does not go off-line when being cleaned)
5	Will personnel need to be licensed as "cross connection specialists" as they are in all areas where non-potable water could possibly contaminate potable water such as backflow preventers etc.. ?	Process_Mech	Reclaimed Water	George Radebaugh	5/4/2011	Jon Beer	5/10/2011	It is not anticipated that additional licenses would be required to operate the in-plant reclaimed water system since it is simply taking the place of the process water system (which does not require "cross connection specialists rating" because it is not potable water.) Section 1, Article 12, Section 3 of September 1997 Water Reclamation and Reuse Standards only applies when in contact with potable water.
6	If the reclaimed water is used throughout the plant for things such as seal water then the use of process water in the event of a reclaim water supply failure would be precluded. Maybe process water should be eliminated.	Process_Mech	Reclaimed Water	George Radebaugh	5/4/2011	Jon Beer	5/10/2011	The preliminary concept included a connection between the reclaimed water system and the process water through a reduced pressure backflow preventer. A dual source for plant process water needs was originally envisioned to provide redundancy should the reclaimed water system be down. See Item 14 for similar discussion.
7	Would storing the gas for use as fuel for vehicles, generators, and boilers be a better option than cogen?	Process_Mech	Cogeneration	George Radebaugh	5/4/2011	Eron Jacobson	5/13/2011	Storage and end use are probably two separate issues. Storage of the digester gas can be done at low pressure or high pressure. Low pressure gas storage helps to smooth out digester gas production variability over a matter of a day so that an end use has a more constant source of fuel. Vendors such as Duosphere can supply these. While this is beneficial for control and may allow a larger cogeneration system, it would add significant cost and complexity to the design process. It is not a requirement for the cogeneration system and is not recommended based on the additional capital cost. High pressure gas storage would mean compressing the digester gas to store it for future use. This could allow greater storage volume of digester gas, but the digester gas would have to be treated so that the storage pressure vessel would not corrode. High pressure gas storage would only be applicable if greater storage volumes and long-term storage were required. Capital costs would be very high and the system would be much more complex than the low pressure gas storage. High pressure storage is not recommended for this project. A different end use of the gas could mean separating the unwanted constituents from the methane resulting in 98% pure biomethane for natural gas grid injection or vehicle use. This end use is viable if a natural gas pipeline is close and if compressed natural gas vehicles could use the fuel. Typical biomethane systems are installed at much larger plants, although small systems are available. If the digester gas were used to produce biomethane and not used for heating, then fuel oil would need to be purchased in current quantities. Since the cogeneration system provides heat to offset fuel oil and electricity to offset plant power, it is likely to be far more valuable than biomethane production for vehicle fuel. The installation of new digester gas boilers would also reduce or alleviate the use of fuel oil. The installation of new digester gas boilers is recommended in the long term facility plan.
8	Will it be possible to keep cogen plant running while cleaning and taking filters in and out of service?	Process_Mech	Cogeneration	George Radebaugh	5/4/2011	Eron Jacobson	5/13/2011	The Sulfatreat and activated carbon systems will have two vessels. One can be taken offline for cleaning or media replacement while the other is online and the cogeneration plant is kept running. A digester gas particulate filter will have a bypass line to keep the plant operating while the filter is changed. UPDATE (7/21/11) - The engine oil lube system will have dual oil filters to keep the engine running while oil filters are changed.
9	Are spare parts readily available for the cogen plant and auxiliary equipment?	Process_Mech	Cogeneration	George Radebaugh	5/4/2011	Eron Jacobson	5/13/2011	The design decision was made to install the MAN 265 kW engine. The MAN representative for the west coast is RDI Marine and they are located in Seattle. They do not package the engines, but they represent the packager 2G Cenergy for the cogeneration system. We can confirm the availability and ship time of parts through RDI marine and 2G Cenergy. Note that MAN is a German engine company (formerly Deutz), and parts will originate in Germany. RDI Marine/2G Cenergy also offer a maintenance plan that can cover scheduled and unscheduled maintenance with mechanics from Seattle. We will post the maintenance plan information on the project portal. UPDATE (5/23/11)- 2G Cenergy stated that they have a 24 hour policy for parts. They have a large warehouse in Florida and Ontario in addition to parts in Seattle. The tentative listed manufacturers for the digester gas treatment system will be in Washington state or Iowa. The digester gas treatment system will be comprised of equipment similar to that around the plant including blowers, pumps, chillers and instrumentation. It is expected that availability will be similar to equipment in the plant.

🟥 Issue still needs to be resolved

Item #	Decision/Comment Item	Discipline	Process Area	Originator	Date Originated	Respondent	Date Resolved	Decision
10	Will there be odor or noise issues associated with this project?	Process_Mech	Cogeneration	George Radebaugh	5/4/2011	Eron Jacobson	5/13/2011	The project will have new blower(s) and an engine which will add noise to the facility. The blowers and the engine can be provided with sound attenuating enclosures to limit noise. UPDATE (7/21/11) - The engine enclosure will limit sound to 65 dBA at 30 feet. The digester gas blower will be limited to 85 dBA at 10 feet. The project will have digester gas treatment with iron sponge and activated carbon. Changing of this media will likely produce some odor, but this will be done infrequently (annually or bi-annually).
11	What is the cost of filter media change out or regeneration?	Process_Mech	Cogeneration	George Radebaugh	5/4/2011	Eron Jacobson	5/13/2011	We are verifying the cost of materials with the vendors. UPDATE (5/23/11): Activated carbon media for siloxane removal is about $3.35 /lb. No regeneration is required. The media is removed and can be sent back to the carbon supplier for regeneration. UPDATE (7/21/11): The Sulfatreat media is about $0.52/lb and about $0.65/lb including shipment. No regeneration is required. The media is removed and landfilled.
12	There are two options for the location of cogeneration and standby power systems. Option A would co-locate the cogeneration unit and the two standby generators (existing 600kW unit and one new) in dedicated building. Option B would keep the existing 600kW unit in its current location and locate the cogeneration unit and new standby generator separately in individual enclosures. An options analysis was completed and presented to the County.	Process_mech and Electrical	Cogeneration	Eron Jacobson and Kelly Kimball	4/25/2011	CK-John Gardner, Rich Neal and George Radebaugh/Kelly Kimball	7/1/2011	Option B is the preferred option. Cogeneration and the new standby generator will be located separately and in individual enclosures. Email from George Radebaugh on 6/10/11: *We did test the existing plant generators under full load and found that the 500kw set was using 90% of its rating when all equipment was running. The 600kw set was only using 18% when all of the associated equipment was in use.* Email from George Radebaugh on 7/1/11: *I have been reviewing the A and B options again with the electricians and crew and I think that we all feel that a modified B plan is the most desirable for the following reasons:* *1. Backup power is distributed rather than in one central location. A fire or other mishap in the building proposed under option A could jeopardize the entire backup power system as well as the co-gen equipment.* *2. Lower voltage distribution allows for crew with present level of training and expertise to maintain the network.* *3. Avoids any paralleling issues when on emergency power since generators will be run separately* *4. Lower initial cost.* *5. Less complex power distribution means less reliance on PLC control for plant power control or maybe additional PLC not necessary at all.* KJK: Based on the direction from the Client, as seen in the two excerpts from the emails, BC will provide a modified option B to meet the needs of the Client. We will not demolish either of the existing generators and attempt to add any new loads that require standby power to the Power Blower Building Switchgear that is backed-up by the 600 kW standby engine generator. We will still install new switchgear in the sludge processing building with relocation of some loads from the Power Blower Building Switchgear to this new switchgear in order to avoid capacity issues at the Power Blower Building. If it is determined that there is some level of back-up power required at the Sludge Processing Building, which feeds the new WAS thickening building, then a new generator will be provided near this building. Alternately if the loads that require standby power in the sludge processing building area are very small, a back feed could be provided from the power blower building (600 kW generator side) supply back-up power for these minimal loads.
13	Will option A require paralleling of gensets of different size?	Process_Mech	Cogeneration	George Radebaugh	5/4/2011	Kelly Kimball	4/25/2011	Yes, currently we anticipate a new 1 MW generator to parallel the existing 600 kW generator (relocated from the existing building).
14	Will both options A and B require paralleling the cogen plant with commercial power or with the gensets of different sizes?	Process_Mech	Cogeneration	George Radebaugh	5/4/2011	Kelly Kimball	4/25/2011	When normal utility power is available the cogen will be in constant parallel with the utility, as long as digester gas is available for the cogen to run. Option A: When the cogen is running and normal utility power is lost, fast trip contacts will open the feeder circuit breaker to the cogen unit, thus separating it from the plant. At the same time the main 15 kV circuit breaker will open and separate the plant from the utility. The generators will start and parallel to each other, plant operation will then sequence back on the plant loads. At this time the possibility does exist for the cogen unit to parallel to the plant generators and contribute to the entire plant loads. Option B: When the cogen is running and normal utility power is lost, fast trip contacts will open the feeder circuit breaker to the cogen unit, thus separating it from the sludge processing building (SPB) electrical gear. At the same time the both main circuit breakers at the SPB will open and separate the plant from the utility. The generator will start and plant operations will then sequence back on the plant loads. At this time the possibility does exist for the cogen unit to parallel to the SPB generator and contribute to standby power needs of the SPB only.

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Item #	Decision/Comment Item	Discipline	Process Area	Originator	Date Originated	Respondent	Date Resolved	Decision
15	Could the existing plant process water pumps be used as a backup water source to the reclaimed water system instead of installing new plant process water pumps? The original requirement for new process water pumps was to add capacity, but if the reclaimed water system is the primary source for process water, could the existing process water pumps provide adequate standby process water pumping so a new plant water pump station would not be required?	Process_Mech	Plant Water	Tadd Giesbrecht	5/9/2011	CK - John Gardner	5/11/2011	Per John Gardner's input: The existing process water pumping system has the capacity to stand as backup. The condition of the equipment is adequate, since it will not be used continually. Additional piping may be needed in the process building in order to keep the process water and reuse water systems separate if the existing process water pumps continue to take a suction from the unfiltered effluent stream. Therefore, the new process water pump station design (at the UV channel) will not be developed as a result of this decision and efforts will be focused on integrating reclaimed water into on-site plant uses.
16	Equipment naming convention for new equipment and renaming of existing equipment to fit within naming convention (e.g., AB mixers)? See detailed email sent 5/10/11.	Process_Mech, Instrumentation	All	Tadd Giesbrecht	5/10/2011	CK - John Gardner	5/12/2011	Per John Gardner's 5/12/11 email, the County desires to rename existing equipment where the addition of new equipment creates a scenario where existing equipment naming becomes non-sequential or generic. For example, the existing mixers in Aeration Basin 1 will become "Aeration Basin 1 Mixer 1" and "Aeration Basins Mixer 2" instead of "Activated Sludge Mixer 1" and "Activated Mixer 2". This will require changing the nameplates for existing equipment that gets renamed. Existing equipment numbers will remain unchanged.
17	Diffuser type evaluation (see 5/11/11 email)	Process_Mech	Aeration Basins	Patricia Tam	5/11/2011	Tadd Giesbrecht	5/12/2011	A teleconference was held on 5/12/11 with the County and BC. The diffuser analysis concluded that the NPV of the Aerostrip option and Sanitaire option were essentially the same. Although Aerostrip has a higher capital cost, it was decided to design around Aerostrip since it has a higher efficiency and a similar NPV value to Sanitaire. During detailed design, we will investigate options for allowing competition to Aerostrip, such as including Sanitaire's new Gold series in the spec (or allowing them to compete as a bid alternate). The County will call Bremerton as a reference for Aerostrip to confirm that actual efficiency and operation and maintenance are acceptable.
18	Blower type evaluation (see 5/11/11 email)	Process_Mech	Aeration Basins	Patricia Tam	5/11/2011	Tadd Giesbrecht	5/12/2011	A teleconference was held on 5/12/11 with the County and BC. The blower evaluation concluded that a hybrid blower system (2 new high speed and 2 existing multistage) was the option with the lowest NPV, highest efficiency (essentially the same as all new high speed blowers), and significantly less capital cost than buying all new high speed blowers. Because the County is comfortable with continuing the use of the existing multistage blowers, this hybrid blower option was preferred. The multistage blower will only be used when the conditions match the blower's best efficiency range and the new high speed blowers will be used for all other air demand conditions. The following details will be investigated: * Include new electronics/soft-starts for existing multi-stage to be reused * Verify that existing multi-stage can operate at the higher pressure required by Aerostrip diffusers * Verify turndown capability and coverage range for this hybrid system
19	If an air gap, tank, and pump station must be utilized for potable water, can the water still be used for drinking?		Plant Water	John Gardner	5/12/2011	Tadd Giesbrecht	5/19/2011	Yes, as long as the current potable water system is maintained as-is and no other connections are made (e.g., seal water) to the system.
20	Can sodium hypochlorite still be used for algae control in aeration basins that are off line, once they have been equipped with Aerostrip Diffusers?		Aeration Basins	John Gardner	5/16/2011	Patricia Tam	6/29/2011	Aerostrip recommends against the use of hypochlorite for algae control in an off-line basin because the chlorine residual would attack the membrane over time (the EPDM membranes in the existing Sanitaire diffusers are supposed to be more resistant). For algae control, they recommend aerating the basins from time to time. Chlorinating the RAS for bulking control is ok as there will be no permanent chlorine residual in that case.
21	It is likely that a new flare is not required if the existing flare can operate at a higher set pressure, but below 10" w.c. The set pressure will be 7.25" w.c. for operation with cogeneration. The County is planning a test to operate the flare at higher pressure to verify that the existing flare can operate adequately.	Process_mech	Cogeneration	Eron Jacobson	6/13/2011	CK-John Gardner, Barbara Zaroff	8/25/2011	In an email on 8/25/11 from Barbara Zaroff and John Gardner, the County has decided to replace the existing flare for a number of reasons discovered during the inspection and testing of the flare in August: - When the flare is removed from service and allowed to cool down it has white ash and steel particles that fall down to the ground. The heating and cooling cycles are particularly hard on the internal iron parts. As the number of these cycles are to increase in conjunction with the co-gen project, the basic burner parts in the flare that are in poor condition will quickly worsen with the increased stress. - The control panel for the flare does not presently meet code. - The existing flare vault is sufficiently sized for the equipment that is now in it, however, installing a total gas flow meter in the same vault will be difficult. - The flare itself is located close to the digesters and is a flame source when gas leaks or is vented. The addition of a third digester would require moving the flare anyway and it may be highly advantageous to move it now. An observation made by the County during the test is that the manometers measuring digester gas pressure do not have an adequate range for service at a higher pressure. The manometers will be replaced with units that have a pressure of 9-11 in w.c. in the middle of the range.
22	Will the new channel air blowers be covered and noise attenuated? There is a neighbor that is concerned about noise so County would like to make sure that outside blowers have noise attenuation.	Process_mech	Aeration Basins	CK - John Gardner	6/23/2011	Patricia Tam	6/29/2011	The new channel air blowers will be enclosed in sound-attenuating enclosures. Based on information provided by one of the accepted vendors (Kaiser), the estimated noise level (with sound insulated piping) is 71 dBA with the enclosure.

Issue still needs to be resolved

Item #	Decision/Comment Item	Discipline	Process Area	Originator	Date Originated	Respondent	Date Resolved	Decision
23	How will sludge trucks off-load to the TSBT? Truck pumps will not be able to provide more than a few feet of lift. Could the new recirc or digester feed pumps be used for this purpose with a control panel outside?	Process_mech	WAS Thickening	CK - Rich Neal	6/23/2011	Bo Vestergaard-Hansen	7/22/2011	A hauled sludge transfer pump will be provided outside next to the TSBT. Truck has quick connect for connection to this pump. Pump will be a PC pump; same make and models as the TSBT circulation pump. Separate control panel will be provided for this pump. Hauled sludge transfer pump will be constant speed and can serve as back up the TSBT circulation pump (manual mode only)
24	Is there a way to have the RDT filtrate flow by gravity to an appropriate sump PS to avoid having filtrate pumps in the WAS Thickening Building? Concern about having the filtrate pumps running continuously within the building.	Process_mech	WAS Thickening	CK - John Gardner	6/23/2011	Bo Vestergaard-Hansen	7/22/2011	RDT filtrate will be routed to the in-plant wastewater pump station by gravity.
25	What material will be specified for the AB baffles?	Process_mech	Aeration Basins	CK - Rich Neal	6/23/2011	Patricia Tam	7/25/2011	For the preliminary design, it was assumed that the same type of materials used for the existing baffles (Redwood No. 1 Grade) will be used for all new baffles. Other materials such as FRP will be considered after the Preliminary Design submittal.
26	What type of pump will be specified for the new WAS pumps? At the meeting on 6/23/11 at CKTP, there was discussion about using a centrifugal pumps vs. rotary lobe. The current thinking is rotary lobe, but plant staff would like verification that a centrifugal pump would not be suitable and provide necessary suction lift and turndown.	Process_mech	Aeration Basins	CK - Rich Neal	6/23/2011	Patricia Tam	7/25/2011	Rotary lobe pumps will be used due to its greater turndown capability.
27	Aeration basin slide gate and valve replacement	Process_mech	Aeration Basins	CK - John Gardner	6/23/2011	Tadd Giesbrecht	6/23/2011	At the meeting on 6/23/11 at CKTP, there was discussion about what channel step feed slide gates should be replaced and what valves on the existing air lines. It was decided that the channel slide gates should be replaced since the existing are old, leaking, and corroded and the County would attempt to fix the existing air valves so that this contract would not involve replacing the existing air valves that are above deck.
28	Based on feedback from LOTT and the County, BC believes that Sulfatreat would be a better hydrogen sulfide scavenging media than iron sponge. Should hydrogen sulfide scavenging media be changed to Sulfatreat and not iron sponge?	Process_mech	Cogeneration	Eron Jacobson	7/1/2011	CK-John Gardner, Rich Neal and George Radebaugh	7/1/2011	Yes, base the design on Sulfatreat.
29	The cogeneration facility can be located west of the digesters as shown in the facility plan or in the area northwest of this location and across the road. There are advantages and disadvantages to both locations as identified in email communications. Which location does the County prefer?	Process_mech	Cogeneration	Eron Jacobson	7/8/2011	CK- John Gardner, Barbara Zaroff	7/29/2011	Because of interference with possible future digester upgrades and the additional cost for fill and retaining walls, it was decided to not locate the cogen system west of the digesters but rather to locate it across the road (option "B" from email interactions). Since this location is closer to the highway and neighbors, the design will need to limit noise. After the Preliminary Design submittal, the design team will look closer at possible noise levels and determine what noise attenuation strategies will be required.
30	WAS Thickening in RDT - continuous or non-continuous operation	Process_Mech	WAS	Bo Vestergaard-Hansen	4/18/2011	Bo Vestergaard-Hansen	5/6/2011	Following the April 18th workshop on WAS thickening, a number of potential long-term implications of non-continuous thickening in the RDT were identified and discussed with the County on 5/6/11. The following decisions were made: *It was decided that the design should accommodate a 24/7 (continuous) RDT operation to allow the operators the flexibility to minimize the concerns and extend the RDT operation as they become more comfortable with the process. *To minimize possible risks associated with an extended/continuous RDT operation, the design will include the following features: ☐ Interlocks will be detailed in the control narrative and will include the kind of monitoring equipment anticipated. Floats are desired for final shut-off duty because of their reliability. ☐ Larger polymer tanks to allow for dilute polymer storage during the weekend operation (from Friday late afternoon until Monday morning). Two tanks at 6 ft diameter x 6 ft tall (or 8x8) are anticipated. ☐ A building drain in case of WAS or TWAS overflows. Drain to location that can handle this fluid (some in-plant manhole or sump)CK experiences periodic power outages of varying lengths the design must include an auto-start feature of WAS thickening operation. *Other related features to be included: ☐ Plumbing to allow for polymer water supply of both potable and plant water ☐ Mag meters on digester feed lines

🟥 Issue still needs to be resolved

Item #	Decision/Comment Item	Discipline	Process Area	Originator	Date Originated	Respondent	Date Resolved	Decision
31	How will aeration basins 3 and 4 and associated channels be drained? At aeration basins 1 and 2, the basins are drained using the existing WAS pumps and old primary sludge pumps (for the last bit of liquid in the tanks). The WAS pumps pump to the gravity thickeners, while the old primary sludge pumps can pump to either the gravity thickeners or directly to the digesters via the scum line. It takes them about a day drain with the WAS pumps and then another day to finish draining with the old primary sludge pumps. To drain one tank completely in 24 hours, the drain pump flow would be 570 gpm. The channels at ABs 1 and 2 have mud valves and drain to the sump outside the utilidor. A decision will need to be made as to where the tank and channels contents should be pumped to (headworks, gravity thickeners or RAS mixing box) and the type of pump for the drain pump.	Process_Mech	Aeration Basins	Patricia Tam	7/28/2011			
32	Should EcoWash be specified for the reclaimed water filters? This reduces washwater reqts by 60 to 90%. It adds about $50K to vendor pkg cost.	Process_Mech	Reclaimed Water	Jon Beer	7/21/2011			Specify EcoWash for the reclaimed water filters. However, continue to size infrastructure for conventional backwash in the event that EcoWash system does not work successfully.
33	In light of the NFPA 820 assessment outlined in the draft Digester Building Review of NFPA Code Compliance sent to the County on 6/10/11 and the County's previous decision to defer digester complex upgrades to the 20-year CIP, Brown and Caldwell would like to review this topic with the County to determine if the County desires to incorporate select Digester Control Building upgrades to address NFPA 820 requirements as part of the initial 6-year CIP Reclamation and Reuse Project, or to continue to defer them to the next scheduled plant improvement project.		Cogeneration	Tadd Giesbrecht	6/10/2011	CK-John Gardner, Barbara Zaroff	6/13/2011	Response from John Gardner with agreement from Barbara Zaroff, "I don't believe that there is any advantage to fully upgrading the old building for fire compliance at this time. When we do upgrade the building, as we planned to with construction of the third digester, the boilers were to be replaced/relocated along with the boiler piping and valves. If we start in now we are in for a big expense with only partial benefits when finished. My take is to side-step if possible without a large expense. I walked the fire inspector through the existing building last February. He made no written comments or recommendations. I don't believe that there is any advantage to fully upgrading the old building for fire compliance at this time. When we do upgrade the building, as we planned to with construction of the third digester, the boilers were to be replaced/relocated along with the boiler piping and valves. If we start in now we are in for a big expense with only partial benefits when finished. My take is to side-step if possible without a large expense. If we start in now we are in for a big expense with only partial benefits when finished. My take is to side-step if possible without a large expense."
34	The design initially includes a foam skimming system that intermittently removes foam. We determined that a true "classifying selector" designed to prevent even the formation of foam induced by *Nocardia* and other foam-causing organisms would be beneficial. A classifying selector continually wastes from the surface to remove the foam causing organisms from the system before they can proliferate and produce foam. By including both a classifying selector and a separate foam removal station located at the mixed liquor channel, the County would have the benefit of a system that is designed to prevent the formation of *Nocardia* foam as well as a way to remove foam caused by other mechanisms such as industrial discharges. The classifying selector would be located at new RAS channel where the pumped RAS will flow through before it enters the RAS mixing box. It will include an overflow weir to allow surface wasting and the new WAS pumps. We recommend both the classifying selector and foam wasting station be included in this project.	Process_Mech	Aeration Basins	Patricia Tam	8/22/2011	CK-John Gardner, Barbara Zaroff	8/23/2011	Response from Barbara Zaroff: "...the overall project cost estimate is coming in low (compared to the budget), so I'm less concerned about additions to the design from a cost standpoint, than what makes the best good sense from a process standpoint." Response from John Gardner: "Richard and I have discussed the need for a system to waste sludge from the top of the aeration basins on many occasions. Your proposed system, floating filamentous bacteria in an RAS channel using fine air diffusers, has a definite advantage at the drum thickener, and we are both in support. As detention times are increased in order to nitrify our effluent, we expect the problem with filamentous bacteria to intensify. I believe that both the classifying selector and the foam wasting station will be well used and should be included in construction plans as indicated in the summary." The design will include both a foam wasting station (at the new ML channel) and a classifying selector (at the new RAS channel).

CKTP Reclamation and Reuse Project
Design Criteria – Flows and Loadings

Parameter	Existing Plant Rating or Basis of Design [b]	Reclamation and Reuse Project [a]		
		Startup (Year 2014)	Plant Rating at Completion of Reclamation and Reuse Project (Year 2016) [c]	20-year Basis of Design for Reclamation and Reuse Project (Year 2030) [h]
Raw influent:				
Annual average flow (AAF), mgd	4.6	4.6	4.8	6.6
Average dry weather flow (ADWF), mgd	4.3	4.2	4.4	6.0
Maximum month flow (MMF)[d], mgd	6.0	5.8	6.1	8.2
Peak day flow (PDF)[d], mgd	11.0	12.7	13.3	17.8
Peak hour flow (PHF)[d], mgd	15.0	16.1	16.9	22.7
TSS:				
Annual average TSS, ppd	8,844	9,200	9.700	13,200
Average peak month TSS, ppd	11,400	11,100	11,600	15,800
Maximum day TSS, ppd	-	16,700	17,600	23,900
BOD_5:				
Annual average BOD_5, ppd	8,403	10,400	10,900	14,800
Average peak month BOD_5, ppd	14,100	11,500	12,100	16,500
Maximum day BOD_5, ppd	-	13,500	14,200	19,200
Septage:				
AAF, gpd	26,900 [e]	8,300 [f]	8,300 [f]	8,300 [f]
Average annual TSS, ppd	5,830 [e]	1,410 [f]	1,410 [f]	1,410 [f]
Average peak month TSS, ppd	-	2,270 [f]	2,270 [f]	2,270 [f]
Average annual BOD_5, ppd	1,570 [e]	390 [f]	390 [f]	390 [f]
Average peak month BOD_5, ppd	-	630 [f]	630 [f]	630 [f]
Sludge from other plants:				
AAF, gpd	13,300	4,400 [g]	4,700 [g]	6,500 [g]
Average annual TSS, ppd	900	950 [g]	1,000 [g]	1,390 [g]
Average peak month TSS, ppd	-	1,300 [g]	1,400 [g]	1,920 [g]
Average annual BOD_5, ppd	390	180 [g]	190 [g]	270 [g]
Average peak month BOD_5, ppd	-	250 [g]	270 [g]	370 [g]

[a] See the Central Kitsap County Wastewater Facility Plan (March 2011) for background and development of these values.

[b] Corresponds to Contract I design flows and loads, except for average peak month TSS and BOD_5 loadings, which correspond to the design loadings shown in the current NPDES permit. The ADF for the secondary treatment system has been re-rated from 6 to 7 mgd per letter from Ecology, July 28, 2008.

[c] 2016 corresponds to the year before the next major upgrade, which includes new aeration basins to achieve nitrogen removal. In order to allow space for the new aeration basins, the existing primary clarifiers will need to be demolished and new ones constructed as part of this upgrade. This design year is given since after construction of the Reclamation and Reuse project, the plant will only be rated to the projected flows and loads associated with year 2016 – after year 2016, additional aeration basins will be required to achieve nitrogen removal. Nonetheless, for most unit processes, new systems added as part of the Reclamation and Reuse project will be sized for the 20-year design condition (year 2030). See the Design Criteria – Equipment table for the number of units to be added in 2016 and in 2030.

[d] In the 2011 Central Kitsap County Wastewater Facility Plan, maximum month flow is referred to as average deign flow (ADF), peak day flow as maximum day flow (MDF), and peak hour flow as peak design flow (PDF).

[e] Values shown reflect original design criteria in Contract I. Actual observed values of these parameters were historically much smaller than the design criteria values listed.

[f] These values are estimated from 2006 observed values. Although septage flows and loads are expected to diminish over time, reduction of septage is not included for conservatism.

[g] Values for sludge from other plants escalated in proportion to population growth from current observed values.

[h] The Reclamation and Reuse project basis of design for equipment and system sizing is year 2030. However, after completion of the Reclamation and Reuse project, the rated capacity of the plant will correspond with the flows and loads projected for year 2016 (see footnote “c”). Once the new aeration basins and associated ancillary equipment are added in year 2017, the rated capacity of the plant will then increase to the flows and loads associated with year 2024 when new secondary clarifiers will need to be constructed. New digesters in year 2028 will be required to achieve the full flows and loads capacity associated with year 2030.

CKTP Reclamation and Reuse Project
Design Criteria – Equipment

Process element (italicized = existing)	Unit	Existing Plant Rating or Basis of Design [a]	Reclamation and Reuse Project		*Criteria of Sewage Works Design* [b]
			Plant Rating at Completion of Reclamation and Reuse Project (Year 2016) [u]	20-year Basis of Design for Reclamation and Reuse Project (Year 2030) [u]	
Bar screens (existing)					
Number, mechanical		*2*	*2*	*2*	*2*
Number, manual		*1*	*1*	*1*	*1*
Screen opening size	*mm*	*6*	*6*	*6*	*--*
Peak hydraulic capacity, each	*mgd*	*30*	*30*	*30*	*--*
Aerated grit tanks (existing)					
Number		*2*	*2*	*2*	*2*
Volume, each	*gal*	*65,000*	*65,000*	*65,000*	*--*
Detention time					
@ MMF	*min*	*--*	*31*	*23*	*--*
@ PHF	*min*	*--*	*11*	*8*	*3 - 5*
Grit washer/classifier system (existing)					
Number		*2*	*2*	*2*	*--*
Washer/classifier capacity, each	*gpm*	*250*	*250*	*250*	*--*
Primary clarifiers, circular (existing)					
Number		*2*	*2*	*To be removed in a future phase of expansion*	*2*
Diameter	*ft*	*65*	*65*		*--*
Depth	*ft*	*10.5*	*10.5*		*8-12*
Total surface area	*sq ft*	*6,600*	*6,600*		*--*
Overflow rate	*gpd/sq ft*				
@ MMF		*909*	*912*		*800-1,200*
@ PHF		*2,260*	*2,545*		*2,000-3,000*
Detention time	*hr*				
@ MMF		*2.1*	*2.1*		*1.5-2.5*
@ PHF		*0.8*	*0.7*		*--*
Future Primary clarifiers, rectangular					
Number		--	--	3	2
Length	ft			120	--
Width	ft			21.5	--
Depth	ft			11	8-12
Total surface area	sq ft			7,740	--
Overflow rate					
@ MMF	gpd/sq ft			1,061	800-1,200
@ PHF	gpd sq ft			2,928	2,000-3,000
Detention time					
@ MMF	hr			1.9	1.5-2.5
@ PHF	hr			0.7	--
Primary sludge pumps (existing)					
Number		*2*	*2*	6	--
Capacity, each	*gpm*	*200*	*200*	100	

CKTP Reclamation and Reuse Project
Design Criteria – Equipment

Process element (italicized = existing)	Unit	Existing Plant Rating or Basis of Design [a]	Reclamation and Reuse Project		*Criteria of Sewage Works Design* [b]
			Plant Rating at Completion of Reclamation and Reuse Project (Year 2016) [u]	20-year Basis of Design for Reclamation and Reuse Project (Year 2030) [u]	
Aeration basins [t]					
Number		*2*	4 (*2 existing*)	6	--
Volume, total	Mgal	*1.62*	3.26	4.86	--
Depth	ft	*14.7*	15.7	15.7	--
Hydraulic detention time @ MMF	hr	*6.5*	13.6	14.2	3-5
Mixed liquor suspended solids (MLSS)	mg/l	*2,300*	1,500 – 3,500	1,500 – 3,500	1,500-3,500
Sludge retention time (SRT)	day	*4.5-6*	8-12	8-12	5-15
RAS to influent flow ratio	%	*42-77*	29-100	50-100	25-75
Loading @MMF [c]					
BOD_5	ppd	*7,940*	9,590	13,160	--
TKN	ppd	*1,140 (NH_3-N)*	2,550	3,500	--
Oxygen demand [d]					
Annual average	ppd	*11,110*	15,040	20,190	--
Maximum month	ppd	*13,260*	17,600	24,040	--
Peak hour	ppd	*14,430*	24,340	33,220	--
Air flow requirements [c, e]					
Annual average	scfm	*4,770*	4,800	6,280	--
Maximum month	scfm	*5,690*	5,690	7,620	--
Peak hour	scfm	*8,180*	7,920	10,980	--
Aeration blowers [f]					
Number, firm/total (existing)		*2/3*	*2/2*	*2/2*	--
Number, firm/total (new)			1/2	1/2	--
Capacity, each	scfm	*4,800*	4,000	4,000	--
Total air flow, firm capacity	scfm	*9,600*	12,000	12,000	
Return activated sludge pumps					
Number, firm/total		*4/5*	*4/5*	5/7	--
Capacity, each	*mgd*	*1.3*	*1.3*	5 @ 2.4 2 @ 3.2	--
Total capacity, firm	*mgd*	*4.6*	*4.6*	16	--
ML wasting/waste activated sludge pumps [g]					
Number		*2*	--	--	--
Capacity, each	*gpm*	*225*	--	--	--
Waste activated sludge pumps					
Number		--	2	2	--
Capacity, each	gpm		210	210	--
ML recycle pumps					
Number		--	4	6	--
Capacity, each	mgd		4.1	4.1	--

CKTP Reclamation and Reuse Project
Design Criteria – Equipment

Process element (italicized = existing)	Unit	Existing Plant Rating or Basis of Design [a]	Reclamation and Reuse Project		*Criteria of Sewage Works Design* [b]
			Plant Rating at Completion of Reclamation and Reuse Project (Year 2016) [u]	20-year Basis of Design for Reclamation and Reuse Project (Year 2030) [u]	
Supplemental carbon addition system					
Methanol storage tank volume	gal	--	10,000	10,000	--
Metering pumps					
Number			4	4	--
Capacity	gph	NA	2 @ 8.0	2 @ 8.0	--
			2 @ 12.0	2 @ 12.0	
Foam wasting pump					--
Number		--	1	1	
Capacity	gpm		115	115	
Channel air blowers					
Numbers		*2*	4	6	--
Capacity, each	scfm	*350*	3 @ 350	3 @ 350	--
			1 @ 700	3 @ 700	--
Secondary clarifiers (existing)					
Number		*2*	*2*	*2*	--
Diameter		*104*	*104*	*104*	--
Depth	*ft*	*11.5*	*11.5*	*11.5*	*15-20*
Total surface area	*ft*	*16,990*	*16,990*	*16,990*	--
Overflow rate					
@ MMF	*gpd/sq ft*	*353*	*356*	*290* [h]	--
@ PHF	*gpd/sq ft*	*883*	*994*	*800* [h]	*1,200*
Future secondary clarifiers					
Number		--	--	1	--
Diameter	ft			100	--
Depth	ft			18	15-20
Total surface area	sq ft			7,854	--
Overflow rate					
@ MMF [h]	gpd/sq ft			418 [h]	--
@ PHF [h]	gpd/sq ft			1,154 [h]	1,200
UV channels (existing)					
Number		*2*	*2*	*2*	--
Length	*ft*	*36*	*36*	*36*	--
Width	*ft*	*4.6*	*4.6*	*4.6*	--
Depth	*in*	*52*	*52*	*52*	--
Design flow per channel	*mgd*	*17*	*17*	*17*	--
Design transmissivity					
Average	*%*	*62*	*62*	*62*	--
Minimum	*%*	*55*	*55*	*55*	--

CKTP Reclamation and Reuse Project
Design Criteria – Equipment

Process element (italicized = existing)	Unit	Existing Plant Rating or Basis of Design [a]	Reclamation and Reuse Project		*Criteria of Sewage Works Design* [b]
			Plant Rating at Completion of Reclamation and Reuse Project (Year 2016) [u]	20-year Basis of Design for Reclamation and Reuse Project (Year 2030) [u]	
Reclaimed water system					
Effluent filters		--			--
Number of cells			3	7	--
Total surface area	sq ft		600	1400	--
Hydraulic loading rate	gpm/sq ft		4.0	4.1	--
Clearwell		--			
Number				*2*	--
Volume, total	*gallons*			*342,000*	--
Detention time [n]	*minutes*			*30*	*30*
Reclaimed water feed pumps		--			
Number			3	4	--
Capacity, each	mgd		1@1.6 2@4.2	1@1.6 3@4.2	-- --
Reclaimed water pumps		--			
Number				*3*	--
Capacity, each	*mgd*			*4.1*	--
Septage receiving station					
Number of screens		*1*	*1*	*1*	--
Capacity, each	*gpm*	*250*	*250*	*250*	--
Screen opening size	*mm*	*6*	*6*	*6*	--
Gravity thickeners (GTs)					
Number		*2*	*2*	*2*	--
Diameter	*ft*	*45*	*45*	*45*	--
Depth	*ft*	*10*	*10*	*10*	--
Solids loading rate [i]					
Annual average	*ppd/sq ft*	*5.4*	*5.1*	*6.6*	*19.2*
Peak month	*ppd/sq ft*	*7.5*	*5.5*	*7.1*	*28.8*
Rotary drum thickener (RDT)					
Number		--	1	1	--
Solids loading rate [j]		--	--	--	--
Annual average	ppd	--	6,300	8,450	--
Peak month	ppd	--	6,930	9,540	--
Solids concentration	%	--	5	5	
Thickened sludge blending tank					
Number		--	1	1	--
Diameter	ft	--	14	14	--
Height	ft	--	19.3	19.3	--
Volume	gal	--	17,160	17,160	--
Detention time			4.8		
Average [p]	hr	--	4.4	3.6	--
Minimum [p]	hr	--		2.0	--

CKTP Reclamation and Reuse Project
Design Criteria – Equipment

Process element (italicized = existing)	Unit	Existing Plant Rating or Basis of Design [a]	Reclamation and Reuse Project		*Criteria of Sewage Works Design* [b]
			Plant Rating at Completion of Reclamation and Reuse Project (Year 2016) [u]	20-year Basis of Design for Reclamation and Reuse Project (Year 2030) [u]	
Mesophilic digesters					
Number		*2*	*2*	*2*	--
Diameter	*ft*	*65*	*65*	*65*	--
Depth	*ft*	*26*	*26*	*26*	--
Volume, each	*cu ft*	*86,280*	*92,913* [k]	*92,913* [k]	--
Annual average loadings					
Total solids feed	*ppd TS*	*16,584*	*14,300* [l]	*18,860* [l]	--
Volatile solids feed	*ppd VS*	*14,320*	*11,980* [l]	*15,820* [l]	--
Volatile solids loading	*ppd VS/1000 cu ft*	*87*	*64*	*85*	*80-220*
Detention time	*days*	*30*	*41*	*31*	*15* [m]
Sludge dewatering					
Plate and frame press [o]					
Number		*1*	*1*		--
Filtration area	*sq ft*	*2,800*	*2,800*		--
Number/size of plates	*m*	*55/1.5 x 2*	*55/1.5 x 2*		--
Capacity	*pph*	--	--		
Centrifuges					--
Number		*1*	*1*	*1*	--
Capacity, each	*gpm*	*186*	*186*	*186*	
Co-generation System					
Cogeneration Unit					
Number		--	1	1	--
Capacity	kWe	--	250	250	--
Fuel, digester gas	std cu ft / day	--	102,000	102,000	
Gas treatment system					
Number		--	1	1	--
Capacity	std cu ft / day	--	108,000	108,000	--
Hydrogen Sulfide Loading	ppmv [q]	--	1,350	1,350	--
Siloxane Loading	ppmv [q]	--	2.05	2.05	--
Media capacity	months	--	12	12	--
Heat reservoir pumps					
Number		--	2	2	--
Flow, each	gpm	--	280	280	--
Waste gas burner					
Number	-	1	1	1	--
Capacity [r]	std cu ft / day	[r]	345,000	345,000	--
Backpressure [r]	in	[r]	7	7	--
Process Water Pumps					
Number		*3*	*3*	*3* [s]	--
Flow, each	*gpm*	*400*	*400*	*400*	--
Head	*ft*	*175*	*175*	*175*	--

Notes:

[a] Existing plant basis of design and rated capacity, including equipment that are being installed in the on-going headworks construction project.

[b] State of Washington Department of Ecology, August 2008.

[c] Includes recycle stream contributions (gravity thickener overflow, RDT filtrate and centrate) and estimated removals across the primary clarifiers.

[d] Based on process analysis performed using BioWin simulator calibrated to plant operations and influent wastewater characteristics determined by special sampling, assuming plant operates in 4-stage Bardenpho nitrogen mode year-round. Oxygen and air flow requirements for existing plant correspond to ADWF, MMF and maximum day conditions.

[e] Based on estimated oxygen transfer efficiencies of the new diffusers to be installed in the aeration basins.

[f] One of the three existing blowers will be replaced by a high-speed turbo blower. In addition, a second new high-speed turbo blower will be installed. The existing blowers will be operated at a higher design discharge pressure than in the original design.

[g] The existing WAS pump can be used for either mixed liquor or RAS wasting. When new WAS pumps are installed, these pumps will be used for draining the basins only.

[h] Assumes a flow split of 60 percent to the existing clarifiers and 40 percent to the new clarifier under all flow conditions.

[i] Solids loadings includes those for primary sludge and septage. The gravity thickeners will not normally receive WAS. Criteria reported are for primary sludge only.

[j] Based on continuous operation of the RDT

[k] Includes 80% of cone volume to recognize improved grit removal from installation of new aerated grit tanks

[l] Based on thickened WAS and Primary sludge, including septage and other sludges with 5.5 percent solids produced from new RDT and GT. Other sludges assumed to be sent directly to the digesters.

[m] The USEPA requires a minimum solids retention time of 15 days in order for a utility to not have to monitor its Class B biosolids for pathogen load.

[n] Detention time includes de-rating factor of 0.5 to account for incomplete mixing. Criteria of Sewage Works requirement based on concentration of 1.0 mg/L.

[o] Plate and frame press is currently not operable.

[p] For in-plant sludge only at the operating set point (excludes hauled sludges)

[q] ppmv = part per million by volume

[r] Capacity and backpressure of existing flare to be verified by manufacturer.

[s] For 2030 design, existing pumps will serve as standby. Primary process water source will be from the reclaimed water system.

[t] The new design includes nitrogen removal

[u] The Reclamation and Reuse project basis of design for equipment and system sizing is year 2030. However, as described in the Design Criteria – Flows and Loadings table, year 2016 is given since it is the year before the next major upgrade and represents flows and loads for the effective rated capacity of the plant after completion of the Reclamation and Reuse project. Once the new aeration basins and associated ancillary equipment are added in year 2017, the rated capacity of the plant will then increase to the flows and loads associated with year 2024 when new secondary clarifiers will need to be constructed. New digesters in year 2028 will be required to achieve the full flows and loads capacity associated with year 2030.

DESIGN CODES AND STANDARDS

This section discusses the key design standards applicable to the design and construction of facility expansions proposed for the Reclamation and Reuse project. The design standards will be described on an engineering-discipline basis.

Civil Site Work

The civil site work required will consist of site clearing and excavation, disposal of excess excavated material, pipe and conduit or ductbank placement, dewatering for structure excavation, and restoration of surfaces, including paved driving and parking areas. Adopted engineering and fire codes (Titles 11, 12, 13, 14, 16, 18, 19, 20 and 21 of the Kitsap County Code), Washington State Department of Transportation design standards, standard specifications and standard plans, , and the latest edition of Kitsap County design and construction standards will be followed. Items of work specific to the civil site work discipline include:

1. Numerous small and large process pipes and electrical conduits will be required between the various plant structures. Wherever possible, the pipes and conduits will utilize common corridors. This will simplify the use of utility chases between structures, and minimize cost. Differential settlement between conduits and structures will be addressed through the use of flexible couplings, special pipe bedding, and pipe materials.
2. Geotechnical investigations determine the type and extent of existing soil materials and their suitability for incorporation into the new work. Maximum use of existing soils, where appropriate, will be identified to minimize hauling of import and waste excess materials.
3. Corrosion of buried metallic pipes is considered to be average at this site. Few if any corrosion protection design measures are expected in the project.
4. A wetland mitigation plan will be prepared to compensate for potential impacts to wetlands on the north and west sides of the treatment plant site. Short retaining walls will be implimented to the maximum extent possible for grading of the site to limit wetland impacts.

Applicable design standards and references will include:

1. *International Fire Code*, (2009 Edition)
2. *Washington State Department of Transportation Standard Specifications and Plans for Road, Bridges and Municipal Construction M41-10,* (January 2010)
3. *Washington State Department of Transportation Design Manual M22-01.07*, (July 2010)
4. *Washington State Department of Ecology Wetland Mitigation in Washington State, Part 1: Policies and Guidelines, (March 2006)*
5. *Washington State Department of Ecology Criteria for Sewage Works Design*, (August 2008)
6. *Kitsap County Stormwater Design Manual*, (February 2010).
7. *Kitsap County Fire Code Requirements for Development*, (May 2008).
8. *Low Impact Development (LID) Guidance Manual*, Version 1.21, (July 2009)

Architectural

The architectural form of the existing structures will be maintained as much as possible in new structures or structural additions. New materials matching existing materials in appearance will be required. See the Architectural Drawings included in the Preliminary Design for elevation views of the new buildings.

Geotechnical Considerations

Geotechnical investigations for improvements were conducted to identify surface and subsurface soil materials in the areas of new work. These investigations gathered information relating to foundation support capacities of soils, behavior when excavated or compacted, and presence or potential for encountering groundwater during construction.

Landau Associates has prepared a final report providing geotechnical recommendations to comply with current codes. This geotechnical report is includes in Section 7 of this Preliminary Design.

Structural Design Standards

The following information outlines the parameters that will form the basis for the structural design, including relevant codes to be used for design, live loads, design stresses, and grades of structural materials.

References

1. American Concrete Institute (ACI) 318-08.
2. *International Building Code*, 2009 Edition (IBC).
3. *Manual of Steel Construction*, American Institute of Steel Construction (AISC); thirteenth edition.
4. American Concrete Institute, Environmental Engineering Concrete Structures, ACI 350-05.
5. American Concrete Institute, Seismic Design of Liquid-Containing Concrete Structures, ACI 350.3-06.

Material and Design Specifications

1. All reinforcing bars shall conform to American Society for Testing and Materials (ASTM) A615, grade 60, deformed bars unless otherwise noted.
2. The minimum ultimate compressive strength of concrete, f'c, at 28 days shall be 4,500 pounds per square inch.
3. All structural steel W-shapes shall conform to ASTM A992; other shapes, plates, etc. shall conform to ASTM A36. Fasteners shall conform to ASTM A325 or ASTM A307. Where stainless steel fasteners are required, stainless steel shall be type 316.
4. All steel welding qualification and workmanship shall be in accordance with American Welding Society (AWS) and all welds shall be E70XX electrodes.
5. Major construction joints shall be shown on the design drawings.
6. Concrete protection for reinforcement shall conform to ACI 318 for building structures and shall conform to ACI 350 for wastewater containing structures.
7. Unless otherwise specified, all handrails, gratings, and checker plates shall be designed with aluminum alloys.

Groundwater

Groundwater elevations throughout the site are somewhat variable. The groundwater appears “perched” on the underlying glacial till materials. Groundwater conditions will vary depending on the season, local subsurface conditions, and other factors. Aeration basins 3 and 4 and the RAS mixing box will be designed for groundwater elevation that coincides with the ground surface of these structures. The aeration basins will have pressure relief valves in the base slab to relief ground water pressure.

Structural Design Criteria

1. Allowable bearing pressure:
    a. Shallow footings (1’-6” to 3’-0” below grade): 2,500 pounds per square foot (psf)
    b. Foundations for below-grade structures: 4,000 psf
2. Allowable lateral pressure:
    a. Active pressure: 32 pounds per cubic foot (pcf) above ground water, 78 pcf below ground water
    b. At rest pressure: 52 pcf moist, 87 pcf saturated soil
    c. Allowable passive pressure: 295 psf per foot above water table, 140 psf per foot below water table
    d. Friction factor (soil and concrete): 0.40
3. Live Loads:
    a. Slab on grade truck area: 300 psf
    b. Stair, landing, and walkway: 100 psf live load (public access)
    c. Grating, checkered plates: 100 psf
    d. Roofs: 40 psf including 20 psf collateral live load allowance
    e. Wind load: 85 miles per hour exposure C
    f. Earthquake load per *International Building Code*
       0.2 sec. Spectral Response, S_s =1.365 g
       1.0 sec. Spectral Response, S_1=0.408 g
       Site Class D
       Importance Factor, 1.25
4. Structural Work:
    a. WAS Thickening Building: The WAS Thickening Building will include a thickener room, for thicken the sludge, a polymer room for storage and processing of the polymers required for the process, pumping area, and a electrical room for motor control centers and other electrical support equipment. The Thickened Sludge Blending tank will be located next to the WAS Thickening Building. The building will have masonry walls, slab on grade floor, and a steel framed roof with metal decking topped with insulation and roofing. Insulations will have mechanical anchor that will penetrate the decking and be visible to the rooms below.
    b. Reclaimed Water Building: This building will be a pre-engineered building that contains compressor room, chemical tanks and pumps, and an electrical room for motor control centers and other electrical support equipment.

c. Aeration basin modifications: Several existing concrete channels will be modified and enlarged. Channel modifications will be made using reinforced cast-in-place concrete. Internal baffles to be placed in the aeration tanks will be redwood held in place with stainless steel members and anchor bolts.

d. RAS Box: The RAS Box structure will be a concrete basin with mixers, cutthroat weirs, and pumps.

e. New Aeration Basins 3 & 4: The new aeration basins will be concrete structures similar to the existing aeration basins with concrete channels and basins, and redwood internal baffles. A sump area will be provided between the basins for channel and basin drainage.

f. Ultraviolet Disinfection Channel Modifications: The effluent channel will be modified to provide a pump pit for reclaimed water.

g. Power/Blower Building: Existing equipment pads will be used for one replacement blower and one new blower.

h. Carbon Addition Facility: This facility will have a truck unloading containment pad, and containment area for two 10,000 gallon tanks. The faculty will be covered with a pre-engineering canopy to keep rain water out of the truck unload and tank containment area.

i. Cogen facility will have equipment placed on a large concrete pavement slab with equipment raised on equipment pads.

Mechanical and HVAC

References

Design of all mechanical equipment and building utility systems will conform to the current applicable requirements of the following standards and practices:

- *International Building Code* (IBC)
- *International Plumbing Code* (IPC)
- *International Mechanical Code* (IMC)
- *Washington State Energy Codes*
- *International Fire Code* (IFC)
- *American Society of Heating, Refrigerating, and Air Conditioning Engineers Standards* (ASHRAE)
- *Sheet Metal and Air Conditioning Contractors National Association* (SMACNA)
- *Air Moving and Conditioning Association* (AMCA)
- *National Fire Protection Association* (NFPA 820) Standard for Fire Protection in Wastewater Treatment and Collection Facilities
- *International Fire Code (*IFC*)*

Design Criteria

A summary of the code and hazard analysis is shown in Table 1.

Table 1. CKTP Reclamation and Reuse Project
Code and Hazard Analysis

Area	Facility	Name	Classification and Extent	Reference	Hazardous	Corrosive	Motor Type(s)
200	Aeration Basins	Aeration Basin 1, 2, 3, 4	Unclassified	NFPA 820 Table 5.2(a) Row 7	No	Yes	
		Aeration Basins Utilidor (existing)	Unclassified	NFPA 820 Table 6.2(a) Row 22	No	No	None
		Aeration Basins 3 and 4 Drainage Area	Unclassified	(same as Aeration Basins)	No	Yes	Type 2
		RAS Mixing Box	Unclassified	NFPA 820 Table 5.2(a) Row 14	No	Yes	Submersible (mixers) Type 2 (rotary lobe)
		Methanol Storage and Feed System	Class 1, Div 1. Group D. Entire covered area and 10 ft boundary.	NFPA 497, Fig 5.9.4(a) NFPA 30 IFC 2006, Ch 27 and 34	Health Hazard: 2 Fire Hazard: 3	No	Type 3
		Mixed Liquor Channel Classifying Selector Sump	Unclassified	(same as Aeration Basins)	No	Yes	Type 2 (Classifying Selector Pump)
		Channel Aeration Blowers	Unclassified	NA	No	Yes	Type 2
200	Aeration Air Blowers	Power/Blower Building	Unclassified	NA	No	No	(TBD; special motor type for high speed)
300	Reclaimed Water Feed Pumping System	-	Unclassified	NFPA 820 Table 5.2(a) Row 24	No	Yes	Type 2
400	WAS Thickening Building	WAS Thickening Room	Unclassified	NFPA 820 Table 6.2(a) Row 12b	No	No	Type 2
		Electrical Room	Unclassified	-	No	No	-

Table 1. CKTP Reclamation and Reuse Project
Code and Hazard Analysis

Area	Facility	Name	Classification and Extent	Reference	Hazardous	Corrosive	Motor Type(s)
600	Thickened Sludge Blending Tank	TSBT	Class 1, Div 1, Group D. Entire space	NFPA 820 Table 6.2(a) Row 11a	Yes	Yes	(None)
		Truck loading area	Class 1, Div 2, Group D for areas within 10 ft from TSBT walls and 18" above liquid level (use 18" above roof of TSBT)	NFPA 820 Table 6.2(a) Row 11c	Yes	Yes	Type 2
		Truck loading area	Unclassified for areas greater than 10 ft from TSBT walls	NFPA 820 Table 6.2(a) Row 11c	No	Yes	Type 2 (Type 1)
800	Reclaimed Water System	Reclaimed Water Filters	Unclassified	NFPA 820 Table 5.2(a) Row 20	No	Yes	Type 2
		Chemical Storage and Pumping Room	Not classified according to NFPA. 350 gal hypochlorite is below the 500 gal threshold; conform to IFC 2006, sections 2701 and 2703	IFC 2006, Table 2703.1.1(2); 2703.1.3; and Ch 31	Health Hazard: 3 (hypochlorite)	Yes	Type 2
		Compressor Room	Unclassified	NA	No	No	Type 2 or Type 1
		Electrical Room	Unclassified	NA	No	No	-
900	Cogeneration System	Cogeneration Facility	Class 1, Div 1, Group D within 10 feet of LSG and MSG tanks (vessels), valves and appurtenances; west side of facility	NFPA 820 Table 6.2(a) Row 18	Yes	Yes	Type 3
		Cogeneration Facility	Unclassified (cogen, chiller, control panel, HRS pumps); east side of facility. Unclassified outside 10 ft equipment above	-	No	Yes	Type 2
Existing	Sludge Processing Area	Chemical Room	Not classified according to NFPA. It is assumed that the hypochlorite amount is above the 500 gal threshold	IFC 2006, Table 2703.1.1(2); 2703.1.4; and Ch 31	Health Hazard: 3 (hypochlorite)	Yes	Type 2

A summary of the HVAC design criteria is shown in Table 2.

Table 2. HVAC Design Criteria

Facility	Temperatures, °F		Ventilation, air changes per hour	NEC Classification (Class 1, Group D)
	Winter	Summer		
WAS Thickening Building				
WAS Thickening Room	50	NA	6	Unclassified
Electrical room	68	72	NA [a]	NA
Reclaimed Water Building				
Chemical storage area	55	NA	1 cfm/sf minimum	NA
Electrical room	68	72	NA [a]	NA
Air compressor room	68	72	NA [a]	NA

[a] *Air conditioning will be provided in electrical room. Final ventilation rate determined by space cooling load.*

Building Systems

Mechanical and chemical storage areas will be provided with 100 percent outside air systems with the installation of supply and exhaust fans. Ventilation for the mechanical spaces will be based on the requirements of NFPA 820 and International Mechanical Code (IMC). Ventilation requirements for the chemical storage areas will be based on the requirements of International Fire Code (IFC) and the IMC. Heating of the mechanical and chemical storage areas will be achieved with electric duct mounted heating coils. Cooling will not be provided for the mechanical and chemical storage areas. Mechanical and chemical storage areas will be maintained at a negative pressure relative to the outside and adjacent rooms (if any) to prevent exfiltration of potentially corrosive air.

Electrical and compressor rooms will generate significant quantities of heat and will therefore be provided with air source unitary heat pump units that will provide both heating and cooling. Unit cooling capacities will be based upon ambient air temperatures and heat loads from equipment within the electric rooms. The heat pump units will be equipped with an economizer and will use 100 percent outside air for cooling whenever temperatures permit. The electrical rooms will be maintained at positive pressure relative to the outside and adjacent mechanical rooms (if any) to prevent infiltration of potentially corrosive air. They will also be equipped with carbon filtration of the outside air to reduce potentially corrosive gases.

Electrical and Instrumentation

This section describes applicable electrical and instrumentation system design standards and criteria for the project.

Electrical

Conduit

Exposed conduit in process areas will in general be 3/4 inch minimum, rigid aluminum. Embedded or buried conduit will be 1-inch minimum size, schedule 40, polyvinyl chloride. Conduit below grade will be encased in reinforced concrete except for those for lighting only. There will be separate conduit and handholes or pullboxes for medium voltage, low voltage, and signal level distribution. Connections to all equipment will be 1/2 inch minimum liquidtight flexible conduit, length not to exceed the lesser of 25 times the diameter or 3 feet.

Boxes, Fittings and Seals

Boxes containing a device or splice will be FD size minimum. Conduit bodies for pulling only will be mogul. In corrosive areas, boxes will be NEMA 4X fiberglass or 316 stainless steel. Large pullboxes, where FD boxes are not adequate, will be JIC except 14 gage minimum sheet steel with hinged covers. NEMA 4X rating shall be installed outdoors and in wet areas and NEMA 12 rating indoors. Conduit connections to all boxes except furred ceilings and stud walls will be by watertight threaded hubs. Boxes in stud walls and above furred ceilings will be 4 inch minimum with plaster ring adapter, double locknut, and insulated bushing conduit connections. Yard boxes will be precast concrete as detailed with solid bottom, trapped drain, pulling irons, permanent ladder (if over 4 feet deep), with checker plate, bolted down cover. When a raceway passes between non-classified and classified areas, seals will be installed.

Conductors

600-volt cable will be XHHW-2. Conductor will be stranded copper, except lighting and receptacle circuits No. 10 AWG and smaller will be solid copper conductor. Minimum size conductor for 120-volt or greater circuits will be No. 12 AWG when used for power applications. Minimum size 120-volt or greater conductors within control panels will be No. 14 AWG. Stranded conductors will be lugged at terminations and splices except where terminations are made on devices available only with box terminals. Lugs will be locking spade type. Terminal blocks will be strap-screw type. Butt splices will be provided for stranded conductors size No. 12 AWG and smaller. Slack will be provided in all enclosures with splices in them. Splices will be made with watertight kits as manufactured by 3M or Raychem.

Wiring Devices

Receptacles and switches will be premium specification grade. Devices and covers exposed to weather or in chemical areas will be marine grade.

Motor Control

Motor control will be indoors and grouped wherever possible. Motor starters will be size 1 minimum magnetic line voltage type with individual control power transformers, 120-volt secondary fuses with blown fuse indicators, and three-phase, solid state overload protection with DeviceNet communications. Primary side fuse overcurrent protection will be provided on all control power transformers. Fractional, single phase equipment (less than 1/2 horsepower, 115 volts) will have manual switch with integral bimetallic overload protection or where auto control required, size 1/0 minimum magnetic starter. Disconnect switches will be provided for motors locally except where it is not feasible, such as for variable frequency driven motors, explosion proof motors or very large motors, and for instrumentation. Low voltage switches will be 600-volt, heavy-duty type with quick-make, quick-break mechanism. Disconnect switches for 120/240-volt circuits will be the same as lighting switches. Disconnect switches for instruments will be non-fused type. Control stations will be heavy-duty corrosion resistant units with hermetically sealed contact blocks suitable for low energy level control circuits. Enclosures will be NEMA 4X stainless steel for corrosive areas, and NEMA 12 for indoor areas. Indicating lamps will be operated at 28 volts or less and colors will be as follows:

Green: Ready
Red: Running
White: Control power on
Amber: Alarm

Unit Substation Transformers

Transformers will be oil-filled with auxiliary fan cooling rated 12470-480/277 volts, three-phase with manual tap changers. Transformers will be provided with primary fused switches and secondary spade termination enclosure.

Medium Voltage Switchgear

Medium voltage switchgear will be fused interrupter type.

Low Voltage Switchgear

Low voltage switchgear will be air blast, metal enclosed type. Circuit breakers will be provided with solid state tripping devices providing long time, short time, and ground fault protection. Where dual services are present, the switchgear will be constructed with a main-tie-main topology. Either kirk key interlocks will be provided or an PLC logic based auto-throwover scheme will be implemented.

Generators

Generators will be 480VAC three phase generators with outdoor quiet site enclosures. Generator distribution topology will be distributed. E.g. single non-paralleling generators sets for each process area where standby power is required.

Lighting Transformers and Panelboards

Lighting transformers will be dry type with two 2-1/2 percent FCAN and two 2-1/2 percent FCBN taps. Maximum size will be 45 KVA, three-phase, 80° C rise with 220° C insulation. Three-phase transformers will be two winding delta-wye connected. 120/208-volt, three-phase and 120/240-volt, single-phase panelboards will be short circuit rated 10,000 amperes RMS symmetrical. All breakers feeding receptacle branch circuits outdoors and in wet areas will be GFI type, bolt on circuit breakers. 277/480-volt, three-phase panelboards will be short circuit rated 65,000 amperes RMS symmetrical. Panelboards will be copper bus bar construction with bolt-on circuit breakers.

Motor Control Centers

Motor control centers will be six high maximum, 20-inch wide by 20-inch deep, front accessible only, braced for 65,000 amperes RMS symmetrical short circuit. Buses will be tin-plated copper. Wiring will be NEMA Class IIB wiring except for vertical sections containing programmable controller equipment, which will be wired IIC.

Lighting Fixtures

Indoor lighting will generally be high-efficiency fluorescent fixtures operating at 120 volts. Illumination levels will be consistent with the recommendations of the Illuminating Engineering Society. Outdoor lighting will be either pole-mounted or building-mounted, and outlets will be provided for the use of portable lighting or tools. Battery back-up emergency lights will be included in egress paths in new facilities.

Grounding System

The grounding system will consist of a perimeter ground grid with ground test wells for each new structure of the new facility with interconnections between each ground grid and also the existing grounding system where applicable. The ground grid will have copper-clad ground rods driven to a depth to intercept the minimum groundwater table elevation. Building steel, process equipment, all electrical equipment and enclosures, and exposed metal which might conduct current will be connected to the ground grid to limit touch potential. Fault return paths will be provided using the metallic raceway as a ground conductor, where loads are 20 hp or less. A code-sized ground conductor will be run in all raceways. Ground connections which are buried or embedded will be made by the compression method.

Final design will be done to the provisions of the 2008 *National Electric Code*.

Instrumentation & Control System

The plant SCADA system network has been reconfigured to isolate the network from the existing County network, and allow direct network connectivity of most existing and all new PLCs. PLCs and Plant control panels shall be networked and individually connected to the main network switch located in the Plant control room. Vendor systems shall be Ethernet enabled, and connected to the Plant supervisory control and data acquisition (SCADA) network via local Plant control panels. Each control panel shall have an integral Human Machine Interface (HMI) for display of monitoring graphics and alarms throughout the Plant. Plant control panels with PLCs shall have industrial computer touch screen HMIs configured to display screens for the entire Plant control system using the Intouch version currently in use by the Plant.

The instrumentation control strategy for plant operation shall remain mostly unchanged, and the existing Siemens PLCs shall remain. New controllers added to the plant shall be Allen-Bradley SLC 500s, and functionallity within the Blower building is being partially transferred to a new PLC as part of the project. Industry standard automated controls for new equipment shall be included in the design, and existing systems shall be automated with new or enhanced features. Systems being enhanced are: RAS Pumping, Digester Flows, and Dissolved Oxygen Control in the Aeration Basins. New systems include Reclaimed Water, WAS Thickening, and Cogeneration, which shall be fully integrated into the Plant SCADA.

Discrete alarm conditions will be monitored in the plant SCADA as is presently configured, and additional alarms shall be added as equipment is added to the plant for the upgrade. The existing HMI computers shall be retained, and reconfigured to include all the new process equipment and control modifications. Many programming enhancements in the HMI and PLC system will be accomplished during the implementation phase of the project. The programming modifications to the plant SCADA will be done by Brown and Caldwell.

CKTP Reclamation and Reuse Project
Equipment List

Equipment Number	Status	Description	Basis of Design Mfgr	Capacity	Size / Pwr	Pwr Unit
B 2003	NEW	AERATION BLOWER 3	Neuros	4000 scfm	217	HP
CV 2003A	NEW	AERATION BLOWER 3 INLET CONTROL VALVE	-	-	1	HP
CV 2003B	NEW	AERATION BLOWER 3 BLOWOFF CONTROL VALVE	-	-	1	HP
FLT 2003	NEW	AERATION BLOWER 3 INLET FILTER	-	-	0	
S 2003	NEW	AERATION BLOWER 3 BLOWOFF SILENCER	-	-	0	
B 2004	NEW	AERATION BLOWER 4	Neuros	4000 scfm	217	HP
CV 2004A	NEW	AERATION BLOWER 4 INLET CONTROL VALVE	-	-	1	HP
CV 2004B	NEW	AERATION BLOWER 4 BLOWOFF CONTROL VALVE	-	-	1	HP
FLT 2004	NEW	AERATION BLOWER 4 INLET FILTER	-	-	0	
S 2004	NEW	AERATION BLOWER 4 BLOWOFF SILENCER	-	-	0	
ME 2101	NEW	AERATION BASIN 1 DIFFUSER GRID 1	Aerostrip	-	0	
ME 2102	NEW	AERATION BASIN 1 DIFFUSER GRID 2	Aerostrip	-	0	
ME 2103	NEW	AERATION BASIN 1 DIFFUSER GRID 3	Aerostrip	-	0	
ME 2104	NEW	AERATION BASIN 1 DIFFUSER GRID 4	Aerostrip	-	0	
ME 2105	NEW	AERATION BASIN 1 DIFFUSER GRID 5	Aerostrip	-	0	
ME 2106	NEW	AERATION BASIN 1 DIFFUSER GRID 6	Aerostrip	-	0	
CV 2111	NEW	AERATION BASIN 1 AIR CONTROL VALVE 1	-	-	1	HP
CV 2112	NEW	AERATION BASIN 1 AIR CONTROL VALVE 2	-	-	1	HP
CV 2113	NEW	AERATION BASIN 1 AIR CONTROL VALVE 3	-	-	1	HP
AE 2114A	NEW	DISSOLVED OXYGEN PROBE BASIN 1 PASS 2	-	-		
AE 2114B	NEW	DISSOLVED OXYGEN PROBE BASIN 1 PASS 4	-	-		
AE 2114C	NEW	DISSOLVED OXYGEN PROBE BASIN 1 PASS 6	-	-		
MXR 2115	EXISTING	AERATION BASIN 1 ACTIVATED SLUDGE MIXER 1	Aqua Aerobics	-	3	HP
MXR 2116	EXISTING	AERATION BASIN 1 ACTIVATED SLUDGE MIXER 2	Aqua Aerobics	-	3	HP
MXR 2117	NEW	AERATION BASIN 1 ACTIVATED SLUDGE MIXER 3	Aqua Aerobics	-	2	HP
MXR 2118	NEW	AERATION BASIN 1 ACTIVATED SLUDGE MIXER 4	Aqua Aerobics	-	2	HP
SLG 2121	NEW	AERATION BASIN 1 CHANNEL SLIDE GATE 1	-	-	0	
SLG 2122	NEW	AERATION BASIN 1 PASS 1 SLIDE GATE 1	-	-	0	
SLG 2123	NEW	AERATION BASIN 1 PASS 1 SLIDE GATE 2	-	-	0	
SLG 2124	NEW	AERATION BASIN 1 PASS 1 SLIDE GATE 3	-	-	0	
SLG 2125	NEW	AERATION BASIN 1 CHANNEL SLIDE GATE 2	-	-	0	
SLG 2126	NEW	AERATION BASIN 1 PASS 2 SLIDE GATE 1	-	-	0	
SLG 2127	NEW	AERATION BASIN 1 PASS 2 SLIDE GATE 2	-	-	0	
SLG 2128	NEW	AERATION BASIN 1 PASS 2 SLIDE GATE 3	-	-	0	
SLG 2129	NEW	AERATION BASIN 1 PASS 3 SLIDE GATE 1	-	-	0	
SLG 2130	NEW	AERATION BASIN 1 PASS 3 SLIDE GATE 2	-	-	0	
SLG 2131	NEW	AERATION BASIN 1 PASS 3 SLIDE GATE 3	-	-	0	
SLG 2132	NEW	AERATION BASIN 1 PASS 3 TO PASS 4 SLIDE GATE	-	-	0	
SLG 2133	NEW	AERATION BASIN 1 PASS 4 SLIDE GATE 1	-	-	0	
SLG 2134	NEW	AERATION BASIN 1 PASS 4 SLIDE GATE 2	-	-	0	
SLG 2135	NEW	AERATION BASIN 1 EFFLUENT CHANNEL SLIDE GATE	-	-	0	
P 2140	NEW	AERATION BASIN 1 ML RECYCLE PUMP	KSB	-	10	HP
ME 2151	NEW	AERATION BASIN 2 DIFFUSER GRID 1	Aerostrip	-	0	
ME 2152	NEW	AERATION BASIN 2 DIFFUSER GRID 2	Aerostrip	-	0	
ME 2153	NEW	AERATION BASIN 2 DIFFUSER GRID 3	Aerostrip	-	0	
ME 2154	NEW	AERATION BASIN 2 DIFFUSER GRID 4	Aerostrip	-	0	
ME 2155	NEW	AERATION BASIN 2 DIFFUSER GRID 5	Aerostrip	-	0	
ME 2156	NEW	AERATION BASIN 2 DIFFUSER GRID 6	Aerostrip	-	0	
CV 2161	NEW	AERATION BASIN 2 AIR CONTROL VALVE 1	-	-	1	HP
CV 2162	NEW	AERATION BASIN 2 AIR CONTROL VALVE 2	-	-	1	HP
CV 2163	NEW	AERATION BASIN 2 AIR CONTROL VALVE 3	-	-	1	HP
AE 2164A	NEW	DISSOLVED OXYGEN PROBE BASIN 2 PASS 2	-	-		
AE 2164B	NEW	DISSOLVED OXYGEN PROBE BASIN 2 PASS 4	-	-		
AE 2164C	NEW	DISSOLVED OXYGEN PROBE BASIN 2 PASS 6	-	-		
MXR 2165	EXISTING	AERATION BASIN 2 ACTIVATED SLUDGE MIXER 1	Aqua Aerobics	-	3	HP
MXR 2166	EXISTING	AERATION BASIN 2 ACTIVATED SLUDGE MIXER 2	Aqua Aerobics	-	3	HP
MXR 2167	NEW	AERATION BASIN 2 ACTIVATED SLUDGE MIXER 3	Aqua Aerobics	-	2	HP
MXR 2168	NEW	AERATION BASIN 2 ACTIVATED SLUDGE MIXER 4	Aqua Aerobics	-	2	HP
SLG 2171	NEW	AERATION BASIN 2 CHANNEL SLIDE GATE 1	-	-	0	
SLG 2172	NEW	AERATION BASIN 2 PASS 1 SLIDE GATE 1	-	-	0	
SLG 2173	NEW	AERATION BASIN 2 PASS 1 SLIDE GATE 2	-	-	0	

EQUIPMENT LIST

Equipment Number	Status	Description	Basis of Design Mfgr	Capacity	Size / Pwr	Pwr Unit
SLG 2174	NEW	AERATION BASIN 2 PASS 1 SLIDE GATE 3	-	-	0	
SLG 2175	NEW	AERATION BASIN 2 CHANNEL SLIDE GATE 2	-	-	0	
SLG 2176	NEW	AERATION BASIN 2 PASS 2 SLIDE GATE 1	-	-	0	
SLG 2177	NEW	AERATION BASIN 2 PASS 2 SLIDE GATE 2	-	-	0	
SLG 2178	NEW	AERATION BASIN 2 PASS 2 SLIDE GATE 3	-	-	0	
SLG 2179	NEW	AERATION BASIN 2 PASS 3 SLIDE GATE 1	-	-	0	
SLG 2180	NEW	AERATION BASIN 2 PASS 3 SLIDE GATE 2	-	-	0	
SLG 2181	NEW	AERATION BASIN 2 PASS 3 SLIDE GATE 3	-	-	0	
SLG 2182	NEW	AERATION BASIN 2 PASS 3 TO PASS 4 SLIDE GATE	-	-	0	
SLG 2183	NEW	AERATION BASIN 2 PASS 4 SLIDE GATE 1	-	-	0	
SLG 2184	NEW	AERATION BASIN 2 PASS 4 SLIDE GATE 2	-	-	0	
SLG 2185	NEW	AERATION BASIN 2 EFFLUENT CHANNEL SLIDE GATE	-	-	0	
P 2190	NEW	AERATION BASIN 2 ML RECYCLE PUMP	KSB	4.1 mgd	10	HP
P 2201	NEW	WAS PUMP 1	Vogelsang	210 gpm	7.5	HP
P 2202	NEW	WAS PUMP 2	Vogelsang	210 gpm	7.5	HP
P 2203	*FUTURE*	*WAS PUMP 3*	*Vogelsang*	210 gpm	*7.5*	*HP*
MXR 2210	NEW	RAS MIXING BOX MIXER 1	Flygt	-	2.55	HP
MXR 2211	NEW	RAS MIXING BOX MIXER 2	Flygt	-	2.55	HP
SLG 2220	NEW	RAS MIXING BOX SLIDE GATE	-	-	0	
SLG 2221	NEW	RAS MIXING BOX PE SLIDE GATE1	-	-	0	
SLG 2222	NEW	RAS MIXING BOX PE SLIDE GATE2	-	-	0	
SLG 2223	NEW	RAS MIXING BOX PE SLIDE GATE3	-	-	0	
SLG 2224	NEW	RAS MIXING BOX PE SLIDE GATE4	-	-	0	
SLG 2225	*FUTURE*	*RAS MIXING BOX PE SLIDE GATE5*	-	-	*0*	
SLG 2226	*FUTURE*	*RAS MIXING BOX PE SLIDE GATE6*	-	-	*0*	
SLG 2227	NEW	RAS MIXING BOX RAS SLIDE GATE 1	-	-	0	
SLG 2228	NEW	RAS MIXING BOX RAS SLIDE GATE 2	-	-	0	
SLG 2229	NEW	RAS MIXING BOX RAS SLIDE GATE 3	-	-	0	
SLG 2230	NEW	RAS MIXING BOX RAS SLIDE GATE 4	-	-	0	
SLG 2231	*FUTURE*	*RAS MIXING BOX RAS SLIDE GATE 5*	-	-	*0*	
SLG 2232	*FUTURE*	*RAS MIXING BOX RAS SLIDE GATE 6*	-	-	*0*	
ME 2301	NEW	AERATION BASIN 3 DIFFUSER GRID 1	Aerostrip	-	0	
ME 2302	NEW	AERATION BASIN 3 DIFFUSER GRID 2	Aerostrip	-	0	
ME 2303	NEW	AERATION BASIN 3 DIFFUSER GRID 3	Aerostrip	-	0	
ME 2304	NEW	AERATION BASIN 3 DIFFUSER GRID 4	Aerostrip	-	0	
ME 2305	NEW	AERATION BASIN 3 DIFFUSER GRID 5	Aerostrip	-	0	
ME 2306	NEW	AERATION BASIN 3 DIFFUSER GRID 6	Aerostrip	-	0	
CV 2311	NEW	AERATION BASIN 3 AIR CONTROL VALVE 1	-	-	1	HP
CV 2312	NEW	AERATION BASIN 3 AIR CONTROL VALVE 2	-	-	1	HP
CV 2313	NEW	AERATION BASIN 3 AIR CONTROL VALVE 3	-	-	1	HP
AE 2314A	NEW	DISSOLVED OXYGEN PROBE BASIN 3 PASS 2	-	-		
AE 2314B	NEW	DISSOLVED OXYGEN PROBE BASIN 3 PASS 4	-	-		
AE 2314C	NEW	DISSOLVED OXYGEN PROBE BASIN 3 PASS 6	-	-		
MXR 2315	NEW	AERATION BASIN 3 ACTIVATED SLUDGE MIXER 1	Aqua Aerobics	-	2	HP
MXR 2316	NEW	AERATION BASIN 3 ACTIVATED SLUDGE MIXER 2	Aqua Aerobics	-	2	HP
MXR 2317	NEW	AERATION BASIN 3 ACTIVATED SLUDGE MIXER 3	Aqua Aerobics	-	2	HP
MXR 2318	NEW	AERATION BASIN 3 ACTIVATED SLUDGE MIXER 4	Aqua Aerobics	-	2	HP
SLG 2321	NEW	AERATION BASIN 3 CHANNEL SLIDE GATE 1	-	-	0	
SLG 2322	NEW	AERATION BASIN 3 PASS 1 SLIDE GATE 1	-	-	0	
SLG 2323	NEW	AERATION BASIN 3 PASS 1 SLIDE GATE 2	-	-	0	
SLG 2324	NEW	AERATION BASIN 3 PASS 1 SLIDE GATE 3	-	-	0	
SLG 2325	NEW	AERATION BASIN 3 CHANNEL SLIDE GATE 2	-	-	0	
SLG 2326	NEW	AERATION BASIN 3 PASS 2 SLIDE GATE 1	-	-	0	
SLG 2327	NEW	AERATION BASIN 3 PASS 2 SLIDE GATE 2	-	-	0	
SLG 2328	NEW	AERATION BASIN 3 PASS 2 SLIDE GATE 3	-	-	0	
SLG 2329	NEW	AERATION BASIN 3 PASS 3 SLIDE GATE 1	-	-	0	
SLG 2330	NEW	AERATION BASIN 3 PASS 3 SLIDE GATE 2	-	-	0	
SLG 2331	NEW	AERATION BASIN 3 PASS 3 SLIDE GATE 3	-	-	0	
SLG 2332	NEW	AERATION BASIN 3 PASS 3 TO PASS 4 SLIDE GATE	-	-	0	
SLG 2333	NEW	AERATION BASIN 3 PASS 4 SLIDE GATE 1	-	-	0	
SLG 2334	NEW	AERATION BASIN 3 PASS 4 SLIDE GATE 2	-	-	0	
SLG 2335	NEW	AERATION BASIN 3 EFFLUENT CHANNEL SLIDE GATE	-	-	0	
P 2340	NEW	AERATION BASIN 3 ML RECYCLE PUMP	KSB	4.1 mgd	10	HP

EQUIPMENT LIST

Equipment Number	Status	Description	Basis of Design Mfgr	Capacity	Size / Pwr	Pwr Unit
ME 2351	NEW	AERATION BASIN 4 DIFFUSER GRID 1	Aerostrip	-	0	
ME 2352	NEW	AERATION BASIN 4 DIFFUSER GRID 2	Aerostrip	-	0	
ME 2353	NEW	AERATION BASIN 4 DIFFUSER GRID 3	Aerostrip	-	0	
ME 2354	NEW	AERATION BASIN 4 DIFFUSER GRID 4	Aerostrip	-	0	
ME 2355	NEW	AERATION BASIN 4 DIFFUSER GRID 5	Aerostrip	-	0	
ME 2356	NEW	AERATION BASIN 4 DIFFUSER GRID 6	Aerostrip	-	0	
CV 2361	NEW	AERATION BASIN 4 AIR CONTROL VALVE 1	-	-	1	HP
CV 2362	NEW	AERATION BASIN 4 AIR CONTROL VALVE 2	-	-	1	HP
CV 2363	NEW	AERATION BASIN 4 AIR CONTROL VALVE 3	-	-	1	HP
AE 2364A	NEW	DISSOLVED OXYGEN PROBE BASIN 4 PASS 2	-	-		
AE 2364B	NEW	DISSOLVED OXYGEN PROBE BASIN 4 PASS 4	-	-		
AE 2364C	NEW	DISSOLVED OXYGEN PROBE BASIN 4 PASS 6	-	-		
MXR 2365	NEW	AERATION BASIN 4 ACTIVATED SLUDGE MIXER 1	Aqua Aerobics	-	2	HP
MXR 2366	NEW	AERATION BASIN 4 ACTIVATED SLUDGE MIXER 2	Aqua Aerobics	-	2	HP
MXR 2367	NEW	AERATION BASIN 4 ACTIVATED SLUDGE MIXER 3	Aqua Aerobics	-	2	HP
MXR 2368	NEW	AERATION BASIN 4 ACTIVATED SLUDGE MIXER 4	Aqua Aerobics	-	2	HP
SLG 2371	NEW	AERATION BASIN 4 CHANNEL SLIDE GATE 1	-	-	0	
SLG 2372	NEW	AERATION BASIN 4 PASS 1 SLIDE GATE 1	-	-	0	
SLG 2373	NEW	AERATION BASIN 4 PASS 1 SLIDE GATE 2	-	-	0	
SLG 2374	NEW	AERATION BASIN 4 PASS 1 SLIDE GATE 3	-	-	0	
SLG 2375	NEW	AERATION BASIN 4 CHANNEL SLIDE GATE 2	-	-	0	
SLG 2376	NEW	AERATION BASIN 4 PASS 2 SLIDE GATE 1	-	-	0	
SLG 2377	NEW	AERATION BASIN 4 PASS 2 SLIDE GATE 2	-	-	0	
SLG 2378	NEW	AERATION BASIN 4 PASS 2 SLIDE GATE 3	-	-	0	
SLG 2379	NEW	AERATION BASIN 4 PASS 3 SLIDE GATE 1	-	-	0	
SLG 2380	NEW	AERATION BASIN 4 PASS 3 SLIDE GATE 2	-	-	0	
SLG 2381	NEW	AERATION BASIN 4 PASS 3 SLIDE GATE 3	-	-	0	
SLG 2382	NEW	AERATION BASIN 4 PASS 3 TO PASS 4 SLIDE GATE	-	-	0	
SLG 2383	NEW	AERATION BASIN 4 PASS 4 SLIDE GATE 1	-	-	0	
SLG 2384	NEW	AERATION BASIN 4 PASS 4 SLIDE GATE 2	-	-	0	
SLG 2385	NEW	AERATION BASIN 4 EFFLUENT CHANNEL SLIDE GATE	-	-	0	
P 2390	NEW	AERATION BASIN 4 ML RECYCLE PUMP	KSB	4.1 mgd	10	HP
T 2400	NEW	METHANOL STORAGE TANK	(tbd)	10000 gal	0	
CV 2400	NEW	METHANOL STORAGE TANK OUTLET CONTROL VALVE	-	-	1	HP
P 2401	NEW	METHANOL METERING PUMP 1	Watson-Marlow	8-12 gph	1/3	HP
P 2402	NEW	METHANOL METERING PUMP 2	Watson-Marlow	8-12 gph	1/3	HP
P 2403	NEW	METHANOL METERING PUMP 3	Watson-Marlow	8-12 gph	1/3	HP
P 2404	NEW	METHANOL METERING PUMP 4	Watson-Marlow	8-12 gph	1/3	HP
PRV 2401	NEW	METHANOL METERING PUMP 1 PRESSURE RELIEF VALVE	-	-	0	
PRV 2402	NEW	METHANOL METERING PUMP 2 PRESSURE RELIEF VALVE	-	-	0	
PRV 2403	NEW	METHANOL METERING PUMP 3 PRESSURE RELIEF VALVE	-	-	0	
PRV 2404	NEW	METHANOL METERING PUMP 4 PRESSURE RELIEF VALVE	-	-	0	
PRV 2410	NEW	METHANOL SOLUTION CARRIER WATER PRESS REG VALVE 1	-	-	0	
CV 2411	NEW	METHANOL SOLUTION CARRIER WATER CONTROL VALVE 1	-	-	1	HP
PRV 2420	NEW	METHANOL SOLUTION CARRIER WATER PRESS REG VALVE 2	-	-	0	
CV 2421	NEW	METHANOL SOLUTION CARRIER WATER CONTROL VALVE 2	-	-	1	HP
P 2500	NEW	FOAM WASTING PUMP	Fairbanks Morse	115 gpm	2	HP
SG 2501	NEW	FOAM WASTING GATE	-	-	-	
AE 2502	NEW	FOAM WASTING STATION LEVEL SENSOR	-	-		
SLG 2503	NEW	SECONDARY CLARIFIER 1 INLET SLIDE GATE	-	-		
SLG 2504	NEW	SECONDARY CLARIFIER 2 INLET SLIDE GATE	-	-		
B 2543	NEW	CHANNEL AIR BLOWER 3	Kaeser	350 scfm	10	HP
B 2544	NEW	CHANNEL AIR BLOWER 4	Kaeser	700 scfm	25	HP
B 2545	*FUTURE*	*CHANNEL AIR BLOWER 5*	*Kaeser*	*700 scfm*	*25*	*HP*
B 2546	*FUTURE*	*CHANNEL AIR BLOWER 6*	*Kaeser*	*700 scfm*	*25*	*HP*
P 3011	NEW	RECLAIMED WATER FEED PUMP 1	Fairbanks Morse	1.6 mgd @ 12 ft	20	HP
P 3012	NEW	RECLAIMED WATER FEED PUMP 2	Fairbanks Morse	4.24 mgd @ 22 ft	50	HP
P 3013	NEW	RECLAIMED WATER FEED PUMP 3	Fairbanks Morse	4.24 mgd @ 22 ft	50	HP
P 3014	*FUTURE*	*RECLAIMED WATER FEED PUMP 4*	*Fairbanks Morse*	*4.24 mgd @ 22 ft*	*50*	*HP*
SLG 3020	NEW	RECLAIMED WATER FEED PUMP WEIR GATE	-	-	0	
SLG 3021	NEW	RECLAIMED WATER FEED PUMP DRAIN GATE	-	-	0	
CV 4006	NEW	RDT ISOLATION VALVE	-	-	1	HP
CV 4007	NEW	RDT BYPASS VALVE	-	-	1	HP

EQUIPMENT LIST

Equipment Number	Status	Description	Basis of Design Mfgr	Capacity	Size / Pwr	Pwr Unit
CV 4008	NEW	SPRAY WATER CONTROL VALVE	-	-	1	HP
MXR 4010	NEW	FLOCCULATION TANK MIXER	FKC	-	2	HP
P 4011	NEW	SPRAY WATER BOOSTER PUMP	FKC	(tbd)	5	HP
RDT 4012	NEW	ROTARY DRUM THICKENER	FKC	200 gpm	3	HP
MME 4013	NEW	SPRAY BAR CLEANING	FKC	-	1	HP
V 4014	NEW	MIXING VALVE	FKC	-	0	
F 4018	NEW	RDT INLINE FAN	(tbd)	-	1	HP
MME 4019	NEW	RDT CARBON CANISTER	(tbd)	-	0	-
P 4020	NEW	TWAS PUMP	Seepex	25 gpm	5	HP
SV 4020	NEW	TWAS PUMP SEAL WATER SOLENOID VALVE	-	-		
PNL 4050	NEW	POLYMER SYSTEM CONTROL PANEL	Dynablend	-	-	-
MXR 4050	NEW	EMULSION POLYMER TOTE MIXER	Dynablend	-	0.75	HP
P 4051	NEW	EMULSION POLYMER PUMP	Dynablend	30 gph	0.5	HP
MXR 4052	NEW	EMULSION POLYMER FEEDER	Dynablend	30 gph	0	
SV 4052A	NEW	DILUTION WATER SOLENOID VALVE 1	Dynablend	-	1	HP
SV 4052B	NEW	DILUTION WATER SOLENOID VALVE 2	Dynablend	-	1	HP
CV 4064	NEW	POLYMER TANK 1 INLET CONTROL VALVE	Dynablend	-	1	HP
T 4065	NEW	POLYMER TANK 1	Dynablend	3000 gal	0	-
CV 4066	NEW	POLYMER TANK 1 OUTLET CONTROL VALVE	Dynablend	-	1	HP
CV 4074	NEW	POLYMER TANK 2 INLET CONTROL VALVE	Dynablend	-	1	HP
T 4075	NEW	POLYMER TANK 2	Dynablend	3000 gal	0	-
CV 4076	NEW	POLYMER TANK 2 OUTLET CONTROL VALVE	Dynablend	-	1	HP
PNL 4080	NEW	POLYMER FEED CONTROL PANEL	Dynablend	-	-	-
P 4080	NEW	POLYMER FEED PUMP 1	Dynablend	0.5-11 gpm	1.5	HP
CV 4081	NEW	POLYMER FEED PUMP 1 CONTROL VALVE	Dynablend	-	1	HP
P 4090	NEW	POLYMER FEED PUMP 2	Dynablend	0.5-11 gpm	1.5	HP
CV 4091	NEW	POLYMER FEED PUMP 2 CONTROL VALVE	Dynablend	-	1	HP
SV 4095	NEW	POST-DILUTION WATER SOLENOID VALVE	Dynablend	-	1	HP
MXR 4095	NEW	POLYMER STATIC MIXER	Dynablend	-	0	-
MXR 4030	*FUTURE*	*FLOCCULATION TANK MIXER*				
P 4031	*FUTURE*	*SPRAY WATER BOOSTER PUMP*				
RDT 4032	*FUTURE*	*ROTARY DRUM THICKENER*				
MME 4033	*FUTURE*	*SPRAY BAR CLEANING*				
V 4034	*FUTURE*	*MIXING VALVE*				
F 4038	*FUTURE*	*RDT INLINE FAN*				
MME 4039	*FUTURE*	*RDT CARBON CANISTER*				
P 4040	*FUTURE*	*TWAS PUMP*				
SV 4040	*FUTURE*	*TWAS PUMP SEAL WATER SOLENOID VALVE*				
4000	*FUTURE*	*POLYMER TANK 3 INLET CONTROL VALVE*	-	-		
4000	*FUTURE*	*POLYMER TANK 3*	-	-	*0*	-
4000	*FUTURE*	*POLYMER TANK 3 OUTLET CONTROL VALVE*	-	-		
4000	*FUTURE*	*POLYMER FEED PUMP 3*	-	-	*2*	*HP*
4000	*FUTURE*	*POLYMER FEED PUMP 3 CONTROL VALVE*	-	-		
HP 4201	NEW	WAS THICKENING BUILDING ELECTRICAL ROOM HEAT PUMP UNIT	Carrier	7.5 ton	3	HP
F 4210	NEW	WAS THICKENING BUILDING ROOF SUPPLY FAN	Greenheck	4,100 cfm	3	HP
F 4211	NEW	WAS THICKENING BUILDING ROOF EXHAUST FAN	Greenheck	4,500 cfm	2	HP
HC 4240	NEW	WAS THICKENING BUILDING ELECTRIC DUCT HEATER 1	Brasch	24 KW	24	KW
HC 4241	NEW	WAS THICKENING BUILDING ELECTRIC DUCT HEATER 2	Brasch	24 KW	24	KW
T 4502	NEW	THICKENED SLUDGE BLENDING TANK	-	18000 gal	0	
MME 4503	NEW	TSBT CARBON CANISTER	(tbd)	-	0	
CV 4504	NEW	THICKENED PRIMARY SLUDGE FEED CONTROL VALVE	-	-	1	HP
CV 4505	NEW	THICKENED PRIMARY SLUDGE BYPASS CONTROL VALVE	-	-	1	HP
P 4506	NEW	TSBT CIRCULATION PUMP	Seepex	400 gpm	60	HP
CV 4507	NEW	TSBT CIRCULATION CONTROL VALVE	-	-	1	HP
P 4508	NEW	HAULED SLUDGE TRANSFER PUMP	Seepex	400 gpm	60	HP
P 4510	NEW	DIGESTER FEED PUMP 1	Seepex	30 gpm	5	HP
P 4520	NEW	DIGESTER FEED PUMP 2	Seepex	30 gpm	5	HP
P 4530	NEW	DIGESTER FEED PUMP 3	Seepex	30 gpm	5	HP
P 4540	*FUTURE*	*DIGESTER FEED PUMP 4*	*Seepex*	*30 gpm*	*5*	*HP*
CV 4561	NEW	DIGESTER 1 FEED CONTROL VALVE	-	-	1	HP
CV 4562	NEW	DIGESTER 2 FEED CONTROL VALVE	-	-	1	HP
T 6801	NEW	EXPANSION TANK 3	AMTROL	(tbd)	0	
T 6802	NEW	EXPANSION TANK 4	AMTROL	(tbd)	0	

EQUIPMENT LIST

Equipment Number	Status	Description	Basis of Design Mfgr	Capacity	Size / Pwr	Pwr Unit
T 7201	EXISTING	COAGULATION SYSTEM STORAGE TANK (existing alum storage tank)	-	-		
P 7210	EXISTING	COAGULATION SYSTEM TRANSFER PUMP 1 (existing alum metering pump	-	-		
P 7211	EXISTING	COAGULATION SYSTEM TRANSFER PUMP 2 (existing alum metering pump	-	-		
P 7330	NEW	HYPOCHLORITE TRANSFER PUMP 1	Siemens	100gph @ 30 psi	1.5	KW
PNL 8210	NEW	COMPRESSOR PACKAGE CONTROL PANEL	Ingersoll-Rand/Dynasand	-		
CP 8210	NEW	COMPRESSOR PACKAGE	Ingersoll-Rand/Dynasand	16.2 scfm	10	HP
8200	*FUTURE*	*COMPRESSOR PACKAGE CONTROL PANEL*	*Ingersoll-Rand/Dynasand*	-		
8200	*FUTURE*	*FUTURE COMPRESSOR PACKAGE*	*Ingersoll-Rand/Dynasand*	*36.4 scfm*	*15*	*HP*
PNL 8200	NEW	RECLAIMED WATER FILTER CENTRAL CONTROL PANEL	Parkson Dynasand	-	2.5	KW
FLT 8201	NEW	RECLAIMED WATER FILTERS CELL 1	Parkson Dynasand	4.86gpm /ft^2	0	
FLT 8202	NEW	RECLAIMED WATER FILTERS CELL 2	Parkson Dynasand	4.86gpm /ft^2	0	
FLT 8203	NEW	RECLAIMED WATER FILTERS CELL 3	Parkson Dynasand	4.86gpm /ft^2	0	
FLT 8204	*FUTURE*	*RECLAIMED WATER FILTERS CELL 4*	*Parkson Dynasand*	*4.86gpm /ft^2*	*0*	
FLT 8205	*FUTURE*	*RECLAIMED WATER FILTERS CELL 5*	*Parkson Dynasand*	*4.86gpm /ft^2*	*0*	
FLT 8206	*FUTURE*	*RECLAIMED WATER FILTERS CELL 6*	*Parkson Dynasand*	*4.86gpm /ft^2*	*0*	
PNL 8201	NEW	FILTER CELL 1 CONTROL PANEL	Parkson Dynasand	-		
PNL 8202	NEW	FILTER CELL 2 CONTROL PANEL	Parkson Dynasand	-		
PNL 8203	NEW	FILTER CELL 3 CONTROL PANEL	Parkson Dynasand	-		
PNL 8204	*FUTURE*	*FILTER CELL 4 CONTROL PANEL*	*Parkson Dynasand*	-		
PNL 8205	*FUTURE*	*FILTER CELL 5 CONTROL PANEL*	*Parkson Dynasand*	-		
PNL 8206	*FUTURE*	*FILTER CELL 6 CONTROL PANEL*	*Parkson Dynasand*	-		
MXR 8212	NEW	COAGULATION SYSTEM IN-LINE MIXER	Walker - InstoMix	-		
SLG 8221	NEW	RECLAIMED WATER FILTER 1 SLIDE GATE	-	-	0	
SLG 8222	NEW	RECLAIMED WATER FILTER 2 SLIDE GATE	-	-	0	
SLG 8223	NEW	RECLAIMED WATER FILTER 3 SLIDE GATE	-	-	0	
SLG 8224	*FUTURE*	*RECLAIMED WATER FILTER 4 SLIDE GATE*	-	-	*0*	
SLG 8225	*FUTURE*	*RECLAIMED WATER FILTER 5 SLIDE GATE*	-	-	*0*	
SLG 8226	*FUTURE*	*RECLAIMED WATER FILTER 6 SLIDE GATE*	-	-	*0*	
MXR 8310	*FUTURE*	*HYPOCHLORITE STATIC MIXER*	-	-	*0*	
P 8301	*FUTURE*	*RECLAIMED WATER PUMP 1*	*Fairbanks Morse*	*2850 gpm @ 100 psi*	*250*	*HP*
P 8302	*FUTURE*	*RECLAIMED WATER PUMP 2*	*Fairbanks Morse*	*2850 gpm @ 100 psi*	*250*	*HP*
P 8303	*FUTURE*	*RECLAIMED WATER PUMP 3*	*Fairbanks Morse*	*2850 gpm @ 100 psi*	*250*	*HP*
PVL 8311	*FUTURE*	*RECLAIMED WATER HYDROPNEUMATIC TANK 1*	*Wessels*	*132 gal*	*0*	
PVL 8312	*FUTURE*	*RECLAIMED WATER HYDROPNEUMATIC TANK 2*	*Wessels*	*132 gal*	*0*	
T 8300	*FUTURE*	*RECLAIMED WATER CLEARWELL*	-	*171,000 gal*	*0*	
T 8400	NEW	COAGULATION SYSTEM DAY TANK	(tbd)	73 gal		
P 8401	NEW	RECLAIMED WATER COAGULATION SYSTEM PUMP 1	Watson-Marlow	1.53 gph @ 30 psi	0.75	KW
P 8402	NEW	RECLAIMED WATER COAGULATION SYSTEM PUMP 2	Watson-Marlow	1.53 gph @ 30 psi	0.75	KW
CV 8430	NEW	ACH DILUTION WATER PRESS REDUCING VALVE				
P 8501	NEW	RECLAIMED WATER HYPOCHLORITE PUMP 1	Watson-Marlow	6.5 gph @ 30 psi	0.75	KW
P 8502	NEW	RECLAIMED WATER HYPOCHLORITE PUMP 2	Watson-Marlow	6.5 gph @ 30 psi	0.75	KW
T 8500	NEW	HYPOCHLORITE DAY TANK	(tbd)	150 gal	0	
CV 8530	NEW	HYPOCHLORITE DILUTION WATER PRESS REDUCING VALVE				
P 8601	NEW	RECLAIMED WATER ASCORBIC ACID PUMP 1	Watson-Marlow	6.5 gph @ 30 psi	0.75	KW
CV 8630	NEW	ASC DILUTION WATER PRESS REDUCING VALVE				
HP 8701	NEW	RECLAIMED WATER BUILDING ELECTRICAL/AIR COMPRESSOR ROOM	Carrier	15 ton	4	HP
F 8710	NEW	RECLAIMED WATER BUILDING SUPPLY FAN	Greenheck	2,300 cfm	1.5	HP
F 8711	NEW	RECLAIMED WATER BUILDING EXHAUST FAN	Greenheck	2,530 cfm	1.5	HP
HC 8740	NEW	RECLAIMED WATER BUILDING ELECTRIC DUCT HEATER	Brasch	30 KW	30	KW
LVR 8750	NEW	RECLAIMED WATER BUILDING INTAKE LOUVER	Greenheck	-	0	
LVR 8751	NEW	RECLAIMED WATER BUILDING EXHAUST LOUVER	Greenheck	-	0	
P 9001	NEW	HRR PUMP 1	Bell and Gosset	280	7.5	HP
P 9002	NEW	HRR PUMP 2	Bell and Gosset	280	7.5	HP
PNL 9111	NEW	WASTE GAS BURNER CONTROL PANEL	VAREC	-		
WGB 9111	NEW	WASTE GAS BURNER	VAREC	(tbd)		
FT 9111	NEW	FLAME TRAP	VAREC	-	0	
FA 9111	NEW	FLAME ARRESTOR	VAREC	-	0	
SV 9111A	NEW	DIGESTER GAS SUSTAINING FUEL VALVE	VAREC	-		
SV 9111B	NEW	DIGESTER GAS PILOT FUEL VALVE	VAREC	-		
SV 9111C	NEW	PROPANE PILOT FUEL VALVE	VAREC	-		
PRV 9111	NEW	DIGESTER GAS PRESSURE REGULATOR	VAREC	-		
PNL 9201	NEW	DIGESTER GAS TREATMENT SYSTEM CONTROL PANEL	UNISON SOLUTIONS	-	25	KW
SEP 9201	NEW	INLET SEPARATOR	UNISON SOLUTIONS	-	0	

EQUIPMENT LIST

Equipment Number	Status	Description	Basis of Design Mfgr	Capacity	Size / Pwr	Pwr Unit
VE 9201	NEW	H2S REMOVAL VESSEL 1	UNISON SOLUTIONS	108,000 scf/d @ 1350 ppmv	0	
VE 9202	NEW	H2S REMOVAL VESSEL 2	UNISON SOLUTIONS	108,000 scf/d @ 1350 ppmv	0	
HEX 9211	NEW	CHILLING HEX	UNISON SOLUTIONS	(tbd)	0	
SEP 9213	NEW	CONDENSATE SEPARATOR	UNISON SOLUTIONS	(tbd)	0	
B 9221	NEW	DIGESTOR GAS BLOWER	UNISON SOLUTIONS	108,000 scf/d		
HEX 9216	NEW	DIGESTER GAS AFTER-COOLER	UNISON SOLUTIONS	(tbd)	0	
P 9212	NEW	CHILLED GLYCOL CIRCULATION PUMP	UNISON SOLUTIONS	(tbd)		
T 9213	NEW	EXPANSION TANK	UNISON SOLUTIONS	(tbd)	0	
TCV 9212	NEW	THREE-WAY CONTROL VALVE	UNISON SOLUTIONS	-		
CLR 9212	NEW	AIR-COOLED GLYCOL CHILLER	UNISON SOLUTIONS	(tbd)		
CV 9221	NEW	MODULATING BY-PASS VALVE	UNISON SOLUTIONS	-		
VE 9231	NEW	SILOXANE SYSTEM VESSEL 1	UNISON SOLUTIONS	108,000 scf/d @ 2.05 ppmv	0	
VE 9232	NEW	SILOXANE SYSTEM VESSEL 2	UNISON SOLUTIONS	108,000 scf/d @ 2.05 ppmv	0	
FLT 9241	NEW	DIGESTER GAS PARTICULATE FILTER	UNISON SOLUTIONS	-	0	
GEN 9301	NEW	ENGINE-GENERATOR	MAN / 2G CENERGY	250 kW	250	KW
P 9321	NEW	LT CIRCUIT PUMP	2G CENERGY	(tbd)		
T 9321	NEW	LT EXPANSION TANK	2G CENERGY	(tbd)	0	
TCV 9321	NEW	LT TEMP CONTROL VALVE	2G CENERGY	-	0	
CLR 9321	NEW	INTERCOOLER RADIATOR	2G CENERGY	(tbd)		
PSV 9321	NEW	LT PRESSURE SAFETY VALVE	2G CENERGY	-	0	
P 9311	NEW	HT CIRCUIT PUMP	2G CENERGY	(tbd)		
T 9311	NEW	HT EXPANSION TANK	2G CENERGY	(tbd)	0	
TCV 9311	NEW	HT TEMP CONTROL VALVE	2G CENERGY	-		
CLR 9311	NEW	WASTE HEAT RADIATOR	2G CENERGY	(tbd)		
PSV 9312	NEW	HT PRESURE SAFETY VALVE	2G CENERGY	-	0	
HEX 9311	NEW	EXHAUST HEAT RECOVERY SILENCER	2G CENERGY	(tbd)	0	
PSV 9311	NEW	EXHAUST SAFETY VALVE	2G CENERGY	-	0	
HEX 9331	NEW	HEAT RECOVERY HEAT EXCHANGER	2G CENERGY	(tbd)	0	
P 9331	NEW	HEAT RECOVERY PUMP	2G CENERGY	(tbd)		
TCV 9331	NEW	HEAT RECOVERY CONTROL VALVE	2G CENERGY	-		
PSV 9331	NEW	HEAT RECOVERY SAFETY VALVE	2G CENERGY	-	0	
SIL 9311	NEW	SUPPLEMENTAL SILENCER	2G CENERGY	(tbd)	0	

Central Kitsap County
Reclamation and Reuse Project
Preliminary Control Narratives (Div 17)

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SECTION 17901

CONTROL STRATEGY FOR WASTE ACTIVATED SLUDGE (WAS) THICKENING SYSTEM

A. PURPOSE:

The thickening system is designed to remove water from the waste activated sludge (WAS) and increase the solids concentration prior to anaerobic digestion. The higher solids concentration in the thickened waste activated sludge (TWAS) will allow for higher hydraulic loading to the anaerobic digesters. The system includes a flocculation tank, rotary drum thickener, spray water booster pump, TWAS pump, and odor control.

B. REFERENCES:

1. P&ID: P-400
2. Mechanical Plan Drawing: Mxxx
3. Control Diagram: A, B, C, E, by Contractor
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 11390, 11599, 11771

C. SYSTEM DESCRIPTION:

The design flow for the WAS thickening system is 208 gpm. If the WAS thickening system is out of service, WAS will be directed to the gravity thickeners by the RDT isolation and bypass valves.

1. Rotary Drum Thickener (RDT) and Flocculation Tank:

The WAS feed pumps, located by the RAS mixing box in the aeration basin area, will feed WAS to the thickening process on a continuous basis. All components of the thickening system will similarly operate on a continuous basis.

WAS is fed to the inlet flocculation tank of the RDT and polymer is added prior to the tank (one just before the tank and one at a mixing and injection point further upstream). Flocculated sludge enters the RDT and unbound water drains through the perforated drum. The collected filtrate drains by gravity to the Plant Wastewater Pump Station. The TWAS discharges at the opposite end of the RDT into the TWAS pump.

The RDT is VFD driven, but operates at a constant speed. This speed is set during startup (can be modified later by the operators).

Spray water is required during RDT operation to wash the screen continuously. The Spray Water Control Valve will open and the Spray Water Booster Pump will operate when the RDT is in operation. The spray header is cleaned automatically by a powered operator and based on a timer. Spray water is collected with filtrate. When RDT is stopped through SCADA, RDT and spray will operate a little longer to clean the screen and flush the drain system.

2. TWAS Pumps

The TWAS discharges at the end of the RDT into an open-throated progressing cavity pump, which transfers the TWAS to the thickened sludge blend tank (TSBT). The TWAS pump is VFD driven and operation is controlled by level in the sludge hopper. A backup float will stop the dewatering operation on a high level and control valves will re-direct flow to the gravity thickeners. Seal water is required for pump operation and interlocks are provided.

3. Odor Control System:

The odor control system is composed of a carbon canister and an inline fan. Ducting containing the inline fan is bolted to a flanged connection on the RDT and draws foul air from the thickener to the carbon canister. The fan operates continuously.

4. RDT Isolation and Bypass Valves:

The RDT isolation and bypass valves are motorized plug valves that divert WAS to the gravity thickeners during a thickening process or equipment failure. In this case, the RDT bypass valve will open and the RDT isolation valve will close.

D. EQUIPMENT:

Equipment No.	Description
CV 4006	RDT Isolation Valve
CV 4007	RDT Bypass Valve
CV 4008	Spray Water Control Valve
MXR 4010	Flocculation Tank Mixer
P 4011	Spray Water Booster Pump
RDT 4012	Rotary Drum Thickener
MME 4013	Spray Bar Cleaning
V 4014	Mixing Valve
F 4018	Inline Fan
MME 4019	RDT Carbon Canister
P 4020	TWAS Pump
SV 4020	TWAS Pump Seal Water Solenoid Valve

E. OPERATOR CONTROLS:

Location	Controls
LOCAL	HS 4006 (HOR)
LOCAL	HS 4007 (HOR)
LOCAL	HS 4008 (HOR)

LOCAL	HS 4010 (HOA)
LOCAL	HS 4011 (HOA)
LOCAL	HS 4012 (HOA)
LOCAL	HS 4013 (HOR)
LOCAL	HS 4018 (HOA)
LOCAL	HS 4020 (HOA)

F. INSTRUMENTATION:

Tag Number	Description
FSL 4011	Spray Water Flow Switch
PI 4011	Spray Water Pressure Indicator
PI 4018	RDT Inline Fan Discharge Pressure
FIT/FE 4020	TWAS Flow Meter
PIT 4020	TWAS Hopper Level
LSH 4020	TWAS Hopper Level Switch Low (Float)
PI 4020	TWAS Pump Discharge Pressure Indicator
PSH 4020	TWAS Pump Discharge Pressure Switch
PSL 4020	TWAS Pump Seal Water Pressure Switch
TSH 4020A	TWAS Pump Motor Temperature Switch
TSH 4020B	TWAS Pump Stator Temperature Switch

G. ALARMS:

Tag Number	Description
FSL 4011	Spray Water Flow Low
FIT 4020	TWAS Flow Fault
PIT 4020	TWAS Hopper Level High
PIT 4020	TWAS Hopper Level Low
LSH 4020	TWAS Hopper Level Switch High
PSH 4020	TWAS Pump Discharge Pressure High
PSL 4020	TWAS Pump Seal Water Pressure Low
TSH 4020A	TWAS Pump Motor Temperature High
TSH 4020B	TWAS Pump Stator Temperature High
MME 4013	Spray Bar Cleaning Fault

H. OPERATION:

All equipment and valves must be in the AUTO or REMOTE, respectively, for the thickening system to operate fully automatic (SCADA AUTO). Provide alarm if operator or system attempts to start thickening operation and this permissive is not met.

In the following paragraphs, AUTO refers to the system automatic operating mode through SCADA.

1. Rotary Drum Thickener (RDT):

a. Automatic: In the AUTO position, the RDT will operate at a constant speed when flow is detected in WAS Flow Meter (FIT 2205) and the RDT Isolation Valve (CV 4006) opens. Drum speed will be set by the operator. The Spray Water Booster Pump (P 4011) will operate and Spray Water Control Valve (CV 4008) will open when the RDT is in operation.

The spray header is cleaned automatically by a powered operator (MME 4013) and based on a timer. Timer will be operator adjustable.

Interlocks: In the AUTO position, the RDT will stop operation, the RDT Isolation Valve (CV 4006) will close, and the RDT bypass valve (CV 4007) will open based on the following:

- WAS flow (FIT 2205) fault
- TWAS Pump (P 4020) fault
- Polymer flow (FIT 4095) fault
- Polymer flow permissive is required prior to RDT start. Provide delay.

b. Manual: The RDT runs continuously when the HOA switch is in the HAND position. The drum will operate at the set speed. The RDT is stopped when the HOA switch is in the OFF position.

In SCADA manual, operator has start, stop, and speed control via SCADA. For SCADA stop, the RDT operation shall be a delayed stop. When the RDT is called to stop through SCADA:

- the RDT Isolation Valve (CV 4006) shall close
- the RDT bypass valve (CV 4007) shall open
- the RDT and booster pump shall continue operating for a set time (shutdown timer) to clean the screen and flush out the drain system. The RDT and booster pump shall then stop and the Spray Water Control Valve close.

The spray water booster pump runs continuously when the HOA switch is in the HAND position. The pump is stopped when the HOA switch is in the OFF position. In SCADA manual, operator has start and stop control via SCADA.

The flocculation tank mixer runs continuously when the HOA switch is in the HAND position. The mixer is stopped when the HOA switch is in the OFF position. In SCADA manual, operator has start and stop control via SCADA.

c. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display

2. TWAS Pump:

a. Automatic: In the AUTO position, the TWAS pump will operate to maintain a constant level in the RDT discharge hopper based on PIT 4020.

Interlocks: In the AUTO position, the TWAS pump will stop operation based on the following:

- High motor winding temperature (TSH 4020A); hardwired
- High stator temperature (TSH 4020B); hardwired
- TWAS flow (FIT 4020) fault
- TWAS hopper high float switch (LSH 4020)
- Low level in the hopper (PIT 4020)
- Thickened Sludge Blending Tank high level (PIT 6002)
- Thickened Sludge Blending Tank high level switch (LSH 6002)

b. Manual: The TWAS pump runs continuously when the HOA switch is in the HAND position. The pump will operate at a speed set by the operator in SCADA. The TWAS pump is stopped when the HOA switch is in the OFF position. In SCADA manual, operator has start, stop, and speed control via SCADA.

c. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display

3. Odor Control System:

a. Automatic: In the AUTO position, the RDT Inline Fan (F 4018), will operate at a constant speed.

a. Manual: In the HAND position, the RDT Inline Fan (F 4018), will operate at a constant speed. In SCADA manual, operator has start and stop control via SCADA.

b. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display

4. Power Outage:

a. In the event of a power outage, the RDT isolation valve (CV 4006) shall close and the RDT bypass valve (CV 4007) shall open to re-direct WAS flow to the gravity thickeners

b. When utility power returns, the system shall automatically come back online. The RDT isolation valve (CV 4006) shall open and the RDT bypass valve (CV 4007) shall close to return the WAS feed to the thickening process.

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value
FSL 4011	25 gpm (adjust to ~75% of mfgr wash water flow)
PIT 4020 High	6 inches below LSH 4020
PIT 4020 Low	__ ft
LSH 4020	__ ft
PSH 4020	20 psi
PSL 4020	5 psi (maintain pressure above max static head of TWAS)
TSH 4xxx	By pump and motor manufacturers
Polymer flow permissive delay	5 sec
Spray bar cleaning interval	30 min (adjust to mfgr recommendation)
Shutdown timer	10 min (adjust to mfgr recommendation)
PIT 6002 High	(see TSBT control strategy: 17902)
LSH 6002	(see TSBT control strategy: 17902)

J. INSTRUMENT RANGES:

Instrument	Range	Description
FSL 4011	0 – 50 gpm	Spray Water Flow Switch
PI 4011	0 – 40 psi	Spray Water Pressure Indicator (all mfgrs, except Westech)
PI 4011	0 – 100 psi	Spray Water Pressure Indicator (Westech only)
PI 4018	0 – 12 in WC	RDT Inline Fan Discharge Pressure
FIT/FE 4020	0 – 25 gpm	TWAS Flow Meter
PIT 4020	3 psi	TWAS Hopper Level
LSH 4020	NA	TWAS Hopper Level Switch Low (Float)
PI 4020	0 – 100 psi	TWAS Pump Discharge Pressure Indicator
PSH 4020	0 – 100 psi	TWAS Pump Discharge Pressure Switch
PSL 4020	0 – 5 psi	TWAS Pump Seal Water Pressure Switch
TSH 4020A	Mfgr	TWAS Pump Motor Temperature Switch
TSH 4020B	Mfgr	TWAS Pump Stator Temperature Switch

END OF SECTION

SECTION 17902

CONTROL STRATEGY FOR THICKENED SLUDGE BLENDING TANK

A. PURPOSE:

The Thickened Sludge Blending Tank (TSBT) blends thickened primary sludge, thickened waste activated sludge, primary and secondary scum, and thickened sludge from other plants. The Thickened Sludge Blending Tank also equalizes peaks in solids production to minimize uneven loading to the anaerobic digesters downstream. The system includes one sludge circulation pump, three digester feed pumps, motorized plug valves, and a tank.

B. REFERENCES:

1. P&ID: P-450, P-451, P-452, P-453
2. Mechanical Plan Drawing: M-400, M-401, M-402, M-404, M-406
3. Control Diagram: A, B, C, E, by Contractor
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 11390

C. SYSTEM DESCRIPTION:

The TSBT circulation pump and two of the digester feed pumps are normally in service. The circulation pump has a capacity of 400 gpm and each digester feed pump has a capacity of 30 gpm.

1. TSBT Circulation Pump:

The TSBT Circulation Pump is a progressing cavity pump that pumps sludge from the bottom of the TSBT to the top or midpoint of the TSBT to induce mixing of the incoming feeds. The TSBT Circulation Pump can turn over the tank every 30 minutes at normal operating level (80 minutes at max liquid level in the tank). The TSBT Circulation Pump operates at a constant speed, which is set by the operator in SCADA.

Operator manually selects the circulation return points by opening and closing manual valves. At the top of the tank, there is a spray bar to entrain foam and floatables into the tank contents.

If pump is out of service, digester feed can continue through automatic valve operation.

2. Digester Feed Pumps

The Digester Feed Pumps are progressing cavity pumps that pump mixed sludge from the TSBT to the anaerobic digesters. The Digester Feed Pump inlets are connected to the discharge piping of the TSBT Circulation Pump. During normal operation, each digester is fed by a dedicated pump while the remaining Digester Feed Pump is a standby. Operators will select the duty and standby pumps and the automated valves will open/close to appropriately direct the flows. When hauled sludge is received, the hauled sludge volume is automatically calculated and pumped to the digesters over an operator selected time frame. The feed pumps will speed up to pump the combined in-plant flow rate and the calculated hauled sludge flow rate. A maximum of two (2) truck loads (8,000 gallons) can be accepted per day; truck can deliver sludge back-to-back.

3. Hauled Sludge Transfer Pump:

The Hauled Sludge Transfer Pump is a progressing cavity pump that pumps sludge from the hauled sludge trucks to the TSBT. The Hauled Sludge Transfer Pump operates at a constant speed and is started and stopped at a local control station at the truck loadout location.

The Hauled Sludge Transfer Pump can be operated to serve as a backup to the TSBT Circulation Pump (used when the circulation pump is offline for service or maintenance).

D. EQUIPMENT:

Equipment No.	Description
T 4502	Thickened Sludge Blending Tank
MME 4503	TSBT Carbon Canister
CV 4504	Thickened Primary Sludge Feed Control Valve
CV 4505	Thickened Primary Sludge Bypass Control Valve
P 4506	TSBT Circulation Pump
SV 4506	TSBT Circulation Pump Seal Water Solenoid Valve
CV 4507	TSBT Circulation Control Valve
P 4508	Hauled Sludge Transfer Pump
SV 4508	Hauled Sludge Transfer Pump Seal Water Solenoid Valve
P 4510	Digester Feed Pump 1
SV 4510	Digester Feed Pump 1 Seal Water Solenoid Valve
P 4520	Digester Feed Pump 2
SV 4520	Digester Feed Pump 2 Seal Water Solenoid Valve
P 4530	Digester Feed Pump 3
SV 4530	Digester Feed Pump 3 Seal Water Solenoid Valve
CV 4561	Digester 1 Feed Control Valve
CV 4562	Digester 2 Feed Control Valve

E. OPERATOR CONTROLS:

Location	Controls
LOCAL	HS 4504 (HOR)
LOCAL	HS 4505 (HOR)
LOCAL	HS 4506 (HOA)

LOCAL	HS 4508 (HOA)
LOCAL	HS 4507 (HOR)
LOCAL	HS 4510 (HOA)
LOCAL	HS 4520 (HOA)
LOCAL	HS 4530 (HOA)
LOCAL	HS 4561 (HOR)
LOCAL	HS 4562 (HOR)

F. INSTRUMENTATION:

Tag Number	Description
FIT/FE 4501	Thickened Primary Sludge Flow Meter
PIT 4502	TSBT Level Indicator
PSL 4502	TSBT Level Switch Low (outdoor installation)
LSH 4502	TSBT Level Switch High-High (Float)
PSL 4506	TSBT Circulation Pump Seal Water Pressure Switch
PI 4506	TSBT Circulation Pump Discharge Pressure Indicator
PSH 4506	TSBT Circulation Pump Discharge Pressure High; hardwired
TSH 4506A	TSBT Circulation Pump Motor Winding Temperature Switch; hardwired
TSH 4506B	TSBT Circulation Pump Stator Temperature Switch; hardwired
FS 4508	Hauled Sludge Flow Switch
PI 4508A	Hauled Sludge Transfer Pump Inlet Pressure Indicator
PSL 4508A	Hauled Sludge Transfer Pump Inlet Pressure Low; hardwired
PI 4508B	Hauled Sludge Transfer Pump Discharge Pressure Indicator
PSH 4508B	Hauled Sludge Transfer Pump Discharge Pressure High; hardwired
PSL 4508C	Hauled Sludge Transfer Pump Seal Water Pressure Switch
TSH 4508A	Hauled Sludge Transfer Pump Motor Winding Temperature Switch; hardwired
TSH 4508B	Hauled Sludge Transfer Pump Stator Temperature Switch; hardwired
PSL 4510	Digester Feed Pump 1 Seal Water Pressure Switch
PI 4510	Digester Feed Pump 1 Pressure Indicator
PSH 4510	Digester Feed Pump 1 Pressure Switch; hardwired
TSH 4510A	Digester Feed Pump 1 Motor Winding Temperature Switch; hardwired
TSH 4510B	Digester Feed Pump 1 Stator Temperature Switch; hardwired
PSL 4520	Digester Feed Pump 2 Seal Water Pressure Switch
PI 4520	Digester Feed Pump 2 Pressure Indicator
PSH 4520	Digester Feed Pump 2 Pressure Switch; hardwired
TSH 4520A	Digester Feed Pump 2 Motor Winding Temperature Switch; hardwired
TSH 4520B	Digester Feed Pump 2 Stator Temperature Switch; hardwired
PSL 4530	Digester Feed Pump 3 Seal Water Pressure Switch
PI 4530	Digester Feed Pump 3 Pressure Indicator

PSH 4530	Digester Feed Pump 3 Pressure Switch; hardwired
TSH 4530A	Digester Feed Pump 3 Motor Winding Temperature Switch; hardwired
TSH 4530B	Digester Feed Pump 3 Stator Temperature Switch; hardwired
ZS 4560	Valve Position Switch
FIT/FE 4561	Digester 1 Feed Flow Meter
FIT/FE 4562	Digester 2 Feed Flow Meter

G. ALARMS:

Tag Number	Description
LSH 4502	TSBT Level High
PSL 4502	TSBT Level Low
PIT 4502	TSBT Level High
PIT 4502	TSBT Level Low
PSL 4506	TSBT Circulation Pump Seal Water Pressure Low
PSH 4506	TSBT Circulation Pump Discharge Pressure High
TSH 4506A	TSBT Circulation Pump Motor Temperature High
TSH 4506B	TSBT Circulation Pump Stator Temperature High
PSL 4508A	Hauled Sludge Transfer Pump Inlet Pressure Low
PSH 4508B	Hauled Sludge Transfer Pump Discharge Pressure High
TSH 4508A	Hauled Sludge Pump Motor Temperature High
TSH 4508B	Hauled Sludge Pump Stator Temperature High
PSL 4508C	Hauled Sludge Pump Seal Water Pressure Low
PSH 4510	Digester Feed Pump 1 Discharge Pressure High
PSL 4510	Digester Feed Pump 1 Seal Water Pressure Low
TSH 4510A	Digester Feed Pump 1 Motor Temperature High
TSH 4510B	Digester Feed Pump 1 Stator Temperature High
PSH 4520	Digester Feed Pump 2 Discharge Pressure High
PSL 4520	Digester Feed Pump 2 Seal Water Pressure Low
TSH 4520A	Digester Feed Pump 2 Motor Temperature High
TSH 4520B	Digester Feed Pump 2 Stator Temperature High
PSH 4530	Digester Feed Pump 3 Discharge Pressure High
PSL 4530	Digester Feed Pump 3 Seal Water Pressure Low
TSH 4530A	Digester Feed Pump 3 Motor Temperature High
TSH 4530B	Digester Feed Pump 3 Stator Temperature High
_________	Only one duty digester feed pump available (or two digester feed pump faults at the same time)
ZS 4560	Valve Open

H. OPERATION:

All equipment and valves must be in the AUTO or REMOTE, respectively, for the TSBT and digester feed systems to operate fully automatic (SCADA AUTO). Provide alarm if operator or system attempts to start thickening operation and this permissive is not met. Hauled Sludge Transfer Pump does not have to be in AUTO for this permissive to be met.

In the following paragraphs, AUTO refers to the system automatic operating mode through SCADA.

1. TSBT Circulation Pump:

a. Automatic: In the AUTO position, the TSBT Circulation Pump (P 4506) will operate at a constant speed. Pump speed will be set by the operator. Speed or flow will be approximated to provide 30 min turnover time of the TSBT volume at normal operating level (190 gpm) and providing 45 gpm for digester feed.

In the event of a TSBT Circulation Pump (P 4506) fault, signal shall be sent to SCADA and the TSBT Circulation Control Valve (CV 4507) shall open. TSBT Circulation Control Valve (CV 4507) shall close when the TSBT Circulation Pump (P 4506) is operating.

If the TSBT level drops below the pressure switch level (PSL 4502), the TSBT Circulation Pump shall stop. Pump shall restart when the TSBT level returns to the low TSBT level (PIT 4502 Low).

Interlocks: In the AUTO position, the TSBT Circulation Pump (P 4506) will stop operation based on the following:

- High motor winding temperature (TSH 4506A); hardwired
- High stator temperature (TSH 4506B); hardwired
- High outlet pressure (PSH 4506); hardwired
- Thickened Sludge Blending Tank low level switch (PSL 4502)
- Low seal water pressure (PSL 4506)

b. Manual: The TSBT Circulation Pump (P 4506) runs continuously when the HOA switch is in the HAND position. The pump will operate at a speed set by the operator in SCADA. The pump is stopped when the HOA switch is in the OFF position. In SCADA manual, operator has start, stop, and speed control via SCADA.

c. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display

2. Digester Feed Pumps:

a. Automatic: In the AUTO position, the two duty Digester Feed Pumps (P 4510, 4520, 4530) will operate to match the plant influent flow rates to the TSBT and draw down the volume of hauled sludge over a specified time frame (Hauled Sludge Return Timer 1 and 2). The influent flow rate will be the sum of TWAS (FIT 4020) and thickened primary (FIT 4501). The pumps will operate with a trim and with a dead-band level. The TSBT normal operating level, for which these pumps operate in this mode, is indicated in paragraph I.

In general, the pumping rate of each duty Digester Feed Pump will be as follows:

$$Q_{digester\_feed,\ duty} = (Q_{FIT4020} + Q_{FIT4501} + Q_{Haul1} + Q_{Haul2}) / 2$$

Q_{Haul1} and Q_{Haul2} are hauled sludge from other plants and will have associated Timer 1 and Timer 2, respectively. The pumping rates and timers for the hauled sludge will be as described below.

When a timer ends, the associated flow rate will disappear from the flow rate calculation and the pumping rate will continue with remaining operating timers. If the level reaches the TSBT normal operating level while any of the timers are on, remaining timers shall turn off. If the level has not reached the TSBT normal operating level before the last remaining timer is off, remaining timer(s) shall continue until the normal level is reached and then turn off.

When hauled sludge begins transfer into the TSBT, a flow switch (FS 4508) is tripped and the level in the TSBT is recorded. At the end of the hauled sludge transfer, the flow switch is disengaged / tripped and the level in the TSBT is recorded. Based on the two level points recorded by the flow switch, the volume of hauled sludge is calculated. SCADA will calculate the required flow rate to pump the hauled sludge from the TSBT to the digesters over an operator specified time (Timer 1).

If a second hauled sludge begins transfer into the TSBT before the Timer 1 is off, the operating scenario for the first hauled sludge is repeated with a second timer (Timer 2). The flow from the Digester Feed Pumps will be the sum of the influent flows to the TSBT and the two calculated hauled sludge flow rate.

If the TSBT level drops below the low level (PIT 4502 low), the Digester Feed Pumps shall stop. If the TSBT level drops below the pressure switch level (PSL 4502), the Digester Feed Pumps shall stop. Pumps shall restart when the level returns to the TSBT Normal Operating Level.

Operators will select duty pumps and standby pump. Based on the duty pump selection, the digester feed control valves shall open and close as follows:

Duty Feed Pumps Selected	Control Valve Position
1 and 2	1 closed; 2 open
1 and 3	1 closed; 2 closed
2 and 3	1 open; 2 closed

In the event of a fault in a duty Digester Feed Pump, the standby shall convert to duty and the control valves re-position according to above table.

<u>Interlocks</u>: In the AUTO position, the Digester Feed Pumps will stop operation based on the following:

- High motor winding temperature (TSH 4510A, 4520A, 4530A); hardwired
- High stator temperature (TSH 4510B, 4520B, 4530B); hardwired

- High outlet pressure (PSH 4510, 4520, 4530); hardwired
- Thickened Sludge Blending Tank low level (PIT 4502)
- Thickened Sludge Blending Tank low level switch (PSL 4502)
- Low seal water pressure (PSL 4510, 4520, 4530)

When a duty pump is stopped based on these interlocks, the system shall automatically re-select duty pumps to the two available and operate valves according to the above table. If only one duty pump is available (or two pumps fault), provide alarm.

b. Manual: The Digester Feed Pumps run continuously when the HOA switch is in the HAND position. The pump will operate at a speed set by the operator in SCADA. The pump is stopped when the HOA switch is in the OFF position. In SCADA manual, operator has start, stop, and speed control via SCADA.

c. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display

3. Hauled Sludge Transfer Pump:

a. Automatic: The Hauled Sludge Transfer Pump (P 4508) will have to AUTO modes: (1) AUTO TRUCK for transfer of sludge and (2) AUTO TSBT CIRCULATION to serve as backup to the TSBT circulation pump.

In the AUTO TRUCK position, the Hauled Sludge Transfer Pump will operate when the pump is manually started at the local control station.

In the AUTO TSBT CIRCULATION position, the Hauled Sludge Transfer Pump will operate when the pump is manually started at the local control station. Operators will open and close manual valves to allow this circulation pattern. The AUTO TSBT CIRCULATION mode can only be enabled when the TSBT Circulation Pump is off (digester withdrawal will be as described under the TSBT Circulation Pump). FS 4508 will be disabled during circulation.

Interlocks: In the AUTO positions, the Hauled Sludge Transfer Pump (P 4508) will stop operation based on the following:

- High motor winding temperature (TSH 4508A); hardwired
- High stator temperature (TSH 4508B); hardwired
- High outlet pressure (PSH 4508B); hardwired
- Low pump inlet pressure (PSL 4508A)
- Thickened Sludge Blending Tank low level switch (PSL 4502)
- Thickened Sludge Blending Tank high level (PIT 4502).
- Thickened Sludge Blending Tank high level switch (LSH 4502).
- Low seal water pressure (PSL 4508C)

b. Manual: The Hauled Sludge Transfer Pump (P 4508) runs continuously when the HOA switch is in the HAND position. The pump is stopped when the HOA switch is in the OFF position. There will be no SCADA manual operation.

c. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display

4. Thickened Primary Sludge Feed and Bypass Valves:

a. Automatic: In the AUTO position, the Thickened Primary Sludge Feed Control Valve (CV 4504), shall normally be open and the Thickened Primary Sludge Bypass Control Valve (CV 4505) shall normally be closed. Each valve shall reverse position based on the following:

- Thickened Sludge Blending Tank high level (PIT 4502)
- Thickened Sludge Blending Tank high level switch (LSH 4502)

Each valve shall return to the normal position when the TSBT level (PIT 4502) has returned to the dead-band level.

b. Manual:

c. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display

5. Power Outage:

a. When utility power returns, the system shall automatically come back online.

b. In the event of a power outage, the Thickened Primary Sludge Feed Control Valve (CV 4504) will close and the Thickened Primary Sludge Bypass Control Valve (CV 4505) will open. When utility power returns, the Thickened Primary Sludge Feed Control Valve will open and the Thickened Primary Sludge Bypass Control Valve will close.

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value
TSBT Circulation Pump Speed	165 rpm (approx 250 gpm). Range: 0 – 300 gpm
TSBT Normal Operating Level	__ ft
Digester Feed Pump Deadband	+/- 6 inches
Hauled Sludge Return Timer 1	24 hrs. Range 1 – 40 hrs
Hauled Sludge Return Timer 2	24 hrs. Range 1 – 40 hrs

PIT 4502 High	6 inches below LSH 4502
PIT 4502 Low	6 inches above PSL 4502
LSH 4502	__ ft (approx 12” below overflow invert)
PSL 4502	__ ft (approx 6” above start of conical/sloped section)
PSH 4506	20 psi
PSL 4506	10 psi (maintain pressure above max static head in TSBT)
PSL 4508A	__ psia
PSH 4508B	20 psi
PSL 4508C	10 psi (maintain pressure above max static head in truck)
PSH 4510	40 psi (1)
PSL 4510	5-10 psi above PSH 4506
PSH 4520	40 psi (1)
PSL 4520	5-10 psi above PSH 4506
PSH 4530	40 psi (1)
PSL 4530	5-10 psi above PSH 4506
TSH 6xxx	By pump and motor manufacturers

1. These pressure switches shall be adjusted based on the outlet pressure requirement when the primary sludge is bypassing the TSBT, but remain below the seal water pressure available (PSL 4510, 4520, 4530).

J. INSTRUMENT RANGES:

Instrument	Range	Description
FIT/FE 4501	0 – 40 gpm	Thickened Primary Sludge Flow Meter
PIT 4502	0 – 10 psi	TSBT Level Indicator
PSL 4502	0 – 10 psi	TSBT Level Switch Low (outdoor installation)
LSH 4502	NA	TSBT Level Switch High-High (Float)
PSL 4506	0 – 15 psi	TSBT Circulation Pump Seal Water Pressure Switch
PI 4506	0 – 100 psi	TSBT Circulation Pump Discharge Pressure Indicator
PSH 4506	0 – 30 psi	TSBT Circulation Pump Discharge Pressure High; hardwired
TSH 4506A	Mfgr	TSBT Circulation Pump Motor Winding Temperature Switch; hardwired
TSH 4506B	Mfgr	TSBT Circulation Pump Stator Temperature Switch; hardwired
FS 4508	NA	Hauled Sludge Flow Switch
PI 4508A	__ – __ psia	Hauled Sludge Transfer Pump Inlet Pressure Indicator
PSL 4508A	__ – __ psia	Hauled Sludge Transfer Pump Inlet Pressure Low; hardwired
PI 4508B	0 – 100 psi	Hauled Sludge Transfer Pump Discharge Pressure Indicator
PSH 4508B	0 – 30 psi	Hauled Sludge Transfer Pump Discharge Pressure High; hardwired
PSL 4508C	0 – 15 psi	Hauled Sludge Transfer Pump Seal Water Pressure Switch

TSH 4508A	Mfgr	Hauled Sludge Transfer Pump Motor Winding Temperature Switch; hardwired
TSH 4508B	Mfgr	Hauled Sludge Transfer Pump Stator Temperature Switch; hardwired
PSL 4510	0 – 45 psi	Digester Feed Pump 1 Seal Water Pressure Switch
PI 4510	0 – 100 psi	Digester Feed Pump 1 Pressure Indicator
PSH 4510	0 – 40 psi	Digester Feed Pump 1 Pressure Switch; hardwired
TSH 4510A	Mfgr	Digester Feed Pump 1 Motor Winding Temperature Switch; hardwired
TSH 4510B	Mfgr	Digester Feed Pump 1 Stator Temperature Switch; hardwired
PSL 4520	0 – 45 psi	Digester Feed Pump 2 Seal Water Pressure Switch
PI 4520	0 – 100 psi	Digester Feed Pump 2 Pressure Indicator
PSH 4520	0 – 40 psi	Digester Feed Pump 2 Pressure Switch; hardwired
TSH 4520A	Mfgr	Digester Feed Pump 2 Motor Winding Temperature Switch; hardwired
TSH 4520B	Mfgr	Digester Feed Pump 2 Stator Temperature Switch; hardwired
PSL 4530	0 – 45 psi	Digester Feed Pump 3 Seal Water Pressure Switch
PI 4530	0 – 100 psi	Digester Feed Pump 3 Pressure Indicator
PSH 4530	0 – 40 psi	Digester Feed Pump 3 Pressure Switch; hardwired
TSH 4530A	Mfgr	Digester Feed Pump 3 Motor Winding Temperature Switch; hardwired
TSH 4530B	Mfgr	Digester Feed Pump 3 Stator Temperature Switch; hardwired
FIT/FE 4561	0 – 40 gpm	Digester 1 Feed Flow Meter
FIT/FE 4562	0 – 40 gpm	Digester 2 Feed Flow Meter

END OF SECTION

SECTION 17903

CONTROL STRATEGY FOR POLYMER SYSTEM

A. PURPOSE:

The polymer system mixes, batches, stores, and feeds polymer to the thickening process. The polymer causes flocculation of the solids particles in the WAS. The system includes the emulsion tote mixer, an emulsion polymer makedown system, two polymer storage tanks and valves, and a polymer feed system.

B. REFERENCES:

1. P&ID: P-402, P-403
2. Mechanical Plan Drawing: M-400
3. Control Diagram: A, B, C, E, by Contractor
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 11771

C. SYSTEM DESCRIPTION:

The polymer system will automatically mix, batch, store, and feed polymer.

1. Emulsion Polymer Tote Mixer:

The emulsion polymer tote mixer is installed onto/into the emulsion totes. The mixer is manually moved between duty totes and need a flexible power supply connection. The mixer is single speed and manually turned on/off.

2. Emulsion Polymer Makedown System:

The emulsion polymer makedown system pumps the emulsion polymer to the emulsion polymer mixer, mixes the emulsion polymer with water to activate it, and stores the mixed/diluted polymer in two polymer tanks. The emulsion feed system components are powered through the polymer feed control panel

The makedown system receives a low tank level signal and automatically feeds and mixes emulsion polymer to the tank by starting the emulsion polymer pump and opening the dilution water solenoid valve. The tank fill time is an operator input. The pump speed and emulsion polymer feed flow based on this fill time. The dilution water flow rate is manually set.

The polymer tanks are operated in series. While polymer is fed to the thickening process from one tank, the other tank is being filled with diluted/mixed emulsion polymer during the required time frame. The powered tank inlet valves are opened/closed as necessary to fill the correct tank. The powered tank outlet valves are opened/closed as necessary to feed from the correct tank.

3. Polymer Feed System:

The polymer feed system pumps the diluted polymer to the thickening process, measures the flow rate, and further mixes the polymer. The polymer feed system components are powered through the polymer feed control panel

These polymer feed pumps will operate based on a flow signal from the RDT and modulate based on the polymer feed flow meter. Operators will select the duty pump. If duty pump faults, switch to the standby unit by opening/closing the inlet control valves and starting the standby pump. Post-dilution water flow rate is manually set during startup.

D. EQUIPMENT:

Equipment No.	Description
PNL 4050	Polymer System Control Panel
MXR 4050	Emulsion Polymer Tote Mixer
P 4051	Emulsion Polymer Pump
MXR 4052	Emulsion Polymer Feeder
SV 4062A	Dilution Water Solenoid Valve 1
SV 4062B	Dilution Water Solenoid Valve 2
CV 4064	Polymer Tank 1 Inlet Control Valve
T 4065	Polymer Tank 1
CV 4066	Polymer Tank 1 Outlet Control Valve
CV 4074	Polymer Tank 2 Inlet Control Valve
T 4075	Polymer Tank 2
CV 4076	Polymer Tank 2 Outlet Control Valve
PNL 4080	Polymer Feed System Control Panel
P 4080	Polymer Feed Pump 1
CV 4081	Polymer Feed Pump 1 Control Valve
P 4090	Polymer Feed Pump 2
CV 4091	Polymer Feed Pump 2 Control Valve
MXR 4095	Polymer Static Mixer
SV 4095	Post-Dilution Water Solenoid Valve

E. OPERATOR CONTROLS:

Location	Controls
PNL 4050	TBD

F. INSTRUMENTATION:

Tag Number	Description
TSH 4051	Emulsion Polymer Pump Motor Temperature High
FSL 4051	Emulsion Polymer Flow Switch Low
FSL 4052A	Dilution Water Flow Low
FSL 4052B	Dilution Water Flow Low
LIT 4065	Polymer Tank 1 Level
LIT 4075	Polymer Tank 2 Level
TSH 4080	Polymer Feed Pump 1 Motor Temperature High
PSH 4080	Polymer Feed Pump 1 Pressure High
TSH 4090	Polymer Feed Pump 2 Motor Temperature High
PSH 4090	Polymer Feed Pump 2 Pressure High
FIT/FE 4095	Polymer Feed Flow

G. ALARMS:

Tag Number	Description
	Polymer System Fault

H. OPERATION:

1. Emulsion Polymer Tote Mixer:

   a. Manual: The mixer is manually turned on/off at the mixer

2. Emulsion Polymer Makedown System:

   a. Automatic: In the AUTO position, the emulsion polymer makedown system is under control of the Vendor PLC.

   b. Manual: The emulsion polymer pump runs continuously when the HOA switch is in the HAND position. Pump conveyor is stopped when the HOA switch is in the OFF position.

   c. When Running, a SYSTEM RNG signal XXX is received at PLC-XXX for monitoring and display.

3. Polymer Feed System:

   a. Automatic: In the AUTO position, the polymer feed system is under control of the Vendor PLC. A start and flow rate signal is sent to the polymer feed system from the RDT Vendor PLC. An AUTO signal XXX is received at PLC-XXX for monitoring and display.

b. Manual: The polymer feed pump runs continuously when the HOA switch is in the HAND position. The pump is stopped when the HOA switch is in the OFF position.

c. When Running, a SYSTEM RNG signal XXX is received at PLC-XXX for monitoring and display.

4. Power Outage:

a. After a power outage, the system shall automatically come back online

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value

J. INSTRUMENT RANGES:

Instrument	Range	Description

END OF SECTION

SECTION 17904

CONTROL STRATEGY FOR AERATION BASIN OPERATION

A. PURPOSE:

The aeration basins provide secondary wastewater treatment for carbonaceous BOD oxidation, nitrification and denitrification, depending on the operating mode. Biomass generated within the aeration basins is transferred to the secondary clarifiers, where it settles out and is either returned to the aeration basins or wasted from the system. Control of the aeration basins includes control of dissolved oxygen (DO) concentration, surface mixers, internal mixed liquor recycle (IMLR) pumps, aeration air flow to the diffusers, and various gates in the aeration basin channels for different operating modes.

B. REFERENCES:

1. P&ID: P-210, P-211, P-230, P-231
2. Mechanical Plan Drawing: M-210, M-211, M-212, M-230, M-231, M-232
3. Control Diagram: A, B, C, E, by Contractor
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 11236, 11266, 11294, 15103, 15185

C. SYSTEM DESCRIPTION:

1. Aeration Basin Process Description:

There are two existing aeration basins, Aeration Basin (AB) 1 and AB 2, each currently divided into a north and a south basin. Each of the south basins also includes a selector cell separated by baffle walls. Additional baffle walls will be added in AB 1 and AB 2 to create a plug flow system with six passes in-series in each basin. Two new basins (AB 3 and AB 4) will also be added with the same process volume and configuration as the two existing basins. The aeration basins can be operated in the following modes:

a. Nitrogen Removal Mode: The plant normally operates in nitrogen removal mode to produce the necessary effluent quality for water reclamation. Under this mode of operation, the system functions as a 4-stage system (anoxic-aerobic-anoxic-aerobic), with Passes 1 and 5 unaerated (anoxic stages) and Passes 2, 3, 4 and 6 aerated (aerobic stages). Primary effluent and RAS combine in the RAS mixing box and enter Pass 1 via three influent gates. Nitrified mixed liquor is pumped from Pass 4 back to Pass 1 for denitrification.

b. Sludge Reaeration Mode: Under high plant flow conditions, the system can operate in sludge reaeration mode to reduce solids loading to the secondary clarifiers. When the system is operating in sludge reaeration mode, it does not provide nitrogen removal. All passes are aerated. Primary effluent and RAS enter separately into the basins, with primary effluent routed directly to Pass 2 via the primary effluent channel and RAS routed to Pass 1. Agitation air is provided in the primary effluent channels via coarse bubble diffusers to keep solids suspended in the channels. The IMLR pumps are not operated.

c. Summer Nitrification Mode: This is the mode of operation in the summer when the plant is not producing reclaimed water and thus does not need to provide total nitrogen removal. The system provides nitrification to reduce ammonia discharge in the effluent and denitrification for alkalinity recovery and aeration energy reduction. Pass 1 is unaerated and serves as the anoxic selector, while the remaining passes are aerated. Primary effluent and RAS combine in the RAS mixing box and enter Pass 1. Nitrified mixed liquor is pumped from Pass 4 back to Pass 1 for denitrification.

d. Winter Anaerobic Selector Mode: This is the mode of operation in the winter when the plant is not producing reclaimed water and thus does not need to provide total nitrogen removal. The system operates at low SRT to minimize nitrification. Pass 1 is unaerated and serves as the anaerobic selector for bulking control. Primary effluent and RAS combine in the RAS mixing box and enter Pass 1. The IMLR pumps are not operated.

e. Step Feed Mode: TBD

The modes of operation described above are manually controlled via valves and gates and operation of equipment as outlined in 17905.

2. Aeration and DO Control:

Aeration air is supplied by four aeration blowers to each pass through a dedicated aeration dropleg and fine pore diffusers installed at the bottom of the basin. For each basin, a single aeration air supply header supplies air to the aeration droplegs. An air flow meter along the basin air supply header measures the total air flow to each basin. Each basin is equipped with three air flow control valves to control combined air flows to Passes 1 and 2, combined air flows to Passes 3 and 4 and combined air flows to Passes 5 and 6. Each dropleg also has a manual valve to provide shutoff and flow adjustment if needed. Under nitrogen removal, summer nitrification, and winter anaerobic selector modes, no air is supplied to Pass 1 (manual valve in closed position); and under nitrogen removal mode, no air is supplied to Pass 5 also (manual valve in closed position). Each basin has three dissolved oxygen (DO) analyzer probes installed in Passes 2, 4, and 6. The DO analyzer probes continuously monitor DO concentrations.

Control of the aeration basin air control valves is integrated with the control of the aeration blowers (see Section 17907). Each control valve is associated with a DO analyzer in the basin (e.g., control valve for Passes 1 and 2 associated with DO analyzer in Pass 2 etc). Based on the measured DO concentration, the position of the control valve is adjusted to achieve the desired the DO set point. Because DO measurements could potentially fluctuate widely within a short interval depending on the sensitivity of the DO analyzer probe, running averages of DO concentrations (e.g. 1-minute period) is used to ensure a more stable valve and consequently blower operation. DO control is cascaded with control of the blowers by maintaining a constant blower discharge manifold pressure or via the "most open valve" control scheme, where the header pressure set point is adjusted downward until one of the control valves at the basins is at its most open valve position for controllability.

3. Surface Mixers:

Passes 1 and 5 in each basin are each equipped with two surface mixers to keep the mixed liquor suspended when these passes are unaerated (under nitrogen control, summer nitrification or winter anaerobic selector mode). Under those conditions, the mixers operate continuously. The air must be shut off before the mixers are turned on. When these passes are aerated (under other modes of operation), the mixers are turned off.

4. Internal Mixed Liquor Recycle Pumps:

One IMLR pump is located in Pass 4 of each aeration basin and piped to return nitrified mixed liquor back to the Pass 1 for denitrification. The IMLR pump is a VFD-controlled, axial flow-type, and will operate during Nitrogen Removal and Summer Nitrification modes. Operation of the IMLR pumps is controlled based on the influent flow rate as measured by the influent flow meters. The pump flow rate is paced at a percent of the influent flow to each basin (measured total plant influent flow divided by number of basins in service), up to 4.1 mgd per basin.

D. EQUIPMENT:

1. Aeration Basin 1:

Equipment No.	Description
ME 2101	Aeration Basin 1 Diffuser Grid 1
ME 2102	Aeration Basin 1 Diffuser Grid 2
ME 2103	Aeration Basin 1 Diffuser Grid 3
ME 2104	Aeration Basin 1 Diffuser Grid 4
ME 2105	Aeration Basin 1 Diffuser Grid 5
ME 2106	Aeration Basin 1 Diffuser Grid 6
CV 2111	Aeration Basin 1 Air Control Valve 1
CV 2112	Aeration Basin 1 Air Control Valve 2
CV 2113	Aeration Basin 1 Air Control Valve 3
MXR 2115	Aeration Basin 1 Activated Sludge Mixer 1
MXR 2116	Aeration Basin 1 Activated Sludge Mixer 2
MXR 2117	Aeration Basin 1 Activated Sludge Mixer 3
MXR 2118	Aeration Basin 1 Activated Sludge Mixer 4
SLG 2121	Aeration Basin 1 Channel Slide Gate 1
SLG 2122	Aeration Basin 1 Pass 1 Slide Gate 1

SLG 2123	Aeration Basin 1 Pass 1 Slide Gate 2
SLG 2124	Aeration Basin 1 Pass 1 Slide Gate 3
SLG 2125	Aeration Basin 1 Channel Slide Gate 2
SLG 2126	Aeration Basin 1 Pass 2 Slide Gate 1
SLG 2127	Aeration Basin 1 Pass 2 Slide Gate 2
SLG 2128	Aeration Basin 1 Pass 2 Slide Gate 3
SLG 2129	Aeration Basin 1 Pass 3 Slide Gate 1
SLG 2130	Aeration Basin 1 Pass 3 Slide Gate 2
SLG 2131	Aeration Basin 1 Pass 3 Slide Gate 3
SLG 2132	Aeration Basin 1 Pass 3 to Pass 4 Slide Gate
SLG 2133	Aeration Basin 1 Pass 4 Slide Gate 1
SLG 2134	Aeration Basin 1 Pass 4 Slide Gate 2
SLG 2135	Aeration Basin 1 Effluent Channel Slide Gate
P 2140	Aeration Basin 1 Internal Mixed Liquor Recycle Pump

2. Aeration Basin 2:

Equipment No.	Description
ME 2151	Aeration Basin 2 Diffuser Grid 1
ME 2152	Aeration Basin 2 Diffuser Grid 2
ME 2153	Aeration Basin 2 Diffuser Grid 3
ME 2154	Aeration Basin 2 Diffuser Grid 4
ME 2155	Aeration Basin 2 Diffuser Grid 5
ME 2156	Aeration Basin 2 Diffuser Grid 6
CV 2161	Aeration Basin 2 Air Control Valve 1
CV 2162	Aeration Basin 2 Air Control Valve 2
CV 2163	Aeration Basin 2 Air Control Valve 3
MXR 2165	Aeration Basin 2 Activated Sludge Mixer 1
MXR 2166	Aeration Basin 2 Activated Sludge Mixer 2
MXR 2167	Aeration Basin 2 Activated Sludge Mixer 3
MXR 2168	Aeration Basin 2 Activated Sludge Mixer 4
SLG 2171	Aeration Basin 2 Channel Slide Gate 1
SLG 2172	Aeration Basin 2 Pass 1 Slide Gate 1
SLG 2173	Aeration Basin 2 Pass 1 Slide Gate 2
SLG 2174	Aeration Basin 2 Pass 1 Slide Gate 3
SLG 2175	Aeration Basin 2 Channel Slide Gate 2
SLG 2176	Aeration Basin 2 Pass 2 Slide Gate 1
SLG 2177	Aeration Basin 2 Pass 2 Slide Gate 2
SLG 2178	Aeration Basin 2 Pass 2 Slide Gate 3
SLG 2179	Aeration Basin 2 Pass 3 Slide Gate 1
SLG 2180	Aeration Basin 2 Pass 3 Slide Gate 2
SLG 2181	Aeration Basin 2 Pass 3 Slide Gate 3
SLG 2182	Aeration Basin 2 Pass 3 to Pass 4 Slide Gate
SLG 2183	Aeration Basin 2 Pass 4 Slide Gate 1
SLG 2184	Aeration Basin 2 Pass 4 Slide Gate 2
SLG 2185	Aeration Basin 2 Effluent Channel Slide Gate

P 2190	Aeration Basin 2 Internal Mixed Liquor Recycle Pump

3. Aeration Basin 3:

Equipment No.	Description
ME 2301	Aeration Basin 3 Diffuser Grid 1
ME 2302	Aeration Basin 3 Diffuser Grid 2
ME 2303	Aeration Basin 3 Diffuser Grid 3
ME 2304	Aeration Basin 3 Diffuser Grid 4
ME 2305	Aeration Basin 3 Diffuser Grid 5
ME 2306	Aeration Basin 3 Diffuser Grid 6
CV 2311	Aeration Basin 3 Air Control Valve 1
CV 2312	Aeration Basin 3 Air Control Valve 2
CV 2313	Aeration Basin 3 Air Control Valve 3
MXR 2315	Aeration Basin 3 Activated Sludge Mixer 1
MXR 2316	Aeration Basin 3 Activated Sludge Mixer 2
MXR 2317	Aeration Basin 3 Activated Sludge Mixer 3
MXR 2318	Aeration Basin 3 Activated Sludge Mixer 4
SLG 2321	Aeration Basin 3 Channel Slide Gate 1
SLG 2322	Aeration Basin 3 Pass 1 Slide Gate 1
SLG 2323	Aeration Basin 3 Pass 1 Slide Gate 2
SLG 2324	Aeration Basin 3 Pass 1 Slide Gate 3
SLG 2325	Aeration Basin 3 Channel Slide Gate 2
SLG 2326	Aeration Basin 3 Pass 2 Slide Gate 1
SLG 2327	Aeration Basin 3 Pass 2 Slide Gate 2
SLG 2328	Aeration Basin 3 Pass 2 Slide Gate 3
SLG 2329	Aeration Basin 3 Pass 3 Slide Gate 1
SLG 2330	Aeration Basin 3 Pass 3 Slide Gate 2
SLG 2331	Aeration Basin 3 Pass 3 Slide Gate 3
SLG 2332	Aeration Basin 3 Pass 3 to Pass 4 Slide Gate
SLG 2333	Aeration Basin 3 Pass 4 Slide Gate 1
SLG 2334	Aeration Basin 3 Pass 4 Slide Gate 2
SLG 2335	Aeration Basin 3 Effluent Channel Slide Gate
P 2340	Aeration Basin 3 Internal Mixed Liquor Recycle Pump

4. Aeration Basin 4:

Equipment No.	Description
ME 2351	Aeration Basin 4 Diffuser Grid 1
ME 2352	Aeration Basin 4 Diffuser Grid 2
ME 2353	Aeration Basin 4 Diffuser Grid 3
ME 2354	Aeration Basin 4 Diffuser Grid 4
ME 2355	Aeration Basin 4 Diffuser Grid 5
ME 2356	Aeration Basin 4 Diffuser Grid 6

CV 2361	Aeration Basin 4 Air Control Valve 1
CV 2362	Aeration Basin 4 Air Control Valve 2
CV 2363	Aeration Basin 4 Air Control Valve 3
MXR 2365	Aeration Basin 4 Activated Sludge Mixer 1
MXR 2366	Aeration Basin 4 Activated Sludge Mixer 2
MXR 2367	Aeration Basin 4 Activated Sludge Mixer 3
MXR 2368	Aeration Basin 4 Activated Sludge Mixer 4
SLG 2371	Aeration Basin 4 Channel Slide Gate 1
SLG 2372	Aeration Basin 4 Pass 1 Slide Gate 1
SLG 2373	Aeration Basin 4 Pass 1 Slide Gate 2
SLG 2374	Aeration Basin 4 Pass 1 Slide Gate 3
SLG 2375	Aeration Basin 4 Channel Slide Gate 2
SLG 2376	Aeration Basin 4 Pass 2 Slide Gate 1
SLG 2377	Aeration Basin 4 Pass 2 Slide Gate 2
SLG 2378	Aeration Basin 4 Pass 2 Slide Gate 3
SLG 2379	Aeration Basin 4 Pass 3 Slide Gate 1
SLG 2380	Aeration Basin 4 Pass 3 Slide Gate 2
SLG 2381	Aeration Basin 4 Pass 3 Slide Gate 3
SLG 2382	Aeration Basin 4 Pass 3 to Pass 4 Slide Gate
SLG 2383	Aeration Basin 4 Pass 4 Slide Gate 1
SLG 2384	Aeration Basin 4 Pass 4 Slide Gate 2
SLG 2385	Aeration Basin 4 Effluent Channel Slide Gate
P 2390	Aeration Basin 4 Internal Mixed Liquor Recycle Pump

E. OPERATOR CONTROLS:

Location	Controls

F. INSTRUMENTATION:

Tag Number	Description
FE 2110	Aeration Basin 1 Air Flow Meter
FIT 2110	Aeration Basin 1 Air Flow Transmitter
AE 2114A	Aeration Basin 1 Pass 2 Dissolved Oxygen Probe
AIT 2114A	Aeration Basin 1 Pass 2 Dissolved Oxygen Transmitter
AE 2114B	Aeration Basin 1 Pass 4 Dissolved Oxygen Probe
AIT 2114B	Aeration Basin 1 Pass 4 Dissolved Oxygen Transmitter
AE 2114C	Aeration Basin 1 Pass 6 Dissolved Oxygen Probe
AIT 2114C	Aeration Basin 1 Pass 6 Dissolved Oxygen Transmitter
FE 2160	Aeration Basin 2 Air Flow Meter
FIT 2160	Aeration Basin 2 Air Flow Transmitter
AE 2164A	Aeration Basin 1 Pass 2 Dissolved Oxygen Probe
AIT 2164A	Aeration Basin 2 Pass 2 Dissolved Oxygen Transmitter

AE 2164B	Aeration Basin 2 Pass 4 Dissolved Oxygen Probe
AIT 2164B	Aeration Basin 2 Pass 4 Dissolved Oxygen Transmitter
AE 2164C	Aeration Basin 2 Pass 6 Dissolved Oxygen Probe
AIT 2164C	Aeration Basin 2 Pass 6 Dissolved Oxygen Transmitter
FE 2310	Aeration Basin 3 Air Flow Meter
FIT 2310	Aeration Basin 3 Air Flow Transmitter
AE 2314A	Aeration Basin 3 Pass 2 Dissolved Oxygen Probe
AIT 2314A	Aeration Basin 3 Pass 2 Dissolved Oxygen Transmitter
AE 2314B	Aeration Basin 3 Pass 4 Dissolved Oxygen Probe
AIT 2314B	Aeration Basin 3 Pass 4 Dissolved Oxygen Transmitter
AE 2314C	Aeration Basin 3 Pass 6 Dissolved Oxygen Probe
AIT 2314C	Aeration Basin 3 Pass 6 Dissolved Oxygen Transmitter
FE 2360	Aeration Basin 4 Air Flow Meter
FIT 2360	Aeration Basin 4 Air Flow Transmitter
AE 2364A	Aeration Basin 4 Pass 2 Dissolved Oxygen Probe
AIT 2364A	Aeration Basin 4 Pass 2 Dissolved Oxygen Transmitter
AE 2364B	Aeration Basin 4 Pass 4 Dissolved Oxygen Probe
AIT 2364B	Aeration Basin 4 Pass 4 Dissolved Oxygen Transmitter
AE 2164C	Aeration Basin 4 Pass 6 Dissolved Oxygen Probe
AIT 2364C	Aeration Basin 4 Pass 6 Dissolved Oxygen Transmitter

G. ALARMS:

Tag Number	Description

H. OPERATION:

1. Air Flow Control Valves

a. Automatic: In AUTO, control the valve position based on maintaining a DO set point in an aeration basin pass which is entered in SCADA (1 to 5 mg/L). The PLC provides proportional-integral-derivative (PID) function block to maintain the DO set points. The PID output is contained during initial startup of the blowers to prevent the valves from full travel. If valve hunting is a problem (because of DO hysterisis), dampening shall be provided on the DO measurement. PID parameters are adjustable at SCADA.

b. Manual: In MANUAL, position the valve from SCADA.

c. SCADA will show valve position (% open)

2. Surface Mixers

a. Automatic: In AUTO, start and stop the mixer at SCADA.

b. Manual: in MANUAL, start and stop mixer at SCADA

c. When Running,

3. IMLR Pumps:

a. Automatic: In AUTO, the IMLR pumps operate continuously when the basin is in service and operating in nitrogen control or summer nitrification mode. Operation of the pumps is controlled based on the influent flow rate to each basin calculated as the total plant influent flow rate divided by the total number of basins in service.. Flow rate of the recycled mixed liquor is paced at a pre-set percentage of the measured influent flow, up to 4.1 mgd per basin, and is controlled by varying the speed of the IMLR pump using a VFD. For example, if the plant influent flow is 5 mgd with 4 basins in service (1.25 mgd per basin) and the recycle rate is set at 300%, then the IMLR pump speed is set to recycle 3.75 mgd back to Pass 1.

b. Manual: The IMLR Pumps run continuously when the HOA switch is in the HAND position. The pump will operate at a speed set by the operator in SCADA. The pump is stopped when the HOA switch is in the OFF position. In SCADA manual, operator has start, stop, and speed control via SCADA.

c. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display

4. Slide Gates:

All slide gates at the aeration basins are manual gates. A number of slide gates are opened or closed to allow a certain mode of operation for the aeration basins. The following table outlines the status for these gates under the different modes of operation.

Status	AB 1	AB 2	AB 3	AB 3
Nitrogen Removal/Summer Nitrification/Winter Anaerobic Selector Modes				
Closed	SLG 2121	SLG 2171	SLG 2321	SLG 2371
Opened	SLG 2122	SLG 2172	SLG 2322	SLG 2372
Opened	SLG 2123	SLG 2173	SLG 2323	SLG 2373
Opened	SLG 2124	SLG 2174	SLG 2324	SLG 2374
Closed	SLG 2125	SLG 2175	SLG 2325	SLG 2375
Closed	SLG 2126	SLG 2176	SLG 2326	SLG 2376
Closed	SLG 2127	SLG 2177	SLG 2327	SLG 2377
Closed	SLG 2128	SLG 2178	SLG 2328	SLG 2378
Closed	SLG 2129	SLG 2179	SLG 2329	SLG 2379
Closed	SLG 2130	SLG 2180	SLG 2330	SLG 2380
Closed	SLG 2131	SLG 2181	SLG 2331	SLG 2381
Opened	SLG 2132	SLG 2182	SLG 2332	SLG 2382
Closed	SLG 2133	SLG 2183	SLG 2333	SLG 2383

Closed	SLG 2134	SLG 2184	SLG 2334	SLG 2384
Sludge Reaeration Mode				
Opened	SLG 2121	SLG 2171	SLG 2321	SLG 2371
Closed	SLG 2122	SLG 2172	SLG 2322	SLG 2372
Closed	SLG 2123	SLG 2173	SLG 2323	SLG 2373
Closed	SLG 2124	SLG 2174	SLG 2324	SLG 2374
Closed	SLG 2125	SLG 2175	SLG 2325	SLG 2375
Closed	SLG 2126	SLG 2176	SLG 2326	SLG 2376
Opened	SLG 2127	SLG 2177	SLG 2327	SLG 2377
Opened	SLG 2128	SLG 2178	SLG 2328	SLG 2378
Closed	SLG 2129	SLG 2179	SLG 2329	SLG 2379
Closed	SLG 2130	SLG 2180	SLG 2330	SLG 2380
Closed	SLG 2131	SLG 2181	SLG 2331	SLG 2381
Opened	SLG 2132	SLG 2182	SLG 2332	SLG 2382
Closed	SLG 2133	SLG 2183	SLG 2333	SLG 2383
Closed	SLG 2134	SLG 2184	SLG 2334	SLG 2384

5. Power Outage:

a. When utility power returns, the system shall automatically come back online.

b. In the event of a power outage, …

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value

J. INSTRUMENT RANGES:

Instrument	Range	Description

END OF SECTION

SECTION 17905

CONTROL STRATEGY FOR RETURN ACTIVATED SLUDGE MIXING BOX (INCLUDES WASTE ACTIVATED SLUDGE PUMPING)

A. PURPOSE:

The Return Activated Sludge (RAS) mixing box provides a location where the RAS streams from the secondary clarifiers combine before it mixes with the primary effluent and split among the aeration basins in operation. Because the aeration basins can operate in four distinct operating modes depending(Nitrogen Removal, Sludge Reaeration, Summer Nitrification, and Winter Anaerobic Selector modes as described in Section 17904), the RAS mixing box enables these operating modes through gates controlling flow distribution and mixing of Primary Effluent (PE) and RAS. Gate settings in the RAS Mixing Box are the same when operating in Nitrogen Removal, Summer Nitrification and Winter Anaerobic Selector modes. Mixing of PE and RAS is prevented during the Sludge Reaeration and Step Feed modes.

Waste Activated Sludge (WAS) is wasted from the secondary treatment system from the RAS Mixing Box. The WAS pumps remove solids from the secondary process at the rate necessary to provide the required sludge age and biomass inventory. Sludge wasting from the RAS Mixing Box is continuous, and the solids are pumped to the Rotary Drum Thickeners. The system also serves to remove larger quantities of biomass when necessary during a process change.

The RAS mixing box also serves as one of the dosing point for methanol as a supplemental carbon. Addition of methanol to the primary effluent or combined primary effluent and RAS enhances denitrification in the first anoxic zone (Pass 1) of each aeration basin in service. The control strategy for methanol addition is given in Section 17908.

B. REFERENCES:

1. P&ID: P-220 and P-221
2. Mechanical Plan Drawing: M-220
3. Control Diagram: A, B, C, E, by Contractor
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 11105, 11269, 11385

C. SYSTEM DESCRIPTION:

Slide gates within the RAS Mixing Box are controlled manually according to the operational mode of the aeration basins.

In the existing system, the existing WAS pumps take suction for the RAS pipeline from Secondary Clarifiers 1 and 2 located in the utilidor. In the modified system, the existing WAS pumps (P 2531, P 2532) will be used for draining aeration basins 1 and 2 only. Two new WAS pumps (P 2201, P 2202) will be installed in the new RAS Mixing Box which will allow wasting of a uniformly mixed RAS. Space for a future third pump is provided.

Manipulation of the WAS flow rate is the primary method for controlling the sludge retention time (SRT) in the secondary system. SRT is an important process parameter that impacts nutrient removal performance, aeration demands and sludge settleability, among others. SRT is a calculation of the total amount of solids in the aeration basins, divided by the rate at which they are removed from the system (in the WAS and the secondary effluent). Therefore, SRT control requires knowledge of the total suspended solids (TSS) concentration in the mixed liquor and RAS.

To determine the operating point for the two WAS pumps (1 duty, 1 standby), the total solids inventory in the aeration basins is calculated from the TSS concentrations of grab mixed liquor collected on the previous day and the total volume of all basins in service. Based on the desired SRT and the TSS concentration of RAS grab samples, the required wastage rate and thus WAS flow rate are calculated. TSS concentrations of the secondary effluent may also be included in this calculation to account for solids leaving the system in the effluent. WAS pump speed will then be adjusted automatically to match the desired WAS flow rate.

In the event that the Rotary Drum Thickening system is offline, WAS will be redirected to the Gravity Thickeners. Control of this interlocking strategy is detailed in Section 17901.

D. EQUIPMENT:

Equipment No.	Description
P 2201	WAS Pump 1
P 2202	WAS Pump 2
MXR 2210	RAS Mixing Box Mixer 1
MXR 2211	RAS Mixing Box Mixer 2
SLG 2220	RAS Mixing Box Mode Control Slide Gate
SLG 2221	RAS Mixing Box AB 1 PE Slide Gate 1
SLG 2222	RAS Mixing Box AB 2 PE Slide Gate 2
SLG 2223	RAS Mixing Box AB 3 PE Slide Gate 3
SLG 2224	RAS Mixing Box AB 4 PE Slide Gate 4
SLG 2225	RAS Mixing Box AB 5 PE Slide Gate 5
SLG 2226	RAS Mixing Box AB 6 PE Slide Gate 6
SLG 2227	RAS Mixing Box AB 1 RAS Slide Gate 1
SLG 2228	RAS Mixing Box AB 2 RAS Slide Gate 2
SLG 2229	RAS Mixing Box AB 3 RAS Slide Gate 3
SLG 2230	RAS Mixing Box AB 4 RAS Slide Gate 4
SLG 2231	RAS Mixing Box AB 5 RAS Slide Gate 5
SLG 2232	RAS Mixing Box AB 6 RAS Slide Gate 6

E. OPERATOR CONTROLS:

Location	Controls

F. INSTRUMENTATION:

Tag Number	Description
AE 2201	WAS Pump P 2201 Temperature Sensor
AE 2202	WAS Pump P 2202 Temperature Sensor
FE 2205	WAS Flow Meter
FIT 2205	WAS Flow Transmitter
AE 2212	RAS Mixing Box Ultrasonic Level Sensor

G. ALARMS:

Tag Number	Description

H. OPERATION:

1. Slide Gates

Slide gates are operated manually and are used to isolate aeration basins and to enable the basins to operate in different modes.

a. Aeration Basin On/Off Operation: Manual control of slide gates in the RAS Mixing Box is used to isolate aeration basins for maintenance and to bring additional aeration basins online in response to influent flow conditions. The catalog of gates associated with each aeration basin is as follows:

Aeration Basin	Gates
AB 1	SLG 2221, SLG 2227
AB 2	SLG 2222, SLG 2228
AB 3	SLG 2223, SLG 2229
AB 4	SLG 2224, SLG 2230

b.Nitrogen Removal, Summer Nitrification and Winter Anaerobic Selector Modes:

Under these modes of operation, PE and RAS are mixed in the RAS Mixing Box and delivered to the aeration basins. The combined PE/RAS blend is delivered to the first anoxic zone (Pass 1) of each basin. Assuming all aeration basins are online, the status of critical equipment and gates is as follows:

RAS Mixing Box	Status
SLG 2220	OPEN
SLG 2221	OPEN

SLG 2222	OPEN
SLG 2223	OPEN
SLG 2224	OPEN
SLG 2227	CLOSED
SLG 2228	CLOSED
SLG 2229	CLOSED
SLG 2230	CLOSED

3. Sludge Reaeration Mode:

Under Sludge Reaeration mode, PE and RAS are routed separately from the RAS Mixing Box to the aeration basins. PE is introduced to Pass 2 and RAS enters Pass 1 of the aeration basins. Assuming all aeration basins are online, the status of critical equipment and gates is as follows:

RAS Mixing Box	Status
SLG 2220	CLOSED
SLG 2221	OPEN
SLG 2222	OPEN
SLG 2223	OPEN
SLG 2224	OPEN
SLG 2227	OPEN
SLG 2228	OPEN
SLG 2229	OPEN
SLG 2230	OPEN

4. Mixers

Submersible mixers MX 2210 and MX 2211 are controlled locally by ON/OFF selectors located immediately adjacent to the mixer, at the equipment pad. No REMOTE control is provided for these mixers. It is expected that these mixers will always be ON, unless a mechanical problem occurs with the mixer. Therefore, only status indication ON/OFF is displayed through SCADA.

a. Automatic: Not Applicable

b. Manual: The mixer runs continuously when the local disconnect switch is ON. The mixer is stopped when the switch is in the OFF position.

c. When Running, a SYSTEM RNG signal XX XXXX is received at PLC-XXXX for monitoring and display.

5. WAS Pumping

Automatic: In the AUTO position, the WAS pumps operate continuously. Operation of the pumps is controlled based on the required WAS flow rate calculated in SCADA to achieve the desired SRT. TSS concentrations of the mixed liquor and RAS are entered manually into SCADA based on grab sampling results. The speed of the WAS pump is varied via the VFD to achieve the desired flow rate.

Interlocks: In the AUTO positions, the WAS Pumps will stop operation based on the following:

- High motor winding temperature (TSH XXXX); hardwired
- High outlet pressure (PSH XXXX); hardwired

b. Manual: The WAS Pumps run continuously when the HOA switch is in the HAND position. The pump will operate at a speed set by the operator in SCADA. The pump is stopped when the HOA switch is in the OFF position. In SCADA manual, operator has start, stop, and speed control via SCADA.

c. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display

6. Power Outage:

a. When utility power returns, the system shall automatically come back online.

b. In the event of a power outage, …

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value

J. INSTRUMENT RANGES:

Instrument	Range	Description

END OF SECTION

SECTION 17906

CONTROL STRATEGY FOR FOAM WASTING STATION

A. PURPOSE:

Activated sludge systems periodically experience excessive foaming likely induced by foam causing organisms and possibly also by industrial discharge. The purpose of the Foam Wasting Station is to allow for periodic removal of the foam associated with pollutants in the industrial discharge, such as surfactants. Surfactants, also known as surface-active agents, are slightly soluble large organic molecules that often cause foaming in the aeration basins of wastewater treatment plants. They adhere to the surface of air bubbles and can thus lead to the creation of a stable foam. At the Central Kitsap Treatment Plant, this foam can be removed from the mixed liquor stream by wasting from the free water surface in the Mixed Liquor Distribution Channel, which prevents the foam from reaching the secondary clarifiers. Aeration in the mixed liquor channel keeps the surfactant-based foam near the mixed liquor surface, and the surfactant-rich liquid can be removed by wasting only from the surface (approximately top 1-2 inches). The collection and removal of the mixed liquor/foam is accomplished by a baffle, downward-opening weir gate, and submersible pump. The baffle collects the foam and prevents it from reaching the secondary clarifies; the gate allows only the surface layer to enter a sump; and the pump then transfers the mixed liquor and foam to the solids handling process (Gravity Thickeners).

B. REFERENCES:

1. P&ID: P-250
2. Mechanical Plan Drawing: M-250
3. Control Diagram: A, B, C, E, by Contractor
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 11346

C. SYSTEM DESCRIPTION:

The Foam Wasting Station system is installed to allow for periodic removal of foam caused by industrial discharges to the Central Kitsap Treatment Plant. The foam wasting system consists of one downward-opening weir gate, a spray system, and a submersible pump. Combined with the bulk fluid movement, sprayers mounted along the Mixed Liquor Distribution Channel help direct floatable material to the weir gate, while spray nozzles in the sump help collapse the foam and facilitate pumping. A hand switch will be used for manual operation of the submersible pump, which delivers the collection of scum, foam and mixed liquor to the Gravity Thickeners, where it can be removed by the existing scum boxes and delivered to the Digesters. Gate operation will be manual due to the anticipated irregularity of use (i.e., the system will only need to be used when there is a pollutant induced foam build-up in the aeration basins).

1. Manual Operation:

The Foam Wasting Station is designed to operate only on occasions when there is excessive foam build-up in the aeration basins, and use of the system is at the discretion of the operator. Accordingly, both the downward-opening weir gate and the submersible pump will be manually controlled. During foaming events, the operator can manually lower the weir and waste all of the foam in the Mixed Liquor Distribution Channel, and then raise the weir. The weir should be lowered just enough to waste the top layer of mixed liquor into the Foam Wasting Station sump, approximately 1 to 2 inches. Note that lowering the weir too much will cause the overflow to exceed pump capacity and would result in wasting more mixed liquor than foam, while also unnecessarily increasing the load to the Gravity Thickeners. This scenario should be avoided. The pump is manually activated via a hand switch to empty the sump and will be turned off automatically when the sump reaches a low level or when the pump runs dry (based on low pump motor amps). Additionally, the pump will be on a timer to prevent continuous wasting and load to the GTs. The sump should remain empty when the Foam Wasting Station is not in use to reduce potential odors.

D. EQUIPMENT:

Equipment No.	Description
P 2500	Foam Wasting Pump
SG 2501	Foam Wasting Slide Gate

E. OPERATOR CONTROLS:

Location	Controls

F. INSTRUMENTATION:

Tag Number	Description
PI 2500	Foam Wasting Pump Discharge Pressure Gauge
TSH 2502	Motor Winding Temperature Switch High
PSH 2502	Pump Outlet Pressure Switch High
LSH 2502	Sump Level Switch Low (Float)

G. ALARMS:

Tag Number	Description

H. OPERATION:

1. Foam Wasting Pump

a. The foam wasting pump can be turn on manually with a hand switch. The pump will turn off based on low level, timer, or low pump motor amps.

Interlocks: The pump will turn off based on high discharge pressure

2. Foam Wasting Station Slide Gate

a. The gate can be opened and closed manually with the hand wheel.

3. Power Outage:

a. When utility power returns, the system shall automatically come back online.

b. In the event of a power outage, …

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value
Pump run timer	10 min

J. INSTRUMENT RANGES:

Instrument	Range	Description

END OF SECTION

SECTION 17907

CONTROL STRATEGY FOR AERATION BLOWERS

A. PURPOSE:

The aeration blowers supply air to the aerated passes in Aeration Basins 1, 2, 3 and 4 for process aeration. Agitation air for the primary effluent and mixed liquor channels are supplied by the channel air blowers.

B. REFERENCES:

1. P&ID: P-203, P-204
2. Mechanical Plan Drawing: M-203
3. Control Diagram: A, B, C, E, by Contractor
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 11488

C. SYSTEM DESCRIPTION:

The original blower system includes three multi-stage centrifugal blowers supplying air to the fine pore diffusers in the aeration basins. One of these blowers is replaced with a new high-speed turbo blower and another high-speed turbo blower is added as the fourth blower. Each blower is actually a blower system, which includes the blower and other equipment that make up the blower system, such as the motor, vibration and temperature monitors, surge control valve, inlet control valve (for the multi-stage centrifugal blowers) and variable speed drive (for the high-speed turbo blowers). Ambient air is pulled from outside the Power/Blower Building through the blower inlet filter dedicated to each blower (outside at the pipe intake for the multi-stage centrifugal blowers and inside within the blower enclosure for the high-speed turbo blowers) and the blowers discharge to a common manifold.

Blower operation is sequenced to operate one of the high-speed turbo blowers at low aeration demand, both high-speed turbo blowers or a combination of one high-speed turbo blower and one multi-stage centrifugal blower at higher aeration demand when it exceeds the capacity of one blower, and a combination of two high-speed turbo blowers and one multi-stage centrifugal blower at peak aeration demand when it exceeds the capacity of two blowers. The second multi-stage centrifugal blower will serve as the standby blower. Because the multi-stage centrifugal blowers operate most efficiently at the design rated capacity, they will operate at this constant flow rate (when the discharge pressure remains the same) while the high-speed turbo blowers will operate at variable speed to meet the air flow requirements.

Automatic control of the aeration blowers is integrated with dissolved oxygen (DO) control at the aeration basins (see Section 17904). Blower control involves control of the aeration basin air control valves via the DO set points and adjustment of the blower output volume via a blower discharge manifold pressure set point. The manifold pressure set point could be constant or variable if the “most open valve” control scheme is employed. In the latter case, the pressure set point is adjusted downward until one of the control valves at the basins is at its most open valve position for controllability.

D. EQUIPMENT:

Equipment No.	Description
B 2003	Aeration Blower 3
FLT 2003	Aeration Blower 3 Inlet Filter
CV 2003A	Aeration Blower 3 Inlet Control Valve
CV 2003B	Aeration Blower 3 Blowoff Control Valve
S 2003	Aeration Blower 3 Blowoff Silencer
B 2004	Aeration Blower 4
FLT 2004	Aeration Blower 4 Inlet Filter
CV 2004A	Aeration Blower 4 Inlet Control Valve
CV 2004B	Aeration Blower 4 Blowoff Control Valve
S 2004	Aeration Blower 4 Blowoff Silencer

E. OPERATOR CONTROLS:

Location	Controls

F. INSTRUMENTATION:

Tag Number	Description
PI 2003A	Aeration Blower 3 Inlet Pressure Indicator
PI 2003B	Aeration Blower 3 Discharge Pressure Indicator
PI 2004A	Aeration Blower 4 Inlet Pressure Indicator
PI 2004B	Aeration Blower 4 Discharge Pressure Indicator
PIT 2005	Aeration Blower Discharge Manifold Pressure Transmitter
TI 2006	Aeration Blower Discharge Manifold Temperature Indicator

G. ALARMS:

Tag Number	Description

H. OPERATION:

1. High-speed Turbo Blowers (B 2003 and B 2004):

Provide operation of the blower system in accordance to Section 11488.

a. Automatic: In AUTO mode, from the operator interface, press START SEQUENCE to enable PLC control to automatically start and stop blowers. Blower speed is adjusted automatically to maintain the manifold pressure set point.

b. Manual: In MANUAL, start and stop from the operator interface directly. This mode is normally used as a test mode to verify controls are configured correctly.

c. When running,

2. Multi-stage Centrifugal Blowers (B 2001 and B 2002):

b. Automatic: In AUTO mode, from the operator interface, press START SEQUENCE to enable PLC control to automatically start and stop blowers. Blower operates with the inlet valve in unthrottled position.

b. Manual: In MANUAL, start and stop from the operator interface directly. This mode is normally used as a test mode to verify controls are configured correctly.

c. When Running,

3. Surge Control:

4. Overload Protection:

5. Power Outage:

a. When utility power returns, the system shall automatically come back online.

b. In the event of a power outage, …

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value

J. INSTRUMENT RANGES:

Instrument	Range	Description

END OF SECTION

SECTION 17908

CONTROL STRATEGY FOR SUPPLEMENTAL CARBON ADDITION SYSTEM

A. PURPOSE:

The supplemental carbon addition system supplies methanol as supplemental carbon to the activated sludge system to enhance denitrification. Other types of supplemental carbon may be used in the future with the same equipment.

B. REFERENCES:

1. P&ID: P-240, P-241, P-242
2. Mechanical Plan Drawing: M-240
3. Control Diagram: A, B, C, E, by Contractor
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 11381, 13206

C. SYSTEM DESCRIPTION:

Under the nitrogen removal mode of operation for the activated sludge system, nitrification and denitrication take place in the aeration basins to produce the desired effluent quality for water reclamation. The denitrification process requires readily biodegradable organics and an adequate level of these organics must be available to reduce oxidized nitrogen (nitrate and nitrite) to the required level. For the Central Kitsap Treatment Plant, it was found that the influent wastewater stream does not contain adequate carbon for the required level of denitrification. Therefore, supplemental carbon is added to enhance denitrification. Methanol is selected as the supplemental carbon source. In the future, when other types of supplemental carbon (such as glycerine) become more cost-effective and available, then they may be used in place of or in combination with methanol.

The methanol storage and feed system includes a storage tank, metering pumps, control and manual valves, flow meters and other instrumentation for delivery of methanol to the activated sludge system. Methanol is mixed with plant water at the bulk storage area and conveyed to the addition points as a blended solution of carrier water and methanol. A 4-to-1 carrier water to methanol ratio is used. The blended solution is added to the secondary influent at the RAS mixing box and to Pass 5 (second anoxic zone) of each aeration basin in operation. Two chemical metering pumps (one as a standby) are provided for each of the two main delivery points (RAS mixing box and aeration basins). Separate pressure regulating valves, control valves, and rotameters are installed for each carrier water line to blend the correct ratio of carrier water with the metered methanol. Flow balancing among the basins is performed using manual valves and rotameters along the injection line to each basin.

Methanol dosing rate and the distribution between the RAS mixing box and aeration basin (Pass 5) injection points will be determined by operators through grab sampling of mixed liquor samples and review of the sampling data. In the future, an on-line nitrate analyzer may be used to provide more accurate feedback control of the methanol feed system.

D. EQUIPMENT:

Equipment No.	Description
T 2400	Methanol Storage Tank
CV 2400	Methanol Storage Tank Outlet Control Valve
P 2401	Methanol Metering Pump 1
PRV 2401	Methanol Metering Pump 1 Pressure Relief Valve
P 2402	Methanol Metering Pump 2
PRV 2402	Methanol Metering Pump 2 Pressure Relief Valve
P 2403	Methanol Metering Pump 3
PRV 2403	Methanol Metering Pump 3 Pressure Relief Valve
P 2404	Methanol Metering Pump 4
PRV 2404	Methanol Metering Pump 4 Pressure Relief Valve
PRV 2410	Methanol Solution Carrier Water Pressure Regulating Valve 1
CV 2411	Methanol Solution Carrier Water Control Valve 1
PRV 2420	Methanol Solution Carrier Water Pressure Regulating Valve 2
CV 2421	Methanol Solution Carrier Water Control Valve 2

E. OPERATOR CONTROLS:

Location	Controls

F. INSTRUMENTATION:

Tag Number	Description
LE 2400A	Methanol Storage Tank Level Sensor
LIT 2400A	Methanol Storage Tank Level Transmitter
PI 2401A	Methanol Metering Pump 1 Discharge Pressure Indicator
PSH 2401A	Methanol Metering Pump 1 Discharge Pressure Switch High
PI 2402A	Methanol Metering Pump 2 Discharge Pressure Indicator
PSH 2402A	Methanol Metering Pump 2 Discharge Pressure Switch High
PI 2403A	Methanol Metering Pump 3 Discharge Pressure Indicator
PSH 2403A	Methanol Metering Pump 3 Discharge Pressure Switch High
PI 2404A	Methanol Metering Pump 4 Discharge Pressure Indicator
PSH 2404A	Methanol Metering Pump 4 Discharge Pressure Switch High
FI 2411A	Methanol Solution Carrier Water Flow Indicator 1

PI 2411B	Methanol Solution Carrier Water Pressure Indicator 1
FI 2411C	Aeration Basin Methanol Solution Combined Flow Indicator
FI 2412	Aeration Basin 1 Methanol Solution Flow Indicator
FI 2413	Aeration Basin 2 Methanol Solution Flow Indicator
FI 2414	Aeration Basin 3 Methanol Solution Flow Indicator
FI 2415	Aeration Basin 4 Methanol Solution Flow Indicator
FI 2421A	Methanol Solution Carrier Water Flow Indicator 2
PI 2421B	Methanol Solution Carrier Water Pressure Indicator 2
FI 2421C	RAS Mixing Box Methanol Solution Flow Indicator

G. ALARMS:

Tag Number	Description

H. OPERATION:

1. Methanol Metering Pumps:

Methanol dosing rate is determined by operators based on process performance (daily composite effluent nitrate data and mixed liquor grab sampling nitrate data). When the effluent and mixed liquor nitrate concentrations are too high, then the total methanol dosing rate should be increased; when the nitrate concentrations are too low, then the total methanol dosing rate should be decreased. The split between dosing at the RAS mixing box and at Pass 5 of the aeration basins is adjusted to optimize the overall nitrate removal performance.

a. Automatic: In AUTO, the pumps are under control of the PLC. Pumps will run at a speed entered in the PLC.

b. Manual: In MANUAL, start and stop from the operator interface directly.

c. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display

2. Methanol Solution Carrier Water Control Valves:

Carrier water is blended with methanol at a ratio of 4 to 1. The carrier water flow through CV 2411 will be four times the methanol flow delivered by Methanol Metering Pumps 1 or 2, and the carrier water flow through CV 2421 will similarly be four times the methanol flow delivered by Methanol Metering Pumps 3 or 4. The control valve setting for a given carrier water flow rate is determined based on periodic calibration of flows through the valves using the rotameter installed on each carrier water line. A calibration curve will be developed and incorporated into the PLC to allow automatic adjustment of the valve setting at different carrier water flow rates.

a. Automatic: In AUTO, the control valves are under control of the PLC. Control valve setting will be adjusted automatically to provide the needed carrier water flow based on the calibration curve.

Interlocks: Metering pumps are interlocked with Methanol Storage Tank level and will stop pumping when tank level is at low setting.

b. Manual: In MANUAL, the control valve setting will be set from the operator interface directly.

c. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display

3. Power Outage:

a. When utility power returns, the system shall automatically come back online.

b. In the event of a power outage, …

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value

J. INSTRUMENT RANGES:

Instrument	Range	Description

END OF SECTION

SECTION 17909

CONTROL STRATEGY FOR CHANNEL AIR BLOWERS

A. PURPOSE:

The channel air blowers supply agitation air to the aeration basin and mixed liquor channels to keep solids in suspension. At the mixed liquor channel conveying the combined mixed liquor to the secondary clarifiers, the agitation air added also drives any biological foam to float to the liquid surface before it is removed by the classifying selector.

B. REFERENCES:

1. P&ID: P-254
2. Mechanical Plan Drawing: M-254
3. Control Diagram: A, B, C, E, by Contractor
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 11476

C. SYSTEM DESCRIPTION:

The original channel aeration blower system includes two rotary lobe blowers supplying air to the channels between the north and south aeration basins and to the mixing basins. The two blowers are 2-speed blowers and are located in the utilidor. Supply air for the blowers is drawn from inside the utilidor. In the modified configuration of aeration basins 1 and 2, the two mixing basins will be partially filled so that their bottom elevation will be the same as the channels. The walls in the channels between the east and west basins will be removed. New coarse bubble diffusers will be installed in the expanded channels. The existing blowers will remain, while new discharge air piping and headers will be installed. The discharge piping will be manifolded so that each blower can supply air to one or both of the aeration basin channels. The expanded channels will allow routing of the primary effluent to bypass Pass 1 of the aeration basins when operating in sludge reaeration mode. During other modes of operation (nitrogen removal, summer nitrification and winter anaerobic selector modes as described in Section 17904), the primary effluent and returned activated sludge (RAS) will combine in the RAS mixing box and enter directly into Pass 1 of each basin. In those cases, air supply to the channels will be turned off. The two existing blowers will be dedicated to supply air to these channels.

At aeration basins 3 and 4, primary effluent channels equipped with coarse bubble diffusers will similarly be included to route primary effluent directly to Pass 2 when the system is operating in sludge reaeration mode. Agitation air to the channels will be supplied by two new channel air blowers to be located outdoors north of the RAS mixing box. Similar to the operation of aeration basins 1 and 2, air supply to those channels will be turned off under other modes of operation.

In addition to the aeration basin channels, agitation air will also be supplied to the expanded mixed liquor channel north of aeration basin 1 and the new mixed liquor distribution channel conveying the combined mixed liquor to the secondary clarifiers. Air to these channels will be supplied continuously by the new channel air blowers.

The two new channel air blowers are connected to a common discharge manifold to allow the combined air flow to become split among the channels for Aeration Basins 3 and 4 and the mixed liquor channels. In the future when aeration basins 5 and 6 are constructed, two more blowers will be added to supply air to the channels at those basins. The blowers and valves are manually operated in accordance to the mode of operation and to balance air flows to the different channels and basins.

D. EQUIPMENT:

Equipment No.	Description
B2541	Channel Air Blower 1 (existing)
B2542	Channel Air Blower 2 (existing)
B 2543	Channel Air Blower 3
FLT 2543	Channel Air Blower 3 Inlet Filter
S 2543A	Channel Air Blower 3 Inlet Silencer
S 2543B	Channel Air Blower 3 Outlet Silencer
PRV 2543	Channel Air Blower 3 Pressure Relief Valve
B 2544	Channel Air Blower 4
FLT 2544	Channel Air Blower 4 Inlet Filter
S 2544A	Channel Air Blower 4 Inlet Silencer
S 2544B	Channel Air Blower 4 Outlet Silencer
PRV 2544	Channel Air Blower 4 Pressure Relief Valve

E. OPERATOR CONTROLS:

Location	Controls

F. INSTRUMENTATION:

Tag Number	Description
None	Channel Air Blower 1 Discharge Pressure Indicator (existing)
None	Channel Air Blower 2 Discharge Pressure indicator (existing)
PI 2543	Channel Air Blower 3 Discharge Pressure Indicator
PI 2544	Channel Air Blower 4 Discharge Pressure Indicator

G. ALARMS:

Tag Number	Description

H. OPERATION:

1. <u>Channel Air Blowers 1 and 2 (B 2541 and B 2542)</u>:
Channel Air Blowers 1 and 2 are operated when either one or both of aeration basins 1 and 2 are operating in sludge reaeration mode. Operation of these blowers is independent of Channel Air Blowers 3 and 4. When only one of those two basins is operating in sludge reaeration mode, then only one of the blowers will be turned on. Channel Air Blower 1 (B2541) supplies air to the channel at Aeration Basin 2, while Channel Air Blower 2 (B2542) supplies air to the channel at Aeration Basin 1. When both of those basins are operating in sludge reaeration mode, then both blowers are in service. Normally, the blowers should be operated in the high speed setting to provide sufficient agitation in the channels.

    a. <u>Automatic</u>: In AUTO, the blowers are under control of the PLC. The blowers in service will operate at the high speed setting.

    b. <u>Manual</u>: In MANUAL, start and stop from the operator interface directly. This mode is normally used as a test mode to verify controls are configured correctly.

    c. When running,

2. <u>Channel Air Blowers 3 and 4 (B2543 and B2544)</u>:
Channel Air Blowers 3 and 4 supply air to the mixed liquor channels and to Aeration Basins 3 and 4 when those basins are operating in sludge reaeration mode. Operation of these blowers is independent of Channel Air Blowers 1 and 2. When basins 3 and 4 are not operating in sludge reaeration mode, only Channel Air Blower 3 (B2543) will be turned on, which supplies air to the mixed liquor channels. When the basins are operating in sludge reaeration mode, both blowers will be turned on and the total air flow from the two blowers is split between the aeration basin channels and the mixed liquor channels.

    b. <u>Automatic:</u> In AUTO, the blowers are under control of the PLC.

    b. <u>Manual</u>: In MANUAL, start and stop from the operator interface directly. This mode is normally used as a test mode to verify controls are configured correctly.

    c. When Running,

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value

J. INSTRUMENT RANGES:

Instrument	Range	Description

END OF SECTION

SECTION 17910

CONTROL STRATEGY FOR RECLAIMED WATER FILTRATION FEED SYSTEM

A. PURPOSE:

The filtration feed system conveys plant secondary effluent from the ultraviolet disinfection effluent box to the influent channel of the reclaimed water filters at a variable flow rate. Flow rate is measured by a propeller meter in the pipeline that conveys the flow to the filters

B. REFERENCES:

1. P&ID: P-300, P-821
2. Mechanical Plan Drawing: M-310
3. Control Diagram:
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 11318

C. SYSTEM DESCRIPTION:

The filtration feed system includes three variable-speed vertical turbine pumps with space to add a fourth pump in the future. The existing ultraviolet disinfection effluent box serves as the wet well for the pumps. The effluent is conveyed to the influent channel of the filters through a buried pipeline. The flow rate to the reclaimed water filters is controlled manually or automatically by varying pump operating speed.

1. Feed Pumps:

The pumps are the vertical turbine type with can-type inlet wells. One smaller pump (jockey pump) with a capacity of about 1,100 gpm is provided to satisfy the flow demand for process water needs. Two large pumps (one duty, one standby) with a capacity of 2,900 gpm each are sized to match 50% of ultimate filter capacity. The future addition of another 2,900 gpm pump will provide a firm capacity of 8.2 mgd to match the ultimate filter capacity.

Flow rate is controlled manually or automatically. Options for automatic flow rate control include pumping at a selected percentage (less than 100%) of plant flow or at a selected percentage (greater than 100%) of process water demand.

2. Wet Well:

To improve pump inlet conditions, can-type inlet wells will be included with the pumps. A baffle between the pumps and the disinfection channel prevents entrained air bubbles from entering the pump area. A weir/slide gate at the effluent end of the wet well maintains a minimum water surface elevation to provide adequate submergence for the pumps and to reduce freefall at the effluent end of the disinfection channels.

D. EQUIPMENT:

Equipment No.	Description
P 3011	Reclaimed Water Feed Pump 1
P 3012	Reclaimed Water Feed Pump 2
P 3013	Reclaimed Water Feed Pump 3
SLG 3020	Reclaimed Water Feed Pump Slide Gate

E. OPERATOR CONTROLS:

Location	Controls
P 3011	P 3011 "HAND/OFF/AUTO" Selector
P 3012	P 3011 "HAND/OFF/AUTO" Selector
P 3013	P 3011 "HAND/OFF/AUTO" Selector

F. INSTRUMENTATION:

Tag Number	Description
LIT 3001	UV Effluent Box Level
FIT 8210	Reclaimed Water Filter Structure 1 Influent Flow

G. ALARMS:

Tag Number	Description
LAL 3001	UV Effluent Box Low Level

H. OPERATION:

1. Reclaimed Water Feed Pumps:

a. Automatic: In the AUTO position, the pump is under control of SCADA. From SCADA, the pump can be run manually to deliver a selected flow rate, as measured by FIT 8210 (filter feed flow rate). From SCADA, two automatic modes are available:

(1) Process Water Production. This mode is used with the jockey pump only. A setpoint (typically about 120%) is entered representing a percentage of process water flow demand. The pump then operates to maintain a flow at the set percentage of the process water demand. This ensures that excess reclaimed water is available for process water needs, accounting for loss through the backwash process.

(2) Plant Flow. This mode is used with the high flow pumps only. A setpoint (typically less than 90%) is entered representing a percentage of influent plant flow. The pump then operates to maintain a flow at the set percentage of influent plant flow. A setpoint of less than 100% ensures that the wet well is not pumped dry.

(3) In either of the above modes, if the wet well level (FIT 3001) drops below the weir elevation, control is transferred to level-based control to maintain a set water level in the wet well. Control transfers back to flow-based control if the pumping rate under level-based control exceeds the rate determined under the selected flow-based control.

(4) HIGH HIGH Level Override: If level in the filter influent channel exceeds a HIGH HIGH level, pumping rate is reduced to maintain influent channel level at HIGH HIGH.

b. Manual: The pump runs continuously when the HOA switch is in the HAND position. The pump will operate at a speed set by the operator in SCADA. The pump is stopped when the HOA switch is in the OFF position. In SCADA manual, operator has start, stop, and speed control via SCADA.

c. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value

J. INSTRUMENT RANGES:

Instrument	Range	Description

END OF SECTION

SECTION 17911

CONTROL STRATEGY FOR RECLAIMED WATER FILTRATION SYSTEM

A. PURPOSE:

The filtration system uses continuous up-flow sand filtration to remove particulate matter from the coagulated plant effluent stream to achieve the maximum 2-NTU requirement for Class A reclaimed water specified in the Washington State Water Reuse Guidelines. Particle removal during filtration also provides further insurance that the 30 mg/L suspended solids limit for Class A reclaimed water is met.

B. REFERENCES:

1. P&ID: P-821, P-822
2. Mechanical Plan Drawing:
3. Control Diagram:
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 11825

C. SYSTEM DESCRIPTION:

A single concrete structure contains 6 filters; each filter is composed of 2 modules. The filters are intermittent, backwash, countercurrent, up-flow sand filters. Secondary effluent is distributed to the filters via a common influent channel. Filtered effluent flows over a weir from each filter into a common effluent channel.

1. Filter Feed Supply:

Coagulated secondary effluent (CSE) is pumped to the influent channel, which runs the length of the filtration structure and is higher than the filter water surface to provide distribution head. Refer to Control Strategy 17910 for feed system control. A manually operated slide gate at the entrance to each filter allows isolation of each individual unit for maintenance.

2. Sand Filter:

The reclaimed water filters are capable of continuous operation without interruption of the filtration process for backwashing. Water flows continuously up through each filter media bed while the filter media laden with removed solids travels counter to this flow toward the bottom of each filter. An air lift/air scour system lifts media and solids to the top of the filter into a wash chamber for cleansing (removal of solids) and subsequent return of the media to the top of the filter media bed. Filtered secondary effluent (FSE) flows through the wash chambers to backwash and remove solids from the filter media. Backwash waste flows over a weir in each filter and exits the filter, carrying solids removed in the filtration process to the plant drain system. The backwash waste flow is supplied from the filtered secondary effluent above the filter media, as long as the filter is operating and producing filtered secondary effluent. Filtered secondary effluent (less the flow lost to backwash) flows over an effluent weir and into a common effluent channel. Each filter has an approximate maximum production rate of 400 gpm. Six filters are provided to achieve the maximum production rate of 2,400 gpm or approximately 3.5 mgd.

The entire filtration system is provided as a vendor package. The package includes the filters, an air control panel, a backwash flow reduction system utilizing a PLC and sand motion sensor, an air compressor for the air lift system, isolation slide gates, and pressure and water level sensors.

3. Air Lift/Air Scour System:

The air lift /air scour system is provided as an integral feature of the filter package. It transfers sand and solids from the bottom of the filter to the washing chamber for cleansing. The air lift also provides an air scouring action that assists in the separation and removal of solids from the filter media. The air lifts use air jets to lift and scour the sand as it travels through a transfer pipe from the bottom of the filter to the wash chamber. An air compressor/receiver and desiccant dryer supplies the air to each filter. The air passes through a filter, dryer, and pressure regulator housed in the air lift control panel. The filtered, dried, and pressure-regulated air supply continues through a rotameter and valve assembly contained in the air control panel for each filter before it reaches the air jet at the bottom of the filter. The air flow rate to each filter is indicated on the rotameter (located on the control panel) and can be adjusted by hand. Air lift air pressure for each filter is also indicated in the air control panel. A solenoid valve stops the flow of air if a level switch at the top of the filter indicates that the flow of FSE over the filtrate weir of the filter has been interrupted. This feature stops the cycling of filter media through the filter whenever the flow of FSE is interrupted since there is not a supply of backwash water available for media cleansing under these circumstances. When the flow of water over the filtrate weir of the filter is resumed the normal flow of air is restored. A second solenoid valve is also opened to allow additional air to flow through the air jets for a short duration (controlled by a timer) when flow over the filtrate weir is resumed. The air flow rate is boosted whenever the air lift/air scour system resumes operation to dislodge or break loose the filter media and restore the movement of filter media through the air lift system. An air flow switch on the air supply piping upstream of the air lift mechanism relays a signal to the PLC indicating if air flow is present. Lack of air flow causes the PLC to initiate an alarm.

4. Backwash System:

A backwash system is included as part of the vendor package. The backwash system operates intermittently and is designed to reduce reject water and power consumption by 60 to 90 percent. It is controlled by a PLC located in a local control panel as part of the vendor package. Two modes are available: differential pressure and timer. The differential pressure mode has a timer override and the timer mode has a differential pressure override. The operator selects the mode and the setpoints at the PLC HMI. The PLC communicates with the plant SCADA system via Ethernet. When a backwash is initiated, a control valve on the backwash waste line opens and the air scour and airlift are started. When backwash is complete (based on timer or differential pressure setpoints), the air supply to the air lift system is shut off and the control valve on the backwash waste line closes.

5. Turbidity Measurement and Filter to Waste Operation:

The filtered secondary effluent exits the filter by flowing over a weir to a collection channel. A flow meter in the FSE pipeline transmits the production rate through the filter battery. A continuous-flow sample tap for analysis of turbidity is also included to insure that the 2 NTU Class A reclaimed water requirement has been met.

For this first phase of construction, there is no clearwell or distribution system. Consequently, all flow is conveyed to the filtrate-to-waste (FTW) pipeline. If the FSE turbidity exceeds 2 NTU, an alarm is initiated, but no automatic action takes place. In the next phase, with the addition of a clearwell and distribution system, a valve on the pipeline to the clearwell will be closed on a high turbidity signal and the effluent will be passed on to the FTW pipeline. The FTW pipeline discharges into the UV effluent box downstream of the filter feed pump wet well.

An elevated loop in the FTW pipeline serves two functions:

a) Maintain positive pressure in the FTW pipeline to force a flooded suction condition for the existing process water pumps, which will use the FTW as a water source. A pressure transducer on the FTW pipeline indicates head available on the suction side of the process water pumps.

b) In the future phase, the loop will provide hydraulic control of the FTW and overflow systems. If FSE production exceeds demand, the level in the clearwell will rise, forcing the level in the FTW loop to rise. Ultimately, the excess water will flow through the FTW pipeline to waste. Because chlorine will be injected downstream of the FTW connection to the FSE piping, the flow to the outfall will not be chlorinated, eliminating the need for dechlorination.

D. EQUIPMENT:

Equipment No.	Description
PNL 8200	Reclaimed Water Filter Control Panel
FLT 8201	Reclaimed Water Filter 1
PNL 8201	Reclaimed Water Filter 1 Air Panel
FLT 8202	Reclaimed Water Filter 2
PNL 8202	Reclaimed Water Filter 2 Air Panel
FLT 8203	Reclaimed Water Filter 3
PNL 8203	Reclaimed Water Filter 3 Air Panel

CP 8210	Reclaimed Water Filter Air Compressor
PNL 8210	Reclaimed Water Filter Air Compressor Panel
SLG 8221	Reclaimed Water Filter 1 Inlet Gate
SLG 8222	Reclaimed Water Filter 2 Inlet Gate
SLG 8223	Reclaimed Water Filter 3 Inlet Gate

E. OPERATOR CONTROLS:

Location	Controls
PNL 8200	PLC HMI. Refer to vendor package information.

F. INSTRUMENTATION:

Tag Number	Description
AE 8230	Reclaimed Water Filter Structure 1 Effluent Turbidity
FIT 8230	Reclaimed Water Filter Structure 1 Effluent Flow
LIT 8235	FTW Pipeline Water Level

G. ALARMS:

Tag Number	Description
AIT 8230	Reclaimed Water Filter Structure 1 Turbidity High
LIT 8235	FTW Pipeline Water Level Low
LIT 8200*	Reclaimed Water Filter Influent Channel Level High

*Part of filter vendor package

H. OPERATION:

1. Reclaimed Water Filters:

a. General Filter Operation: Each filter is brought on-line by manually opening the associated slide gate. Flow rate to the entire filter battery is controlled independently as described in Control Strategy 17910, Reclaimed Water Filtration Feed System. Backwash air flow rate is adjusted for each filter using a needle valve next to the rotameter in the air control panel for that filter. Air flow is stopped automatically when the liquid level sensor detects lack of flow over the effluent weir. Because all six filters are fed from a common channel and discharge to a common channel, there is no performance parameter measurement on individual units. Flow through an individual filter can be roughly estimated by observing the level of water flowing over the effluent weir.

b. Backwash System: The intermittent backwash system is controlled at the PLC located in the filter central control panel, PNL 8200. The operator selects the backwash initiation mode (timer or differential pressure) and the associated setpoints (backwash frequency, backwash duration, filter differential pressure). Differential pressure is measured by a transducer in the influent channel. Remote monitoring and alarms are communicated to the plant SCADA system.

2. Process Water Level Control:

The existing process water pumps are shut down on LOW LOW Level in the FTW pipeline.

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value

J. INSTRUMENT RANGES:

Instrument	Range	Description

END OF SECTION

SECTION 17912

CONTROL STRATEGY FOR RECLAIMED WATER COAGULATION SYSTEM

A. PURPOSE

The Reclaimed Water Coagulation System consists of metering Aluminum Chlorohydrate (ACH) for coagulation of UV-disinfected plant effluent prior to filtration. Coagulant is added to improve particle removal during the filtration process. Coagulant forms a chemical precipitate with colloidal particles in the water. The precipitate and the particulate matter agglomerate into larger particles through flocculation. The larger particles are more easily removed during filtration. The coagulant is injected upstream of an in-line mixer. The mixer causes a high turbulence zone for complete mixing of the plant effluent and the coagulant solution.

B. REFERENCES

1. P&ID: P-720, P-840, and P-821
2. Mechanical Plan Drawing:
3. Control Diagram:
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 11380, 11389, 11797

C. SYSTEMS DESCRIPTION

1. Coagulation System Storage Tank:

Bulk liquid coagulant solution will be delivered to the Sludge Processing Building by tanker trucks. The coagulant solution will be stored in an existing 800-gallon fiberglass tank. The tank is located inside a containment area designed to contain any chemical spills.

2. Coagulation System Transfer Pumps:

The Coagulation System Transfer Pumps are existing diaphragm pumps that draw the coagulant solution from the bulk liquid storage tank and transfer it to the new 110-gallon Coagulation System Day Tank located in the Reclaimed Water Building. There are two pumps: one duty and one stand-by. The pumps are controlled by the liquid level in the Day Tank.

3. Coagulation System Day Tank and Feed Pumping System:

The Reclaimed Water Coagulation System Pumps are positive displacement flexible tube pumps. The pumps draw the solution from the Coagulation System Day Tank and discharge it into the Reclaimed Water In-line Mixer, located in the Reclaimed Water Building. The pumps are set to deliver a dosage based on the Reclaimed Water Filter influent flow rate as measured by FIT 8210. A manual adjustment provides a means of adjusting the dosage. The coagulant solution is diluted with plant water to enhance mixing before entering the in-line mixer upstream of the Reclaimed Water Filters.

D. EQUIPMENT

Equipment description	Equipment number
Coagulation System Storage Tank	T 7201
Coagulation System Transfer Pump 1	P 7210
Coagulation System Transfer Pump 2	P 7220
Coagulation System Day Tank	T 8400
Reclaimed Water Coagulation System Pump 1	P 8401
Reclaimed Water Coagulation System Pump 2	P 8402
Coagulation System In-line Mixer	MXR 8212

E. OPERATOR CONTROLS

Location	Controls
P 7210	“HAND/OFF/AUTO” Selector
P 7220	“HAND/OFF/AUTO” Selector
P 8401	HMI
P 8402	HMI
MXR 8212	SCADA Control

F. INSTRUMENTATION

Tag Number	Description
PI 7210 (existing)	*Coagulation System Transfer Pump 1 Discharge Pressure Gauge*
PI 7220 (existing)	*Coagulation System Transfer Pump 2 Discharge Pressure Gauge*
FIT 8210	Reclaimed Water Flow Indicator Transmitter
FE	Reclaimed Water Flow Element
LIT 8400	Coagulation System Day Tank Level Indicator
LIT 8400	Coagulation System Day Tank Level Indicator Diaphragm
PI 8401	Reclaimed Water Coagulation System Pump 1 Discharge Pressure Gauge
PI 8402	Reclaimed Water Coagulation System Pump 2 Discharge Pressure Gauge
PI 8430	Plant Process Water Pressure Gauge
FI 8430	Plant Process Water Flow Indicator

G. ALARMS

Tag Number	Description
LIT 8400	Coagulation System Day Tank Level Indicator – High Level

H. OPERATION

1. Coagulation System Transfer Pumps:

a. Automatic: In the AUTO position, the pumps are under control of SCADA. From SCADA, the pumps run to deliver an operator-selected flow rate. The pumps run and stop as dictated by the operating level setpoints on the Coagulation System Day Tank. Once the low liquid level is reached, one pump will start transferring the ACH solution. When the high liquid level in the tank is reached, the pump will stop. The pumps will alternate operation.

b. Manual: The pump runs continuously when the HOA switch is in the HAND position. The pump will operate at a speed set locally by the operator. The pump is stopped when the HOA switch is in the OFF position. In SCADA manual, operator has start, stop, and speed control via SCADA.

c. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display

2 Reclaimed Water Coagulation System Pumps:

a. Automatic: In the AUTO position, the pump is under control of SCADA. From SCADA, the pump will be run to deliver a dosage based on the secondary effluent flowrate to the filters, as measured by FIT 8210.

b. Manual: The pump runs continuously when the local control is set to manual. The pump operates at a speed set locally by the operator. The pump is stopped when the local control is in the OFF position. In SCADA manual, operator has start, stop, and speed control via SCADA.

c. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value

J. INSTRUMENT RANGES:

Instrument	Range	Description

END OF SECTION

SECTION 17913

CONTROL STRATEGY FOR RECLAIMED WATER HYPOCHLORITE SYSTEM

A. PURPOSE

The Reclaimed Water Hypochlorite System includes the Hypochlorite Storage Tank and Transfer Pumps, and the Reclaimed Water Hypochlorite Day Tank and Metering Pumps. Sodium hypochlorite solution (hypochlorite or NaOCl) is used for reclaimed water filters maintenance purposes and in the future it will be used for the disinfection of the off-campus reclaimed water stream.

B. REFERENCES

1. P&ID: P-721, P-850, P-821, and P-300
2. Mechanical Plan Drawing:
3. Control Diagram:
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 11380, 11389

C. SYSTEMS DESCRIPTION

1. Hypochlorite System Storage Tank:

NaOCl solution (10 to 15 percent concentration) is stored in the existing Chemical Storage Area in the Sludge Processing Building. The existing tank is capable of storing up to 6,000 gallons and will be used for bulk storage. The NaOCl will be delivered to the Sludge Processing Building by tanker trucks. The tank is located inside a containment area designed to contain any chemical spills.

2. Hypochlorite Transfer Pump:

The Hypochlorite Transfer Pump is a new diaphragm type pump installed in the existing Sludge Processing Building. The pump draws the NaOCl solution from the bulk liquid storage tank and transfers it to the Hypochlorite System Day Tank located in the Reclaimed Water Building. The pump is controlled by the liquid level in the Day Tank, as measured by LIT 8500.

3. Reclaimed Water Hypochlorite System:

The Reclaimed Water Hypochlorite System is located in the new Reclaimed Water Building and includes a Hypochlorite Day Tank and Reclaimed Water Hypochlorite Metering Pumps. The day tank is of FRP construction and is capable of storing up to 350 gallons of NaOCl solution. The metering pumps are positive displacement flexible tube pumps. The pumps draw NaOCl solution from the day tank and discharge it to the secondary effluent pipeline immediately upstream of the Reclaimed Water In-line Mixer, located in the new Reclaimed

Water Building. The pumps are set to deliver a dosage based on the Reclaimed Water Filter influent flow rate, as measured by FIT 8210. The dosage can also be adjusted manually. A calibration column provides a means of calibrating the metering pumps. The NaOCl solution is diluted with plant water to enhance mixing before injecting into the filter influent flowstream.

D. EQUIPMENT

Equipment description	Equipment number
Sodium Hypochlorite Tank (existing)	*T 7300*
Reclaimed Water Hypochlorite Transfer Pump	P 7330
Hypochlorite Day Tank	T 8500
Reclaimed Water Hypochlorite Metering Pump 1	P 8501
Reclaimed Water Hypochlorite Metering Pump 2	P 8502

E. OPERATOR CONTROLS

Location	Controls
P 7330	"HAND/OFF/AUTO" Selector
P 8501	HMI
P 8502	HMI

F. INSTRUMENTATION

Tag Number	Description
PIT 7330	Reclaimed Water Hypochlorite Transfer Pump 1 Discharge Pressure
LIT 8500	Hypochlorite Day Tank Level Indicator
PI 8501	Reclaimed Water Hypochlorite Metering Pump 1 Discharge Pressure Gauge
PI 8503	Reclaimed Water Hypochlorite Metering Pump 1 Pulsation Dampener Pressure Gauge
PI 8502	Reclaimed Water Hypochlorite Metering Pump 2 Discharge Pressure Gauge
PI 8504	Reclaimed Water Hypochlorite Metering Pump 2 Pulsation Dampener Pressure Gauge
PI 8530	Plant Process Water Pressure Gauge
FI 8530	Reclaimed Water Hypochlorite System Flow Indicator

G. ALARMS

Tag Number	Description
LSH 8500	Hypochlorite Day Tank High Level

H. OPERATION

1. Reclaimed Water Hypochlorite Transfer Pump:

a. Automatic: In the AUTO position, the pump is under control of SCADA. From SCADA, the pump runs to deliver an operator-selected flow rate. The pump runs and stops as dictated by the operating level setpoints on the Hypochlorite Day Tank. When the liquid level in the day tank drops to the low setpoint, the pump starts. When the liquid level in the tank reaches the high setpoint, the pump stops.

b. Manual: The pump runs continuously at a speed set locally by the operator when the HOA switch is in the HAND position. The pump is stopped when the HOA switch is in the OFF position. In SCADA manual, operator has start, stop, and speed control via SCADA.

c. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display

2. Reclaimed Water Hypochlorite Metering Pumps:

a. Automatic: In the AUTO position, the pump is under control of SCADA. The pump runs to deliver a dosage proportional to the reclaimed water filter influent flowrate as measured by FIT 8210.

b. Manual: The pump runs continuously when the HOA switch is in the HAND position. The pump will operate at a speed set by the operator. The pump is stopped when the HOA switch is in the OFF position. In SCADA manual, operator has start, stop, and speed control via SCADA.

c. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display.

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value

J. INSTRUMENT RANGES:

Instrument	Range	Description

END OF SECTION

SECTION 17914

CONTROL STRATEGY FOR RECLAIMED WATER DECHLORINATION SYSTEM

A. PURPOSE

The Reclaimed Water Dechlorination System uses ascorbic acid to dechlorinate filtered effluent flowing to the outfall during periods when the filters are dosed with sodium hypochlorite.

B. REFERENCES

1. P&ID: P-300, P-860
2. Mechanical Plan Drawing:
3. Control Diagram:
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 11389

C. SYSTEMS DESCRIPTION

The Reclaimed Water Dechlorination System is located in the new Reclaimed Water Building, and includes an ascorbic acid drum (provided by Owner) and the Ascorbic Acid Metering Pump. The metering pump is a positive displacement flexible tube type pump. The pump draws ascorbic acid solution from the drum and discharges it into the filter-to-waste (FTW) stream through an in-line diffuser. The pumps are set to deliver a dosage that will be manually adjusted based on the hypochlorite dosage delivered to the filters. A calibration column provides a means of calibrating the pump. The ascorbic acid solution is diluted with plant water to enhance mixing before injecting it into the effluent flowstream.

D. EQUIPMENT

Equipment description	Equipment number
Ascorbic Acid Metering Pump	P 8601

E. OPERATOR CONTROLS

Location	Controls
P 8601	HMI

F. INSTRUMENTATION

Tag Number	Description

PI 8601	Ascorbic Acid Metering Pump Pulsation Dampener Pressure Gauge
PI 8630	Plant Process Water Pressure Gauge
FI 8620	Ascorbic Acid Flow Indicator

G. ALARMS

Tag Number	Description

H. OPERATION

1. Ascorbic Acid Metering Pump:

a. Manual: The pump runs continuously when the local control is in the HAND position. The pump will operate at a speed set locally by the operator. The pump is stopped when the local control is in the OFF position.

b. Remote: When the local control is set to REMOTE, operator has manual start, stop, and speed control via SCADA.

c. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display.

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value

J. INSTRUMENT RANGES:

Instrument	Range	Description

END OF SECTION

SECTION 17915

CONTROL STRATEGY FOR COGENERATION SYSTEM

A. PURPOSE:

The cogeneration system combusts treated digester gas to produce electricity and heat for hot water. The cogeneration system has an electrical power output range between 125 kW and 250 kW. The cogeneration system electrical output is adjusted based on a plant control signal, which maintains a set pressure in the LSG header. Heat is captured from the engine jacket and exhaust in a high temperature water loop and transferred through a heat exchanger and pumped secondary loop to the heat reservoir system. Excess heat is rejected through a waste heat radiator and an intercooler radiator.

The system includes an engine-generator, an exhaust heat recovery silencer, a supplemental silencer, a heat recovery heat exchanger, a high temperature circuit pump, a high temperature expansion tank, a high temperature control valve, a waste heat radiator, a high temperature pressure safety valve, a low temperature control valve, a low temperature expansion tank, a low temperature circuit pump an intercooler radiator, a low temperature pressure safety valve, a heat recovery pump, a heat recovery control valve and a control panel.

The cogeneration system includes a switchboard and electrical protective gear for connection to the plant electrical distribution. The generator will be connected to a paralleling switchboard lineup located in the cogeneration weatherproof enclosure. This lineup will include a generator circuit breaker, a main circuit breaker for connecting the plant electrical distribution system, and a branch circuit breaker for serving loads within the cogeneration enclosure. The switchboard will have an integral PLC and OIT which will control the switchboard and provide status to the plant SCADA system and the engine-generator controller.

B. REFERENCES:

1. P&ID: P-910, P-930
2. Mechanical Plan Drawing: M-920
3. Control Diagram: A, B, C, E, by Contractor
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 11082

C. SYSTEM DESCRIPTION:

The cogeneration system is a vendor packaged system that has plant SCADA interface for monitoring and control. The cogeneration system cannot run until the digester gas treatment system is ready, running and providing adequate pressure for cogeneration system operation. The cogeneration system also cannot run unless there is adequate digester gas available as measured by the LSG header pressure. The plant SCADA system provides a 4-20 mA signal to the cogeneration system to adjust electrical power output between 50% and 100% of rated electrical capacity. The cogeneration system provides process condition data to the plant SCADA.

D. EQUIPMENT:

Equipment No.	Description
PNL 9301	Cogeneration System Panel

E. OPERATOR CONTROLS:

Location	Controls

See Section 11082 for operator control of the cogeneration system.

F. INSTRUMENTATION:

Tag Number	Description
PIT 9121	LSG Header Pressure
FIT 9151	Digester Gas to Cogeneration
PIT 9241	Treated Digester Gas Pressure (vendor package)
TT 9311	HT Circuit Supply Temperature (vendor package)
TT 9321	LT Circuit Supply Temperature (vendor package)
TT 9332	Hot Water Supply Temperature (vendor package)

G. ALARMS:

Tag Number	Description
TAHH 9311	HT Circuit Temperature High
TAHH 9321	LT Circuit Temperature High
TAHH 9332	Hot Water Supply Temperature High
UA 9301	Cogeneration System Trouble

The rest of the alarm listed below will be added later

H. OPERATION:

1. <u>Cogeneration System</u>:

   a. The cogeneration system is a vendor package and controlled by the vendor control panel PNL 9301.

   b. Starting: The cogeneration system can be started and stopped remotely through the plant SCADA system when in the remote condition. The cogeneration system will be allowed to start when the following conditions are met:

1. Gas conditioning system is running and ready PNL 9201.
2. LSG header pressure is above set pressure PIT 9121.
3. Treated digester gas pressure is above set point pressure PIT 9241 (part of digester gas treatment system).
4. Electrical interlock

c. When running, the cogeneration system control panel PNL 9301 will provide the following status indications to plant SCADA for monitoring:

1. Ready for remote start signal (Discrete)
2. Engine running at speed signal (Discrete)
3. Generator running status (Discrete)
3. Demand for Auxiliaries (Discrete)
5. Breaker Open/Close and Local/Remote switch status
    a. Main (Discrete)
    b. MCC Feeder (Discrete)
    c. Generator (Discrete)
6. Main breaker
    a. Voltage - Volts
    b. Current - Amps
    c. Power - kW
7. Generator breaker
    a. Voltage - Volts
    b. Current - Amps
    c. Power - kW
8. Control power available (Discrete)
9. Remote trip
    a. Main Breaker (Discrete)
    b. Generator Breaker (Discrete)
10. Parallel operation ready (Discrete)
11. Generator Run Status (Discrete)
12. Circuit Temperature
13. LT Circuit Temperature
14. Hot Water Supply Temperature

The plant SCADA system will display these inputs.

d. The plant SCADA system will provide the following signals to the cogeneration system control panel PNL 9301:

1. Cogeneration system START/STOP (Discrete)
2. Cogeneration system EMERGENCY STOP (Discrete)
3. Cogeneration system electrical power output set point - kW (4-20 mA analog)
4. Enable breaker close

a. Main breaker (Discrete)
b. Generator breaker (Discrete)

e. The following alarms will be provided to the plant SCADA from the cogeneration system control panel PNL 9301:

1. Cogeneration System General Warning
2. Cogeneration System General Shutdown
3. Emergency Stop has occurred
4. Low power output trip has occurred
5. Switchboard - Protective relay trip
6. Main Breaker (Discrete)
7. Generator Breaker (Discrete)
8. Generator – Fail to Start.
9. Generator – Fail to Synchronize.
10. Generator – Circuit Breaker open status.
11. Generator – Circuit Breaker protective relay trip.
12. Generator – Circuit Breaker lockout.
13. Generator – Circuit Breaker– position.
14. Heating water system alarm (Discrete)

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value

J. INSTRUMENT RANGES:

Instrument	Range	Description

END OF SECTION

SECTION 17916

CONTROL STRATEGY FOR DIGESTER GAS TREATMENT SYSTEM

A. PURPOSE:

The digester gas treatment system conditions the digester gas for combustion in the cogeneration engine. The system removes hydrogen sulfide, water, and siloxanes from the digester gas. The system also boosts the pressure of the gas and maintains appropriate temperatures for combustion. The system includes hydrogen sulfide removal vessels, a chilling heat exchanger, a separator, a digester gas blower, a digester gas aftercooler, a modulating bypass valve, siloxane removal system vessels, a digester gas particulate filter, an air-cooled glycol chiller, a chilled glycol circulation pump, a three-way temperature control valve and a glycol expansion tank.

B. REFERENCES:

1. P&ID: P-910, P-920
2. Mechanical Plan Drawing: M-920
3. Control Diagram: A, B, C, E, by Contractor
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 11045

C. SYSTEM DESCRIPTION:

The gas treatment system is a vendor packaged system that has minimal plant SCADA interface. The gas treatment system must be ready and running for the cogeneration system to run. The gas treatment system shuts down when the LSG header pressure switch is activated. The gas treatment system provides process condition data to the plant SCADA.

D. EQUIPMENT:

Equipment No.	Description
PNL 9201	Digester Gas Treatment System Panel

E. OPERATOR CONTROLS:

Location	Controls

See Section 11045 for operator control of the digester gas system.

F. INSTRUMENTATION:

Tag Number	Description

PSL 9122	LSG Header Low Pressure Switch
TT 9211	Chilled Digester Gas Temperature (vendor package)
TT 9216	Treated Digester Gas Temperature (vendor package)
PIT 9241	Treated Digester Gas Pressure (vendor package)

G. ALARMS:

Tag Number	Description
TAHH 9211	Chilled Digester Gas Temperature High
TAHH 9216	Treated Digester Gas Temperature High
TALL 9216	Treated Digester Gas Temperature Low
PALL 9241	Treated Digester Gas Pressure Low
UA 9201	Digester Gas Treatment System Trouble

H. OPERATION:

1. Digester Gas Treatment System:

   a. The digester gas treatment system is a vendor package and controlled by the vendor control panel PNL 9201.

   b. The digester gas treatment system can be started and stopped remotely through the SCADA system.

   c. When running, the digester gas treatment system control panel PNL 9201 will provide the following signals to plant SCADA:

      1. SYSTEM RUNNING signal.
      2. SYSTEM READY signal.
      3. Chilled Digester Gas Temperature (TT 9211)
      4. Treated Digester Gas Temperature (TT 9216)
      5. Treated Digester Gas Pressure (PIT 9241)
      6. Digester Gas Treatment System Trouble (UA 9201)

   d. The plant SCADA system will provide the following signals to the digester gas treatment system control panel PNL 9201:

      1. Digester gas treatment system START/STOP
      2. LSG Header Low Pressure Switch (PSL 9122)

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value

J. INSTRUMENT RANGES:

Instrument	Range	Description

END OF SECTION

SECTION 17917

CONTROL STRATEGY FOR HEAT RESERVOIR SYSTEM

A. PURPOSE:

The heat reservoir system provides hot water to the two sludge heat exchangers and the space heating loads. The heat is provided by two existing boilers and a new cogeneration system. The hot water is circulated to heat loads by hot water pumps. The heat reservoir system includes existing equipment and new equipment. The new equipment includes two HRS pumps, two expansion tanks and a cogeneration system. Existing equipment includes two boilers, four hot water pumps, two expansion tanks and a chemical addition pot.

B. REFERENCES:

1. P&ID: P-680, P-900, P-930
2. Mechanical Plan Drawing: Mxxx
3. Control Diagram: A, B, C, E, by Contractor
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 11365, 15515

C. SYSTEM DESCRIPTION:

Hot water is circulated through the heat reservoir loop by pumps. All of the hot water flows directly through the boilers and either through the heat loads (via the hot water circulation pumps) or bypasses the heat loads through the flow balancing valve. The flow is split evenly to each boiler by virtue of equal head loss per the existing design. The cogeneration system normally provides heat to the heat reservoir when it is running. The cogeneration system operates as a pumped secondary loop meaning that all of the water does not flow through the cogeneration system; a pump is used to draw water from the loop and return it. When the cogeneration system is not running or cannot meet the heat demand, the boilers will fire fuel oil to provide supplemental heat.

1. <u>HRS Pumps</u>

The HRS pumps circulate water continuously through the heat reservoir system including through boilers and to the cogeneration system. The pumps are designed to operate as duty-standby. The pumps have variable speed drives to allow the flow rate to be adjusted for cold or warm ambient temperatures. In cold temperatures the speed and flow can be increased. For warm ambient temperatures the speed and flow can be decreased.

2. <u>Boilers</u>

The boilers are existing equipment and the controls will not be modified with this plant improvement. The boilers operate in a lead-lag configuration. When the temperature of the hot water falls below the low temperature set point (170 deg F), the lead boiler fires until the hot water temperature reaches the high temperature set point (190 deg F). The lag boiler begins to fire when a low-low temperature set point is reached (150 deg F). The temperature control is by existing temperature limit controls in the Digester Control Room.

3. Hot Water Circulation Pumps

The four hot water circulation pumps are existing equipment and the controls will not be modified with this plant improvement. These pumps provide hot water to the heat demands. These pumps are always running.

4. Cogeneration

The cogeneration system is a vendor packaged system. The control of this system is described in Section 17915. The heat recovery pump circulates hot water from the heat reservoir through the heat recovery heat exchanger and through the heat recovery temperature control valve. The heat recovery temperature control valve operates as a warm-up valve for the engine during start-up and operates to control the heat recovery outlet hot water temperature to the heat reservoir at all other times.

5. Expansion Tanks

The new expansion tanks are bladder-type tanks that compensate for hot water expansion. No control is associated with them.

D. EQUIPMENT:

Equipment No.	Description
P 9001	HRS Pump 1
P 9002	HRS Pump 2
T 6801	Expansion Tank 3
T 6802	Expansion Tank 4
Boiler 1	*Boiler 1 (existing)*
Boiler 1	*Boiler 2 (existing)*
HWCP 1	*Hot Water Circulating Pump 1 (existing)*
HWCP-2	*Hot Water Circulating Pump 2 (existing)*
HWCP 3	*Hot Water Circulating Pump 3 (existing)*
HWCP 4	*Hot Water Circulating Pump 4 (existing)*
HEX 9331	Heat Recovery Heat Exchanger (vendor package)
P 9331	Heat Recovery Pump (part of vendor package)
TCV 9331	Heat Recovery Temperature Control Valve (vendor package)

E. OPERATOR CONTROLS:

Location	Controls
P 9001	HRS Pump 1 "HAND/OFF/AUTO" Selector
P 9001	HRS Pump 1 "Stop" Pushbutton
P 9001	HRS Pump 1 “Speed” Variable speed drive selector
P 9002	HRS Pump 2 "HAND/OFF/AUTO" Selector
P 9002	HRS Pump 2 "Stop" Pushbutton
P 9002	HRS Pump 2 “Speed” Variable speed drive selector

F. INSTRUMENTATION:

Tag Number	Description
FIT 9001	Heat Reservoir Flow
TT 9351	Heat Reservoir Supply Temperature
TT 9352	Heat Reservoir Return Temperature
TT 9332	Heat Recovery Outlet Temperature (vendor package)

G. ALARMS:

Tag Number	Description
FALL 9001	Heat Reservoir Flow Low
TAHH 9351	Heat Reservoir Temperature High
TAHH 9352	Heat Reservoir Temperature Low
UA 9001	HRS Pump 1 Trouble
UA 9002	HRS Pump 2 Trouble

H. OPERATION:

1. HRS Pumps:

a. Automatic: In the AUTO position, the pumps run at the speed set at the VFD panel.

Interlocks: In the AUTO position, the pumps will stop operation based on the following:

-

b. Manual: The pumps continuously at the speed set at the VFD panel when the HOA switch is in the HAND position. The pump is stopped when the HOA switch is in the OFF position. In SCADA manual, operator has start, stop, and speed control via SCADA.

c. When Running, a SYSTEM RNG signal XXX is received at XXX for monitoring and display

2. Boilers:

a. No change to existing boiler controls.

3. Hot Water Circulation Pumps:

a. No change to existing hot water circulation pump controls.

4. Cogeneration:

a. The cogeneration system is a vendor packaged system. Controls are described in Section 17915. The plant SCADA will provide an alarm signal to cogeneration for TAHH 9351.

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value

J. INSTRUMENT RANGES:

Instrument	Range	Description

END OF SECTION

SECTION 17918

CONTROL STRATEGY FOR LSG HEADER PRESSURE AND WASTE GAS BURNER

A. PURPOSE:

The LSG header pressure control provides the operating power set point for the cogeneration system to maintain a constant pressure in the digesters. The waste gas burner combusts digester gas when the cogeneration system is not running or if digester gas production exceeds the capacity of the cogeneration system. The waste gas burner includes a waste gas burner, a pressure regulating valve, a flame arrestor, a flame trap, a propane pilot solenoid valve, a digester gas pilot solenoid valve a, a digester gas sustaining gas valve, and a control panel. The waste gas burner will have an electrode sparking type ignition system with on-demand (not continuous) digester gas and propane pilot burners.

B. REFERENCES:

1. P&ID: P-910, P-920
2. Mechanical Plan Drawing: Mxxx
3. Control Diagram: A, B, C, E, by Contractor
4. Instrument Index, PLC I/O List
5. Equipment Specifications: 13852

C. SYSTEM DESCRIPTION:

The plant SCADA controls the electrical power output of the cogeneration system to maintain a set LSG header pressure. The cogeneration system can only operate between 50% and 100% of the rated electrical output (125 kW to 250 kW). When the LSG header pressure increases above the set point pressure, the plant SCADA will increase the electrical power output set point of the cogeneration system and increase the digester supply to the engine. This in turn will reduce the LSG header pressure.

Digester gas production will vary and at times will be below or above the operating range of the cogeneration system. If the electrical power output of the cogeneration system is at 100% and the LSG header pressure continues to increase above the set point, the waste gas burner will relieve pressure in the LSG header so the digesters are not over-pressured. If the electrical power output of the cogeneration system is at 50% and the LSG header pressure continues to decrease, the cogeneration system will be shut down. The plant SCADA system will display and record the digester gas flow rate to the cogeneration system.

The waste gas burner is a vendor packaged system that has minimal plant SCADA interface. The waste gas burner operates automatically to maintain the LSG header pressure below that which would cause the digester pressure relief valves to open. When the pressure in the LSG header reaches a set pressure waste gas burner will open the regulating valve and combust the digester gas resulting in a drop in the LSG header pressure. When the pressure drops below the set pressure, the waste gas burner will close the regulating valve. The waste gas burner system provides process condition data to the plant SCADA.

D. EQUIPMENT:

Equipment No.	Description
PNL 9111	Waste Gas Burner Control Panel
PNL 9301	Cogeneration System Control Panel

E. OPERATOR CONTROLS:

Location	Controls

See Section 11556 for operator control of the waste gas burner.

F. INSTRUMENTATION:

Tag Number	Description
FIT 9111	Digester Gas to Flare
PIT 9121	LSG Header Pressure
FIT 9151	Digester Gas to Cogeneration

G. ALARMS:

Tag Number	Description
UA 9111	Waste Gas Burner Trouble
PAL 9121	LSG Header Pressure Low
PALL 9121	LSG Pressure Level Low Low

H. OPERATION:

1. LSG Header Pressure Control:

a. The plant SCADA will provide a signal to the cogeneration system control panel (PNL 9301) to control the electrical power output set point of the cogeneration system.

1. The signal will be a PID controller that modulates the signal to maintain the set pressure for the LSG header pressure PIT 9121.
2. The LSG header set pressure will preliminarily be set at 6” water column and will be available during commissioning.
3. If the pressure in the LSG header falls below the low-low set point, the START signal to the cogeneration system will be removed and the

electrical power output signal will be set to zero power output. The low-low set point will preliminarily be set at 2” water column and will be available during commissioning.

b. The plant SCADA system will monitor and display the LSG header pressure PIT 9121 and the digester gas flow rate to cogeneration FIT 9151.

2. Waste Gas Burner:

a. The waste gas burner is a vendor package and controlled by the vendor control panel PNL 9111.

b. The waste gas burner cannot be started and stopped remotely through the plant SCADA system.

c. When running, the waste gas burner control panel PNL 9111 will provide the following signals to plant SCADA:

1. Waste gas burner running signal (Discrete)
2. Waste gas burner OPEN/CLOSED signal (Discrete)

d. The plant SCADA system will display the digester gas flow rate to the waste gas burner FIT 9111.

I. INITIAL SET POINTS:

The following values will be used as initial set points. SCADA input values shall be adjusted during startup.

Description	Initial Value

J. INSTRUMENT RANGES:

Instrument	Range	Description

END OF SECTION

Brown AND Caldwell

6962 Deframe Ct.
Arvada, Colorado 80004
Tel: 303-284-3058
Fax: 303-284-3354

Memorandum

Date: August 17, 2011

To: Tadd Giesbrecht, Seattle

cc: Bill Persich, Seattle

From: Bob Ferguson, Arvada

Reviewed by: Butch Matthews, Jacksonville

Project Number: 140912-130

Subject: Central Kitsap Reclamation and Reuse Project

Preliminary Design Completion

Basis of Estimate of Probable Construction, Revision 2

The Basis of Estimate Report for the subject project is attached. Please call me if you have questions or need additional information.

RAF:bf

Enclosures (2)

1. Summary Estimate
2. Detailed Estimate

BASIS OF ESTIMATE REPORT

CENTRAL KITSAP RECLAMATION AND REUSE PROJECT

Introduction

Brown and Caldwell (BC) is pleased to present this estimate of probable construction cost (estimate) prepared for the Central Kitsap Reclamation and Reuse Project, Kitsap County, Washington.

Summary

This Basis of Estimate contains the following information:

- Scope of work
- Background of this estimate
- Class of estimate
- Estimating methodology
- Direct cost development
- Indirect cost development
- Bidding assumptions
- Estimating assumptions
- Estimating exclusions
- Allowances for known but undefined work
- Contractor and other estimate markups

Scope of Work

This project will involve improvements related to the following Central Kitsap Treatment Plant processes:

- WAS Thickening
- Plant Process Water System

Resource Reclamation and Reuse:

- Reclaimed Water Production
- Aeration Basin Addition/Modifications (nitrogen removal)
- Blower Replacement (with high efficiency blowers)
- Aeration Diffuser Upgrade
- Digester Gas Cogeneration

Background of this Estimate

The attached estimate of probable construction cost is based on documents dated August 2011, received by the ESG. These documents are described as 30 percent complete based on the current project progression, additional or updated scope and/or quantities, and ongoing discussions with the project team. Further information can be found in the detailed estimate reports.

Class of Estimate

In accordance with the Association for the Advancement of Cost Engineering International (AACE) criteria, this is a Class 3 estimate. A Class 3 estimate is defined as a Project Budget Estimate or Funding Request Estimate. Typically, engineering is from 10 percent to 40 percent complete. Class 3 estimates are used to prepare budget funding request or to evaluate design options and form the base work for the Class 2 Design Baseline or Control Estimate.

Expected accuracy for Class 3 estimates typically range from -20 percent to +30 percent, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. In unusual circumstances, ranges could exceed those shown.

Estimating Methodology

This estimate was prepared using quantity take-offs, vendor quotes, and equipment pricing furnished either by the project team or by the estimator. The estimate includes direct labor costs, including a shift differential if applicable, and anticipated productivity adjustments to labor, and equipment. Where possible, estimates for work anticipated to be performed by specialty subcontractors have been identified.

Construction labor crew and equipment hours were calculated from production rates contained in documents and electronic databases published by R.S. Means, Mechanical Contractors Association (MCA), National Electrical Contractors Association (NECA), and Rental Rate Blue Book for Construction Equipment (Blue Book).

This estimate was prepared using BC's estimating system, which consists of a Windows-based commercial estimating software engine using BC's material and labor database, historical project data, the latest vendor and material cost information, and other costs specific to the project locale.

Direct Cost Development

Costs associated with the General Provisions and the Special Provisions of the construction documents, which are collectively referred to as Contractor General Conditions (CGC), were based on the estimator's interpretation of the contract documents. The estimates for CGCs are divided into two groups: a time-related group (e.g., field personnel), and non-time-related group (e.g., bonds and insurance). Labor burdens such as health and welfare, vacation, union benefits, payroll taxes, and workers compensation insurance are included in the labor rates. No trade discounts were considered.

Indirect Cost Development

Excise sales tax has been applied to the total probable contract value. A percentage allowance for contractor's home office expense has been included in the overall rate markups. The rate is standard for this type of heavy construction and is based on typical percentages outlined in Means Heavy Construction Cost Data, 2011.

The contractor's cost for builders risk, general liability, and vehicle insurance has been included in this estimate. Based on historical data, this is typically two to four percent of the overall construction contract amount. These indirect costs have been included in this estimate as a percentage of the gross cost, and are added to the net totals after the net markups have been applied to the appropriate items.

Bidding Assumptions

The following bidding assumptions were considered in the development of this estimate.

1. Bidders must hold a valid, current Contractor's credentials, applicable to the type of project.
2. Bidders will develop estimates with a competitive approach to material pricing and labor productivity, and will not include allowances for changes, extra work, unforeseen conditions, or any other unplanned costs.
3. Estimated costs are based on a minimum of four bidders. Actual bid prices may increase for fewer bidders or decrease for a greater number of bidders.
4. Bidders will account for General Provisions and Special Provisions of the contract documents and will perform all work except that which will be performed by traditional specialty subcontractors as identified here:
   - Electrical
   - Miscellaneous metalwork
   - Painting

Estimating Assumptions

As the design progresses through different completion stages, it is customary for the estimator to make assumptions to account for details that may not be evident from the documents. The following assumptions were used in the development of this estimate.

1. Contractor performs the work during normal daylight hours, nominally 7 a.m. to 5 p.m., Monday through Friday, in an 8-hour shift. No allowance has been made for additional shift work or weekend work.
2. Contractor has complete access for lay-down areas and mobile equipment.
3. Equipment rental rates are based on verifiable pricing from the local project area rental yards, Blue Book rates, and/or rates contained in the estimating database.
4. Contractor markup is based on conventionally accepted values that have been adjusted for project-area economic factors.
5. Major equipment costs are based on both vendor supplied price quotes obtained by the project design team and/or estimators, and on historical pricing of like equipment.
6. Process equipment vendor training using vendors' standard Operations and Maintenance (O&M) material, is included in the purchase price of major equipment items where so stated in that quotation.
7. Bulk material quantities are based on manual quantity take-offs.
8. There is sufficient electrical power to feed the specified equipment. The local power company will supply power and transformers suitable for this facility.
9. Soils are of adequate nature to support the structures. No piles have been included in this estimate.
10. Aeration Basin area has groundwater at ground surface and will require extensive 24 hour/day dewatering.
11. The WAS structure, reclaimed water structure and reclaimed water filters are founded on poor soils which will require over-excavation, removal, and replacement with imported structural fill.
12. Over-excavated poor quality soils will require tipping fees for disposal. It is assumed that all other excess excavated material can be used in the site road fill along the west and northwest boundaries of the facility.
13. Unspecified pipeline materials were assumed consistent with BC standard specification 15050.
14. Non-detailed concrete reinforcing quantities are based on normal BC designs from other projects.
15. All structure excavations in high groundwater areas are shored.

16. Over-excavations have a 1-1/2:1 side slope based on recommendations of the geotechnical engineer.
17. Trench spoils will be disposed of within 10 miles of the jobsite.
18. Imported fill material will be available within 20 miles of the jobsite.
19. Gravel surfacing will consist of a 6-inch aggregate base course with 2-inch aggregate leveling course.
20. Asphalt paving will consist of a 8-inch aggregate base course with 3-inch asphalt concrete surface.
21. Temporary erosion control will consist of silt fence at the perimeter of disturbed areas, and hydraulic application of temporary mulch and seed mix during periods of non activity.
22. Permanent landscape restoration will be limited to reseeding of areas disturbed by the new construction.
23. Yard pipe size and lengths are based on civil sketches provided by the design team.
24. Dewatering will be discharged into the plant process systems or surface waters. Pretreatment of discharge will be limited to the use of desilting tanks.
25. Slide gate dimensions where scaled from the mechanical drawings.
26. Polymer tanks T4065 and T4075 are included in the polymer vendor package per the equipment list notes.
27. Sluice gates SG-2503 and SG-2504 on drawing M-250 are existing.
28. Existing aeration basins will be cleaned and sludge will be disposed of by County.
29. Aeration basin redwood overflow weirs will be approximately 20-foot in height.

Estimating Exclusions

The following estimating exclusions were assumed in the development of this estimate.

1. Hazardous materials remediation and/or disposal.
2. O&M costs for the project with the exception of the vendor supplied O&M manuals.
3. Utility agency costs for incoming power modifications.
4. Permits beyond those normally needed for the type of project and project conditions.
5. Dewatering permit or discharge fees.

Allowances for Known but Undefined Work

The following allowances were made in the development of this estimate.

1. Electrical/Instrumentation
2. HVAC ducting
3. Small bore (< 3”) piping
4. Erosion control materials and maintenance.
5. Purchase of imported common earth for mass fills.
6. Yard pipe fittings.
7. Existing yard pipe demolition.
8. Methanol tank T2400.
9. RAS mix box davit cranes.
10. RDT inline fan.
11. RDT carbon canister.
12. TSBT carbon canister.
13. RW inline mixer.

Contractor and Other Estimate Markups

Contractor markup is based on conventionally accepted values which have been adjusted for project-area economic factors. Estimate markups are shown in Table 1.

Table 1. Estimate Markups

Item	Rate, percent
Prime Contractor	
Labor (employer payroll burden)	8
Materials and process equipment	5
Equipment (construction-related)	5
Subcontractor	5
Sales Tax (State Excise-Gross Receipts-Contract Value)	9
Startup, Training, O&M	2
Builder's Risk, Liability, and Vehicle Insurance	2
Material Shipping and Handling	2
Subcontractor Markups	Same as Prime
Escalation to Midpoint of Construction	4
Contingency	20
Performance and Payment Bonds	1.5

Labor Markup. The labor rates used in the estimate were derived chiefly from the latest published State Prevailing Wage Rates. These rates include costs beyond raw labor for such items as Payroll Tax and Insurance (PT&I), FICA, and Workers Compensation Insurance. In addition to these markups, the General Contractor (GC) typically adds a percentage to each raw labor dollar to cover overhead and profit, payroll and accounting costs, additional insurance, retirement, 401k contributions, and sick leave/vacation cost.

Materials and Process Equipment Markup. This markup consists of the additional cost to the contractor beyond the raw dollar amount for material and process equipment. This includes shop drawing preparation, submittal and/or re-submittal cost, purchasing and scheduling materials and equipment, accounting charges including invoicing and payment, inspection of received goods, receiving, storage, overhead and profit.

Equipment (Construction) Markup. This markup consists of the costs associated with operating the construction equipment used in the project. Most GCs will rent rather than own the equipment and then charge each project for its equipment cost. The equipment rental cost does not include fuel, delivery and pick-up charges, additional insurance requirements on rental equipment, accounting costs related to home office receiving invoices and payment. However, the crew rates used in the estimate do account for the equipment rental cost. Occasionally, larger contractors will have some or all of the equipment needed for the job, but in order to recoup their initial purchasing cost they will charge the project an internal rate for equipment use which is similar to the rental cost of equipment. The GC will apply an overhead and profit percentage to each individual piece of equipment whether rented or owned.

Subcontractor Markup. This markup consists of the GC's costs for subcontractors who perform work on the site. This includes costs associated with shop drawings, review of subcontractor's submittals, scheduling of subcontractor work, inspections, processing of payment requests, home office accounting, and overhead and profit on subcontracts.

Sales Tax (Excise-Gross Receipts-Contract Value). This is the tax that the contractor must pay according to state and local taxation laws. The percentage is based on state, county and local rates in place at the time the estimate was prepared. The percentage is applied to the total anticipated contract value.

Contractor Startup, Training, and O&M Manuals. This cost markup is often confused with either vendor startup or owner startup. It is the cost the GC incurs on the project beyond the vendor startup and owner startup costs. The GC generally will have project personnel assigned to facilitate the installation, testing, startup, and O&M Manual preparation for equipment that is put into operation by either the vendor or owner. These project personnel often include an electrician, pipe fitter or millwright, and/or I&E technician. These personnel are not included in the basic crew makeup to install the equipment but are there to assist and trouble shoot the startup and proper running of the equipment. The GC also incurs a cost for startup for such things as consumables (oil, fuel, filters, etc.), startup drawings and schedules, startup meetings, and coordination with the plant personnel in other areas of the plant operation.

Builders Risk, Liability, and Vehicle Insurance. This percentage comprises all three items. There are many factors which make up this percentage, including the contractor's track record for claims in each of the categories. Another factor affecting insurance rates has been a dramatic price increase across the country over the past several years due to domestic and foreign influences. Consequently, in the construction industry we have observed a range of 0.5 to 1 percent for Builders Risk Insurance, 1 to 1.25 percent for General Liability Insurance, and 0.85 to 1 percent for Vehicle Insurance. Many factors affect each area of insurance, including project complexity, and contractor's requirements and history. Instead of using numbers from a select few contractors, we believe it is more prudent to use a combined 2 percent to better reflect the general costs across the country. Consequently, the actual cost could be higher or lower based on the bidder, region, insurance climate, and on the contractor's insurability at the time the project is bid.

Material Shipping and Handling. This can range from 2 percent to 6 percent, and is based on the type of project, material makeup of the project, and the region and location of the project. Material shipping and handling covers delivery costs from vendors, unloading costs (and in some instances loading and shipment back to vendors for rebuilt equipment), site paper work, and inspection of materials prior to unloading at the project site. BC typically adjusts this percentage by the amount of materials and whether vendors have included shipping costs in the quotes that were used to prepare the estimate. This cost also includes the GC's cost to obtain local supplies, e.g., oil, gaskets, and bolts that may be missing from the equipment or materials shipped.

Escalation to Midpoint for Labor, Materials and Subcontractors. In addition to contingency, it is customary for projects that will be built over several years to include an escalation to midpoint of anticipated construction to account for the future escalation of labor, material, and equipment costs beyond values at the time the estimate is prepared. For this project the anticipated rate of escalation is 2 percent per annum.

The estimated construction time for this project is 24 months, exclusive of unusual weather or site conditions delays. Construction is anticipated to start July 1, 2012, and complete July 1, 2014. The escalation factors used in this estimate are calculated from the date the estimate is finalized to the anticipated midpoint of construction at approximately 23 months from the date of this estimate.

Construction Contingency. The contingency factor covers unforeseen conditions, area economic factors, and general project complexity. This contingency is used to account for those factors that can not be addressed in each of the labor and/or material installation costs. Based on industry standards, completeness of the project documents, project complexity, the current design stage, and area factors, construction contingency can range from 10 percent to 50 percent.

Range of Accuracy. The amount of contingency in the estimate should not be confused with the accuracy of the estimate. The Expected Accuracy Range defines the window within which the bids are expected to fall based on the project complexity, information available during the estimate process, outside influences (wage rates, material, bidding climate), and includes a level of contingency appropriate to the project definition at the time the estimate was prepared. It is important to understand that AACEI notes on its ranges of accuracy that,

> "The state of process technology and availability of applicable reference cost data affect the range markedly. The +/- value [of the ranges] represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50 percent level of confidence) for given scope."

While a 50-percent level of confidence in the contingency may seem broad, typically this results in a 90-percent confidence that the actual cost will fall within the bounds of the low and high ranges.

The caution here is that these estimates are not what are often referred to as "bid quality," i.e., estimates prepared by contractors who are receiving competitive bids from subcontractors, equipment vendors, and materials suppliers. In general, we receive reasonable budget values from those willing to provide quotations.

Performance and Payment Bonds. Based on historical and industry data, this can range from 0.75 percent to 3 percent of the project total. There are several contributing factors including such items as size of the project, regional costs, contractor's historical record on similar projects, complexity, and current bonding limits. BC uses 1.5 percent for bonds, which we have determined to be reasonable for most heavy construction projects.

Brown AND Caldwell

SUMMARY ESTIMATE REPORT WITH MARK-UPS ALLOCATED

CKTP RECLAMATION AND REUSE PROJECT
KITSAP COUNTY
PRELIMINARY DESIGN ESTIMATE

Project Number:	140912-130
BC Project Manager:	BILL PERSICH / TADD GIESBRECHT
BC Office:	SEATTLE
Estimate Issue Number:	01
Estimate Original Issue Date:	AUGUST 8, 2011
Estimate Revision Number:	02
Estimate Revision Date:	AUGUST 17, 2011
Lead Estimator:	BOB FERGUSON / DON GORDON
Estimate QA/QC Reviewer:	BUTCH MATTHEWS / DESIGN TEAM
Estimate QA/QC Date:	AUGUST 8, 2011 / AUGUST 11, 2011

PROCESS LOCATION/AREA INDEX

01 - CONTRACTOR GENERAL CONDITIONS
02 - SITE CIVIL / YARD PIPING
03 - WAS THICKENING
04 - RECLAIMED WATER PRODUCTION
05 - AERATION BASINS NO 1 & 2 MODIFICATIONS
06 - AERATION BASINS NO 3 & 4 - NEW
07 - BLOWER REPLACEMENT
08 - DIGESTER GAS COGENERATION
09 - CARBON ADDITION
10 - ELECTRICAL / INSTRUMENTATION

CKWWTP

CKTP RECLAMATION AND REUSE PROJECT
KITSAP COUNTY

Description	Total w/ Markups Allocated
--- Base Estimate ---	24,227,040
01 - CONTRACTOR GENERAL CONDITIONS	
01 - General Requirements	1,218,453
01 - CONTRACTOR GENERAL CONDITIONS Total	1,218,453
02 - SITE CIVIL / YARD PIPING	
01 - General Requirements	186,488
02 - Site Construction	1,808,196
03 - Concrete	35,261
05 - Metals	6,000
15 - Mechanical	521,974
02 - SITE CIVIL / YARD PIPING Total	2,557,919
03 - WAS THICKENING	
01 - General Requirements	17,445
02 - Site Construction	81,047
03 - Concrete	249,677
04 - Masonry	128,675
05 - Metals	135,120
07 - Thermal & Moisture Protection	48,876
08 - Doors & Windows	18,562
09 - Finishes	50,719
11 - Equipment	750,871
15 - Mechanical	511,963
03 - WAS THICKENING Total	1,992,955
04 - RECLAIMED WATER PRODUCTION	
01 - General Requirements	74,534
02 - Site Construction	323,558
03 - Concrete	519,310
04 - Masonry	30,284
05 - Metals	135,434
07 - Thermal & Moisture Protection	3,227
08 - Doors & Windows	19,989
09 - Finishes	31,133
11 - Equipment	1,359,551
13 - Special Construction	74,881
15 - Mechanical	510,464
04 - RECLAIMED WATER PRODUCTION Total	3,082,365
05 - AERATION BASINS NO 1 & 2 MODIFICATIONS	

Description		Total w/ Markups Allocated
02 - Site Construction		26,669
03 - Concrete		156,814
05 - Metals		48,219
06 - Wood & Plastics		18,732
11 - Equipment		1,259,809
15 - Mechanical		307,239
	05 - AERATION BASINS NO 1 & 2 MODIFICATIONS Total	1,817,482
06 - AERATION BASINS NO 3 & 4 - NEW		
01 - General Requirements		206,543
02 - Site Construction		998,636
03 - Concrete		2,523,965
05 - Metals		605,517
06 - Wood & Plastics		18,732
11 - Equipment		1,336,683
14 - Conveying Systems		12,167
15 - Mechanical		555,196
	06 - AERATION BASINS NO 3 & 4 - NEW Total	6,257,437
07 - BLOWER REPLACEMENT		
02 - Site Construction		1,642
11 - Equipment		508,661
15 - Mechanical		108,874
	07 - BLOWER REPLACEMENT Total	619,177
08 - DIGESTER GAS COGENERATION		
02 - Site Construction		15,594
03 - Concrete		72,994
05 - Metals		38,133
09 - Finishes		5,164
11 - Equipment		1,288,151
15 - Mechanical		496,956
16 - Electrical		643,416
17 - Instrumentation		2,813
	08 - DIGESTER GAS COGENERATION Total	2,563,222
09 - CARBON ADDITION		
02 - Site Construction		12,865
03 - Concrete		146,341
05 - Metals		26,002
09 - Finishes		2,869

CKTP RECLAMATION AND REUSE PROJECT
KITSAP COUNTY

Description	Total w/ Markups Allocated
11 - Equipment	120,602
13 - Special Construction	89,557
15 - Mechanical	29,674
09 - CARBON ADDITION Total	427,910
10 - ELECTRICAL / INSTRUMENTATION	
16 - Electrical	3,690,120
10 - ELECTRICAL / INSTRUMENTATION Total	3,690,120

Grand Total at 20% Contingency.................$24.23 M
Grand Total at 30% Contingency.................$26.25 M
Potential PSE Grant (TBD).........................~($0.5 M)

Report
Geotechnical Engineering Services
Central Kitsap Wastewater Treatment Plant
Phase IV Upgrades
Kitsap County, Washington

July 22, 2011

Prepared for

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APPENDICES

1.0 INTRODUCTION

This report summarizes the results of geotechnical engineering services conducted for the proposed Central Kitsap Wastewater Treatment Plant Phase IV Upgrades project in Kitsap County, Washington. The general project location is shown on the Vicinity Map (Figure 1). The general configuration of a portion the project site, as well as some of the existing site features, is shown on the Site and Exploration Plans (Figures 2A and 2B).

This report has been prepared based on data collected during our field exploration and laboratory testing programs; our discussions with representatives of Brown and Caldwell; preliminary plans for the project provided by Brown and Caldwell; our review of geotechnical information previously collected by others at the project site (Dames & Moore 1977, Hong West & Associates 1995, and Landau Associates 2008), our familiarity with geologic conditions within the vicinity of the project area; and our experience on similar projects.

1.1 PROJECT DESCRIPTION

We understand that Kitsap County plans to expand the existing Central Kitsap Wastewater Treatment Plant. We understand that current expansion plans call for a new reclaimed water facility, new aeration basins 3 and 4 (ABs 3 and 4), a new return activated sludge (RAS) mixing box, a cogeneration building, and a waste-activated sludge (WAS) thickening building. ABs 3 and 4 and the RAS mixing box will be located west of the existing primary clarifiers and aeration tanks. The reclaimed water facility will be located north of existing Secondary Clarifier 2. The cogeneration and WAS thickening buildings will be located east and north of existing Digester 2, respectively.

Based upon discussions with Brown & Caldwell, ABs 3 and 4 will likely have a finish floor elevation of approximately 132 ft (bottom of footings would be lower) and would retain soil below the existing ground surface, resulting in a retained soil height varying from about 8 to 18 ft. A temporary excavation elevation of about 128 ft would likely be necessary to construct the foundations and floor of the aeration basins. For the current proposed layout shown on Figure 2A, a temporary slope of about 2H:1V (horizontal:vertical) away from the bottom of the new AB could be maintained to prevent exposure of the existing primary clarifier foundation and the RAS mixing box footing.

We understand that the proposed reclaimed water facility will be a relatively lightly-loaded, at-grade structure. Two preliminary locations were identified as possible sites for the reclaimed water facility: 1) a location south of the existing headworks, which was subsequently dismissed, and 2) a location to the north and northeast of Secondary Clarifier 2.

We understand that the proposed cogeneration building will be either a lightly-loaded, 52 x 65 ft at-grade structure, or be broken into two outdoor pads at 25 x 30 ft for gas treatment and 15 x 30 ft for the cogeneration unit.

The proposed WAS thickening building will be an at-grade structure with a finish floor elevation of 160 ft. This structure will include an adjacent concrete pad that will be used to support a thickened sludge blending tank. We understand that the dead load, footing and content weight of the tank will be about 420 kips on a 22 ft octagonal footing.

The project is currently in the preliminary design stage. As the project progresses through design, the locations, dimensions and/or depths of the proposed structures might be modified. If the locations and/or depths of the proposed structures change, Landau Associates should be given the opportunity to review this report to determine if the conclusions and recommendations contained herein are applicable to the revised structure locations and/or depths.

1.2 SCOPE OF SERVICES

Brown and Caldwell retained Landau Associates to provide geotechnical engineering services to support design of the proposed Central Kitsap Wastewater Treatment Plant Phase IV Upgrades project. Our services were provided in general accordance with the scope of services outlined in a Standard Subcontract for Geotechnical Services between Brown and Caldwell and Landau Associates (Purchase Order No. 9845). Our scope of services included the following specific tasks:

- Reviewing relevant information from the geotechnical investigation performed during execution of the previous design efforts for the project (i.e., Phases I through III of the project).

- Conducting a geologic reconnaissance of the project area to collect information on the general nature and physical features of the project site.

- Arranging underground utility location (“call before you dig”) prior to performing a subsurface investigation.

- Hiring a private underground utility locating service to check the planned exploration locations for potential conflicts.

- Advancing two exploratory borings to depths of about 15 and 35 ft below the ground surface (BGS) in the vicinity of the proposed aeration basins and the proposed southerly reclaimed water facility location.

- Obtaining representative samples of the various soils encountered and maintaining a detail log of each boring.

- Performing geotechnical laboratory testing on selected soil samples, including determination of moisture content and grain size distribution.

- Performing geotechnical engineering analyses in support of our conclusions and recommendations.

- Preparing and submitting this written report. This report contains descriptions of surface and subsurface conditions at the site, results of our engineering analyses, and design-level geotechnical engineering recommendations pertaining to:

  - shallow foundation design parameters
  - site seismicity and seismic design parameters
  - site grading and earthwork, including suitability of excavated soil for reuse as backfill
  - anticipated excavation difficulties and configuration of temporary excavation slopes
  - temporary shoring design and construction
  - methods for construction dewatering
  - lateral earth pressures on below-grade walls
  - influence of new construction on adjacent existing facilities
  - soil corrosivity and the need for cathodic protection
  - geotechnical monitoring and consultation during construction.

Our proposed scope of services included advancing two borings: one to a depth of 35 ft BGS (boring B-1-11 for ABs 3 and 4 and the RAS mixing box) and one to a depth of approximately 15 ft BGS (boring B-2-11 for the previously considered reclaimed water facility location). At boring B-1-11, the driller encountered refusal at a depth of approximately 25.7 ft BGS due to a cobble or boulder and the borehole was terminated.

2.0 SITE CONDITIONS

This section discusses the general geologic setting of the project area and describes the surface and subsurface conditions observed at the project site at the time of our field investigation. Interpretation of the site subsurface conditions is based on the results of our review of available geotechnical information (Dames & Moore 1977, Hong West & Associates 1995, and Landau Associates 2008), and the results of our site reconnaissance, subsurface explorations, and laboratory testing.

2.1 GEOLOGIC SETTING

Near-surface deposits in the vicinity of the project site consist of undocumented fill, topsoil, recent alluvium, and glacial drift (which by definition includes recessional outwash, glacial till, and advance outwash). A more detailed discussion of the regional geologic history is included in Landau Associates' 2008 geotechnical report for Phase III of this project.

2.2 SURFACE CONDITIONS

The project site is located on the west side of State Highway 303, approximately 1½ miles south of Keyport, Washington. The project site is situated along the western flank of a north-south trending ridge and is surrounded by relatively undeveloped property that is forested by small- to large-diameter deciduous and coniferous trees.

The location of the proposed RAS mixing box and ABs 3 and 4 extends westward beyond the currently-fenced treatment plant perimeter. The ground surface at this location slopes gently downward to the west and is covered with moderately spaced, second growth conifers. Wetlands have been delineated by others a short distance to the north, south, and west of the proposed aeration basin footprint.

The currently proposed location for the reclaimed water facility is north and northeast of existing Secondary Clarifier 2 in a relatively flat grassy area. At the time of our site reconnaissance (April 2011), soft, wet soils were evident at the ground surface. Wetlands have been delineated by others a short distance north of the footprint of the currently proposed reclaimed water facility.

2.3 SUBSURFACE SOIL AND GROUNDWATER CONDITIONS

Subsurface conditions at the project site were investigated by advancing and sampling two exploratory borings and by reviewing geotechnical information previously collected by others at the project site (Hong West & Associates 1995). Current explorations were completed with a track-mounted, hollow-stem auger drill rig on April 26, 2011. Exploratory boring B-1-11 was drilled to a depth of approximately 25.7 ft BGS in the vicinity of the proposed ABs 3 and 4 and the proposed RAS mixing box. At a depth of 25.7 ft BGS, drill refusal on a cobble or boulder was encountered and drilling was terminated at this depth. Boring B-2-11 was drilled to a depth of approximately 16.3 ft BGS in the vicinity of the proposed southern reclaimed water facility location. The approximate locations of the exploratory borings are shown on the Site and Exploration Plans (Figures 2A and 2B). A discussion of the field exploration procedures, together with edited logs of the exploratory borings, is presented in Appendix A. A discussion of laboratory test procedures, together with the laboratory testing program results, is presented in Appendix B. Pertinent previous exploration logs and geologic cross sections are included in Appendices C and D, respectively.

Aeration Basins 3 and 4 and RAS Mixing Box

Based on the results of our current exploration program and our review of previous nearby explorations, the proposed aeration basin location appears to be underlain by 2 to 8 ft of medium dense to dense sand with silt and gravel, which we interpret to be glacial recessional outwash. Below the recessional outwash, a very dense silty sand and gravelly silty sand is present. This sand is interpreted to be glacial till. Several inches of organic-rich topsoil are present at the ground surface and, near the existing aeration basin; several feet of granular fill are also present. Within the footprint of the proposed aeration basins, the top of the glacial till unit is located at or above an elevation of about 132 ft. It is our understanding that the ABs would be founded at about elevation 128 ft. The top of the glacial till rises gradually to the east; near the west side of existing Primary Clarifier 1, the top of the glacial till is located at about elevation 144 ft. We understand that the proposed RAS mixing box would have a finish floor elevation of about 143.5 ft, so the footings of the structure would likely be located near the top of the glacial till unit.

While advancing boring B-1-11 we encountered a cobble or boulder at a depth of about 25.7 ft (approximately elevation 116 ft), which resulted in refusal of the drilling equipment. Cobbles and boulders are not uncommon in glacial till, though their distribution can be highly variable. Given the available data, it is not possible to quantify their size or frequency of occurrence within the footprint of the proposed ABs.

While advancing boring B-1-11, we observed wet soil samples below approximate elevation 122 ft. However, a standpipe piezometer in a previous exploration (Hong West & Associates boring BH-3) near existing Primary Clarifier 1 indicated groundwater at approximate elevation 141 ft on January 26, 1995. During our field reconnaissance, we observed an unidentified monitoring well south of the existing Headworks and measured a groundwater elevation of about 139 ft. These observations suggest a regional groundwater table at an elevation of about 139 to 141 ft in the vicinity of the proposed ABs.

Southern Reclaimed Water Facility Location

Subsurface soil conditions at the location of exploratory boring B-2-11 consist of stiff, gray, sandy silt and clay with varying amounts of gravel and interbeds of orange oxidized soils. We interpret this soil to be recent alluvium. Based upon Standard Penetration Test resistance and drilling action (no sample was recovered), the bottom of the recent alluvium is interpreted to be located at a depth of about 12 ft BGS (approximate elevation 132 ft). Below elevation 132 ft, we anticipate that glacial till is present.

Wet soils were present at the ground surface at the time of our field investigation. This observation is likely indicative of a perched groundwater condition. The unidentified monitoring well (described in the previous section) indicates a regional groundwater table elevation at this location of approximately 139 ft.

We understand that this southern location is not the preferred site of the reclaimed water facility.

Northern Reclaimed Water Facility Location

Because no current explorations were advanced at the northern reclaimed water facility location, our understanding of the subsurface conditions in the portion of the site is limited to the conditions reported by Hong West & Associates in 1995. Soil and groundwater conditions at the present time may differ from those encountered in 1995 as a result of site grading, irrigation, dewatering, and/or other activities that may have occurred since 1995. We understand that this northern location is the preferred site of the reclaimed water facility.

As reported by previous explorations (Hong West & Associates borings BH-4, BH-5, and BH-7), up to 3 ft of topsoil and soft, wet clay are present within the northern reclaimed water facility footprint. These soils were interpreted by Hong West & Associates to be recent alluvium. The thickness of the clay, plus interbedded silt, varies from approximately 7 to 12 ft and becomes stiff to very stiff at a depth of 3 to 5 ft below the 1995 ground surface. 0 to 7 ft of recessional outwash is reported to underlie the recent alluvium, followed by glacial till. The recessional outwash and glacial till are reported to be dense to very dense.

Standpipe monitoring wells were installed in two of Hong West & Associates' 1995 borings; both wells indicated groundwater at or immediately below the 1995 ground surface. We observed soft, wet soil at the ground surface during our site visit in April 2011.

Cogeneration Building

Based on the results of our review of a previous nearby exploration (Hong West & Associates boring BH-10), the proposed cogeneration building location appears to be underlain by about 2 ft of medium dense, poorly graded gravel with sand, which was interpreted by Hong West & Associates to be fill. Below the fill, a medium dense, poorly graded sand with silt and gravel was reported by Hong West & Associates. This sand was interpreted by Hong West & Associates to be recessional outwash. The recessional outwash is underlain by about 5½ ft of very dense silty sand (glacial till). The glacial till is reportedly underlain by very dense sand with varying amounts of silt and gravel (advance outwash).

A standpipe monitoring well was installed by Hong West & Associates in boring BH-10. During the winter of 1994/1995, Hong West & Associates recorded groundwater elevations ranging from 148½ to 149½ in this monitoring well.

WAS Thickening Building

Based on the results of our review of a previous nearby exploration (Hong West & Associates boring BH-12), the proposed WAS thickening building location appears to be underlain by about 2 of loose silty sand, which was interpreted by Hong West & Associates to be fill. The fill is reportedly underlain by about ½ ft of soft organic soil that was described by Hong West & Associates to be a remnant topsoil layer. Below the remnant topsoil layer, a loose to medium dense silty sand (recessional outwash) is reportedly present.

Hong West & Associates' summary log for boring BH-12 indicated groundwater at a depth of about 1 ft below the 1995 ground surface.

3.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the field exploration and laboratory testing conducted by Landau Associates and previous investigators, and the engineering analyses we performed, it is our opinion that the proposed Phase IV upgrades to the existing wastewater treatment plant are feasible as currently planned, provided the recommendations presented in this report are implemented during design and construction. Conclusions and specific recommendations regarding seismic design, site grading and earthwork, wet weather earthwork, temporary excavations, temporary shoring, foundation support, concrete slab-on-grade floors, lateral earth pressures, groundwater considerations, and corrosion considerations are provided below.

3.1 SUMMARY OF CONCLUSIONS

Based on the results of our study, and our understanding of the current design concept, it is our opinion that the site is geotechnically suitable for the proposed improvements. Key design items are briefly summarized below, and are discussed in greater detail in the following sections of this report.

- **Seismic Considerations:** The project site could be subject to ground shaking from a moderate to major earthquake. Consequently, moderate levels of earthquake shaking should be anticipated during the design life of the proposed facilities, and the proposed structures should be designed to resist earthquake loading using appropriate design methodology. See Section 3.2.

- **Subgrade Preparation:** Loose, organic-rich topsoil, recessional outwash, and fill soils may underlie the proposed AB and RAS mixing box locations. However, these locations are underlain by very dense glacial till near the proposed foundation elevations. Glacial till is capable of providing a competent subgrade for the proposed structures. If the overlying loose soils are encountered beneath footings, pavements, or other structures, they should be overexcavated and replaced with compaction import fill. At the northern proposed reclaimed water facility location, soft, wet unsuitable soils are present to a depth of 3 to 5 ft BGS. These soils should be partially or completely removed and replaced with granular fill. Beneath the soft soil, the stiff, clay and silt can provide adequate footing support; however, these soils will be susceptible to disturbance, especially during wet weather, and should be protected from construction traffic and additions of moisture. At the cogeneration and WAS thickening building locations, loose to medium dense fill soils and soft organic soils are present to a depth of about 2 to 2½ ft BGS. These soils should be removed and replaced with granular fill. The underlying recessional outwash at these two building locations can provide adequate footing support. See Section 3.3.

- **Fills:** Some of the native soils may be reused as structural fill, if properly moisture conditioned. Some drying could be required if construction takes place during periods of wet weather and/or soil is obtained from excavations that encounter groundwater. If compacted fills are constructed during periods of wet weather, imported granular fill material may be needed. See Section 3.4.

- **Wet Weather Earthwork:** The on-site fill and native soils are considered to be moderately to highly moisture sensitive. As a result, it may be difficult to control the moisture content of the on-site soils during periods of wet weather and the on-site soils may be disturbed by construction equipment. See Section 3.5.

- **Temporary Excavations:** Temporary unsupported excavations within the existing on-site fill, alluvial deposits, and recessional outwash should be sloped no steeper than 1½H:1V (horizontal:vertical). Temporary unsupported excavations within glacial till may be sloped as steep as ¾H:1V. However, flatter side slopes will be necessary for excavations that extend below the water table and where groundwater seepage is encountered. In areas where unsupported temporary excavations are not feasible, temporary shoring will be required. See Section 3.6.

- **Temporary Shoring:** In areas where temporary unsupported excavations are not feasible, such as between the existing clarifiers and aeration basins and the proposed RAS mixing box, unsupported excavations may not be feasible and temporary shoring may be required. See Section 3.7.

- **Foundation Support:** Foundations that bear on structural fill or on undisturbed native soils can be designed using an allowable bearing pressure of between 2,500 and 4,000 psf, depending on the condition of the native subgrade. See Section 3.8.

- **Floor Slab Support:** All concrete slab-on-grade floors should be provided with a minimum of 6 inches of compacted, clean, free-draining, sand and gravel. See Section 3.9.

- **Below Grade Walls:** Below grade walls should be designed to resist the lateral earth pressures that will develop against them. See Section 3.10.

- **Groundwater Considerations:** The need to dewater some or all of the temporary excavations that will be required to construct the proposed improvements should be anticipated. In addition, the proposed below-grade structure should be designed to resist upward buoyant forces. See Sections 3.11 through 3.13.

- **Corrosion Protection:** Results of the previous laboratory testing conducted by others indicate that the onsite soils have a “moderate” to “severe” potential for sulfate attack. Consequently, sulfate-resisting Portland cement (Type V) should be used to construct below grade concrete structures. See Section 3.14.

This summary is intended for introductory and reference purposes only. A thorough reading of the entire report is essential for a complete understanding of the design concepts and limitations.

3.2 SEISMIC CONSIDERATIONS

The Pacific Northwest is seismically active and the project site could be subject to ground shaking from a moderate to major earthquake. Consequently, moderate levels of earthquake shaking should be anticipated during the design life of the proposed facilities, and the proposed structures should be designed to resist earthquake loading using appropriate design methodology.

We understand that the proposed Phase IV structures will be designed according to the 2009 International Building Code (IBC). The 2009 IBC accounts for an earthquake ground motion with a 2 percent probability of exceedance in 50 years (a 2,475-year return period), but with a reduced acceleration (about two-thirds of the acceleration that corresponds to a 2,475-year event). The seismic parameters in the 2009 IBC are based on maps prepared by the United States Geological Survey (USGS). According to the USGS, the design earthquake magnitude for the project site is 7.0 with a design rock acceleration of approximately .0404g (about two-thirds of the peak horizontal acceleration of 0.606g).

The subject site is underlain by glacially derived soils that are overlain by a general sequence of fill overlying remnant topsoil and alluvial soils. Based on the stratigraphy of the project site and the criteria presented in Table 1613.5.2 in the 2009 International Building Code, the site is classified as Site Class D. Based on the project location (approximately Latitude 47.67 and Longitude -122.63), the following spectral accelerations should be used to estimate the maximum considered earthquake spectral response accelerations for the site per Section 1613.5.3 of the 2009 International Building Code:

Spectral Acceleration for short periods (Ss):	136.5 percent of gravity (1.365g)
Spectral Acceleration for 1-second period (S_1):	47.8 percent of gravity (0.478g)

Soil liquefaction is generally limited to granular soils located below the water table that are in a relatively loose, unconsolidated condition at the time of a large, nearby earthquake. The dense, glacially consolidated deposits that underlie the project site are anticipated to have a low susceptibility to soil liquefaction. Consequently, it is our opinion that no special liquefaction-related design or construction procedures will be necessary for the project. However, it should be noted that some of the soil surrounding the existing and proposed structures (particularly zones of loose sand below the groundwater surface) may be subject to liquefaction under a strong motion earthquake, which could cause settlement and/or distortion of the ground surface adjacent to the these structures.

3.3 SUBGRADE PREPARATION

Subgrade preparation in the vicinity of the proposed improvements should begin with the removal of all deleterious matter, asphalt, concrete, trees, and vegetation. We also recommend that all loose materials such as topsoil and organic material be completely removed from all areas that will support the proposed improvements. The excavated soils should either be stockpiled for later use in landscaped areas, or exported from the site if unsuitable for landscaping.

3.3.1 BELOW GRADE STRUCTURES

Excavation for below-grade structures should be performed in such a manner as to minimize disturbance to subgrade soils. All areas of subgrade disturbed during the excavation process should be removed. In addition, areas of saturated and/or loose material should be removed prior to placement of bedding or underdrain materials. We also recommend that the subgrade for the below-grade structures be observed by the geotechnical consultant, to verify that the recommendations of this report have been followed, and that an appropriate bearing stratum is exposed.

3.3.2 LIGHTLY LOADED ABOVE GRADE STRUCTURES

We understand that the proposed northern reclaimed water facility, cogeneration building, and WAS thickening building will consist of lightly loaded structures. Several feet of soft, wet alluvial soil consisting predominantly of clay and silty clay are present immediately below the existing ground surface at the northern reclaimed water facility location. At the cogeneration and WAS thickening building locations, loose to medium dense fill soils and soft organic soils are present to a depth of about 2 to 2½ ft BGS. These soils will be unable to support construction loads and structure foundations and will be vulnerable to construction traffic and additions of moisture.

If the northern reclaimed water facility will be supported on mat foundations and concrete slabs-on-grade, the uppermost 3 ft of soft soil be removed and replaced with compacted granular fill. A lesser depth of removal and replacement may be possible, such as through the use of geogrid reinforcement at the bottom of a thinner section of fill, or cement-soil mixing of the native clay beneath a thinner section of fill. These alternatives (or others) may be of further interest to bidding contractors. If the reclaimed water facility will be supported on strip or isolated footings, the footings should either bear directly on the stiffer soils located typically 3 to 5 ft below the existing ground surface, or upon compacted granular fill extending to the top of the stiff clay. For planning purposes, it should be assumed that the area(s) requiring overexcavation to competent soil will need to extend laterally beyond the edge of each footing or foundation elements a distance equal to the depth of excavation below the base of the footing or foundation element. We also recommend that the geotechnical consultant confirm actual foundation subgrade conditions during construction prior to and during the placement of granular fill.

We recommend completely removing the 2 to 2½ ft of loose to medium dense fill soils and soft organic soils that are anticipated in the vicinity of the proposed cogeneration and WAS thickening buildings. The removed soil should be replaced with compacted granular fill.

3.4 SITE EARTHWORK RECOMMENDATIONS

The onsite recent alluvium and fill units (if encountered) contain a high percentage of fine-grained material and are considered to be moderately to highly moisture sensitive. It is our opinion that these soils will not be suitable for re-use as structural fill on the project. Some of the glacial deposits may be suitable for re-use as structural fill, provided the earthwork is performed during relatively dry weather, the soil is protected from additional moisture (such as by tarping stockpiles) and the contractor's methods are conducive to proper compaction of the soil.

Any imported material used as structural fill should consist of material meeting the requirements for Gravel Borrow in Section 9-03.14(1) of the 2010 WSDOT *Standard Specifications for Road, Bridge, and Municipal Construction* (WSDOT *Standard Specifications*). If imported fill is placed during periods of wet weather or under wet conditions, the amount of fines should be limited to 5 percent by dry weight, based on the fraction passing the ¾-inch sieve. At the reclaimed water facility location, where the over-excavated subgrade may consist of relatively soft soil, an initial lift of crushed ballast may be necessary to facilitate placement of upper lifts. Crushed ballast, if used, should meet the requirements of Section 9-03.9(2) of the WSDOT *Standard Specifications.*

Structural fill soils should be moisture conditioned to within about 3 percent of optimum moisture content, placed in loose, horizontal lifts less than 8 inches in thickness, and compacted to at least 95 percent of the maximum dry density, as determined using test method ASTM D 1557 (modified Proctor).

Behind subgrade walls, the imported structural fill should be placed in lifts not exceeding 12 inches in loose thickness and compacted to a minimum of 90 percent of the maximum dry density. Beneath pavements, the structural fill should be placed in lifts not exceeding 12 inches in loose thickness and compacted to a minimum of 92 percent of the maximum dry density.

The procedure to achieve proper density of a compacted fill depends on the size and type of compacting equipment, the number of passes, thickness of the layer being compacted, and certain soil properties. When access restricts the use of heavy equipment, smaller equipment can be used, but the soil must be placed in thin enough lifts to achieve the required compaction.

Generally, loosely compacted soils are a result of poor construction technique or improper moisture content. Soils with a high percentage of silt or clay are particularly susceptible to becoming too wet, and coarse-grained materials easily become too dry, for proper compaction. Silty or clayey soils with a moisture content too high for adequate compaction should be dried as necessary, or moisture conditioned by mixing with drier materials, or other methods. Sprinkling is sometimes required to wet a coarse-grained soil to near optimum moisture content before compaction.

Earthwork can be performed most economically during dry weather conditions. Compaction should take place immediately after subgrade preparation, and the newly prepared areas should be protected against saturation from precipitation. If protective measures are not provided, and the subgrade soils become saturated and spongy due to rain and/or construction traffic, the required relative compaction may not be achieved. In such an event, the soft soils should be removed. Imported sand and gravel meeting the gradation specification described above should be placed to bring the affected area to proposed grade. If earthwork must be performed in wet weather, the construction techniques described in Section 3.5 should be implemented.

3.5 WET WEATHER EARTHWORK

The onsite fill and native soils are considered to be moderately to highly moisture sensitive. As a result, it may be difficult to control the moisture content of the onsite soils during periods of wet weather and the on-site soils may be disturbed by construction equipment. If fill is to be placed or earthwork is to be performed in wet weather or under wet conditions, the contractor may reduce soil disturbance by:

- Accomplishing earthwork in small sections
- Sloping excavated surfaces to promote surface water runoff
- Limiting construction traffic over unprotected soil
- Limiting the size and type of construction equipment used
- Providing gravel “working mats” over areas of prepared subgrade
- Removing wet surficial soil prior to commencing fill placement each day
- Sealing the exposed ground surface by rolling with a smooth drum compactor at the end of each work shift
- Providing upgradient perimeter ditches or low earthen berms and using temporary sumps to collect runoff and prevent water from ponding and damaging exposed subgrades
- Stabilizing the non-organic, onsite soil with an additive (such as lime or cement kiln dust) to allow its use in wet weather.

3.6 TEMPORARY EXCAVATIONS

We understand that excavations up to about 22 ft in depth will be required at the location of proposed ABs 3 and 4 and the proposed RAS mixing box. Based on the soil conditions observed in exploratory boring B-1-11, we anticipate that the on-site soils can be excavated using conventional heavy duty construction equipment. In areas, ripping and/or other special excavation techniques may be required. In addition, cobbles and boulders may be encountered and the contractor should be prepared to remove such material if encountered.

Based on our current understanding of ABs 3 and 4, a finish floor elevation (FFE) of 132 ft is proposed; temporary excavation down to as low as elevation 128 ft may be necessary for construction. Nearby existing structures include Primary Clarifer 1 and Aeration Basin 1, which have FFEs of approximately 138 and 132 ft, respectively. The proposed location of the footprint for ABs 3 and 4 appears to be set back far enough from existing structures to allow temporary construction slopes of 2H:1V in most areas. In localized areas, temporary excavations may be required immediately adjacent to existing underground structures, such as portions of the RAS mixing box excavation nearest to the walls of Clarifier 1 and Aeration Basin 1, or in the immediate vicinity of existing underground utilities. Temporary excavations immediately adjacent to existing structures could require shoring, bracing, or trench boxes.

For planning purposes relative to temporary unsupported excavations, the guidelines presented in *Safety Standards for Construction Work Part N*, Washington Administrative Code (WAC) 296-155-657, may be used. These guidelines govern safety aspects of all excavations in soil and require sloping or engineered shoring for all excavations greater than 4 ft in depth. Per these guidelines, the existing on-site alluvial deposits and outwash soils are classified as Type C soils and the dense, glacial till is classified as Type A. Temporary unsupported excavations within Type C soils should be sloped no steeper than 1½H:1V; temporary unsupported excavations within Type A soils may be sloped as steep as ¾H:1V. However, the recommended maximum slopes are applicable to temporary excavations above the water table only; flatter side slopes are necessary for excavations below the water table and where groundwater seepage is encountered. Also, the recommended temporary slope inclinations are for excavations up to 20 ft in depth. Due to these limitations and the likelihood of encountering the regional groundwater table, plus perched zones of water, we recommend that temporary slopes of 2H:1V be employed for construction of the ABs and RAS mixing box.

With time and the presence of seepage and/or precipitation, the stability of temporary unsupported cut slopes can be significantly reduced. Therefore, all temporary slopes should be protected from erosion by installing a surface water diversion ditch or berm at the top of the slope and by covering the cut face with well-anchored sheets of visqueen. In addition, the contractor should monitor the stability of the temporary cut slopes and adjust the construction schedule and slope inclination accordingly.

3.7 TEMPORARY SHORING

As discussed in the previous section, sloped excavations may not be feasible in certain locations due to space limitations or other constraints and temporary shoring may be required. Where the retained height of soil is 6 ft or less and the soils encountered allow it, a temporary gravity retaining wall is a feasible and relatively inexpensive temporary shoring option. Such a wall could be constructed using concrete ecology blocks founded on a dense subgrade and laid back at a suitable batter; the design of such walls could be completed by the Contractor. Where greater retained heights are required, a shoring system consisting of a series of steel H-piles placed in pre-drilled holes and encased with concrete may be used. Timber lagging is typically used to span between the soldier piles and provide horizontal support. If shoring in excess of about 12 ft in height is required, tiebacks may be needed for the system to remain economical. Recommendations relative to design and construction of such a shoring system are provided below.

3.7.1 LATERAL EARTH PRESSURES

For cantilevered shoring systems that are free to rotate at the top, and shoring systems with a single row of tiebacks, the active and passive earth pressures shown on Figure 3 are recommended for use in design. Figure 3 also shows the recommended lateral earth pressures for use in design of shoring systems with multiple levels of tiebacks. No seismic lateral earth pressures are provided for the shoring system because it is assumed to be a temporary structure. It should be noted that even though Figure 3 shows the groundwater level at the base of the excavation, the lateral earth pressures shown are also applicable for design of shoring systems with the groundwater level located several feet below the base of the excavation, as recommended in Section 3.11.

Above the bottom of the excavation, active earth pressure should be assumed to act over the exposed wall area, and over 1 pile diameter below the bottom of the excavation. The passive resistance may be calculated using an equivalent fluid pressure of 210 pcf, acting over an effective width of two pile diameters. This value is allowable; a factory of safety has been applied. The passive earth pressure should be ignored to a depth of 2 ft below the bottom of the proposed excavation.

If the shoring system will be subjected to the influence of surcharge loading within a horizontal distance equal to or less than the exposed height of the shoring system, the shoring system should be designed for the additional horizontal pressure. It is typical practice to accommodate traffic and construction equipment loading with a vertical surcharge pressure of 250 psf. Earth stockpiles or other larger surcharge loads should be addressed by use of a higher surcharge pressure, if applicable. For uniform surcharge pressures, Figure 3 depicts the additional lateral pressure recommended for use in design.

3.7.2 SOLDIER PILE CAPACITY

Soldier piles founded at least 8 ft into dense, undisturbed glacially consolidated materials (such as glacial till) may be designed for an allowable vertical capacity of 10,000 pounds per square foot (psf) in end bearing. The allowable end bearing pressure may be increased by 1,500 psf for each additional foot of penetration to a maximum of 22,000 psf in dense, glacially consolidated soils. In addition, an allowable frictional resistance of 1,000 psf may be included in determining the allowable vertical capacity of each pile; however, only the portion of the pile extending more than 2 ft below the base of the excavation should be considered in calculating vertical capacity due to frictional resistance.

3.7.3 TIMBER LAGGING

Timber lagging should be designed to resist lateral earth pressure and surcharge loads. Due to the soil arching effect behind the soldier pile wall, 50 percent of the lateral earth pressure uniformly distributed over the width of the lagging may be used to design lagging that is simply supported.

3.7.4 SOLDIER PILE AND LAGGING INSTALLATION CONSIDERATIONS

During excavation and placement of timber lagging, some voids will inevitably occur behind the timber lagging. Ground subsidence could occur if these voids are left unattended. We therefore recommend that these voids, when present, be backfilled with free-draining material such as pea gravel to minimize horizontal movement and subsidence of the ground surface behind the wall. In addition, the maximum unsupported height of the exposed cut before placing lagging should be limited to 6 ft. The unsupported height should be reduced if sloughing occurs. Furthermore, timber lagging should be installed, and backfilled if necessary, on the same day the vertical excavation is made.

3.7.5 TIEBACK ANCHORS

Soldier pile walls more than about 12 ft in height may require tiebacks to remain cost effective. If used, the tiebacks should extend beyond zones of compacted fill or loose surficial soils. In addition, the bonded portion of the tieback should be at least 15 ft long and located entirely within undisturbed native materials located beyond the “No-Load Zone” (Figure 3). The ultimate unit adhesion that can be developed at the grout/soil interface of the tieback is highly dependent on subsurface conditions and construction techniques utilized. Therefore, the contractor should be responsible for designing tiebacks. For preliminary estimating purposes, assuming auger-cast tiebacks are used, an allowable load transfer of 1,000 psf can be used in the native glacially consolidated deposits. Higher tieback capacities may be achieved if small-diameter pressure grouted tiebacks are used.

3.8 FOUNDATION SUPPORT

We recommend that footings for the proposed lightly-loaded structures (i.e., the reclaimed water facility, cogeneration building, and WAS thickening building) be founded on either conventional spread footings bearing directly on stiff alluvium or compacted structural fill bearing on stiff alluvium or medium dense recessional outwash, or mat footings bearing on 3 ft of granular fill as described in our recommendations for site earthwork. Where foundations are constructed in dense, glacially overconsolidated soil, such as the glacial till expected at ABs 3 and 4 and the RAS mixing box, footings can be constructed directly upon the native glacial soils.

For frost considerations, all exterior footings should be founded at least 18 inches below the lowest adjacent finished grade; interior footings may be founded a minimum of 12 inches below top of slab. We recommend minimum footing widths of 18 and 24 inches for continuous strip and isolated column footings, respectively.

Provided continuous or isolated spread footings are founded as described above, they may be proportioned using a maximum net allowable soil bearing pressure of 2,500 pounds per square foot (psf) for the reclaimed water facility, cogeneration building, and WAS thickening building and 4,000 psf for ABs 3 and 4 and the RAS mixing box. The term "net allowable bearing pressure" refers to the pressure that can be imposed on the soil at foundation level resulting from the total of all dead plus live loads, exclusive of the weight of the footing or any backfill placed above the footing. The net allowable bearing pressures may be increased by one-third for transient wind or seismic loads.

Lateral loads will be resisted by passive earth pressures on the sides of the footings and by friction on the base of the footings and slabs. Passive and frictional resistance may be evaluated using the design parameters presented in Section 3.10.

If the proposed structures are supported on spread footings and the bearing soils are prepared as described in Sections 3.3, total and differential settlements are anticipated to be within 1 inch and ½ inch, respectively. In addition, it is anticipated that a majority of settlement will occur during construction, as loads are applied. Post-construction settlements will be less.

3.9 CONCRETE SLAB-ON-GRADE FLOORS

Prior to slab construction, the slab subgrade soil should be proof-rolled with heavy construction equipment to identify any soft or unstable zones and provide a smooth, unyielding surface for slab support. Any areas exhibiting significant deflection, pumping, or weaving that cannot be adequately reworked and/or compacted should be overexcavated and backfilled with material compacted to at least 95 percent of the maximum density as determined by ASTM test method D 1557. It is recommended that proof rolling be observed by the geotechnical engineer.

We recommend that interior concrete slab-on-grade floors be underlain by a minimum of 6 inches of compacted, clean, free-draining sand and gravel with less than 5 percent passing the U.S. Standard No. 200 sieve (based on a wet sieve of that portion passing the U.S. Standard No. 4 sieve). The purpose of this layer is to provide uniform support for the slab and provide a capillary break. To reduce the potential for water vapor migration through floor slabs, we recommend a continuous impermeable membrane be installed below the slab as a condensation barrier. American Concrete Institute (ACI) guidelines recommend that 4 inches of compacted granular fill, such as 5/8-inch minus crushed rock be placed over the barrier to facilitate curing of the concrete floor slab and to protect the condensation barrier. The ACI no longer recommends sand for the protection layer. If moisture control within the building is critical, we recommend an inspection of the condensation barrier to verify that all openings have been properly sealed.

3.10 BELOW GRADE WALLS

The magnitude of lateral earth pressures that develop against below-grade walls will depend upon the inclination of any adjacent slopes, type of backfill, degree of wall restraint, method of backfill placement, degree of backfill compaction, drainage provisions, magnitude and location of any adjacent surcharge loads, and the degree to which the wall can yield laterally during or after placement of backfill. When the wall is restrained against lateral movement or tilting, the soil pressure exerted is the at-rest soil pressure. Such wall restraint may develop if a rigid structural network is constructed prior to backfilling, or if the wall is inherently stiff or is otherwise restrained from rotation. In contrast, active soil pressure will be exerted on a subsurface structure or wall if its top is allowed to rotate or yield a distance of approximately 0.001 times its height or greater.

For this project, it is anticipated that the proposed below-grade structures will be restrained against rotation and that the structures will have level backfill. As such, the below-grade structures should be designed for a horizontal at-rest equivalent fluid pressure of 52 pounds per cubic foot (pcf) above the design groundwater elevation and 87 pcf below the design groundwater elevation. If yielding walls are required, they should be designed for an active earth pressure equivalent to that generated by a fluid weighing 32 pcf above the design groundwater elevation and 78 pcf below the design groundwater elevation. The values recommended for use below the design groundwater elevation include hydrostatic pressure.

The above recommendations regarding active and at-rest earth pressures assume that the backfill placed against the below-grade walls will consist of properly compacted structural fill, and no adjacent surcharge loads. If the subsurface walls will be subjected to the influence of surcharge loading within a horizontal distance equal to or less than the height of the walls, the walls should be designed for the additional horizontal pressure. For rigid walls with level backfill, a uniformly distributed lateral pressure of 0.43 times the surcharge pressure should be included. For walls with level backfill that are free to rotate during loading, a uniformly distributed lateral pressure of 0.27 times the surcharge pressure should be included.

Resistance to lateral loads may be assumed to be provided by friction acting on the base of foundations, and by passive lateral earth pressures acting against the below-grade portion of structures. For design purposes, the passive resistance of well-compacted fill placed against walls or the sides of foundations may be estimated using an equivalent fluid density of 295 pcf for soils above the groundwater table and 140 pcf for soils below the groundwater table. The recommended values include a safety factor of about 1.5 and are based on the assumption that the ground surface adjacent to the structure is level in the direction of movement for a distance equal to or greater than twice the embedment depth. In design computations, the upper 12 inches of passive resistance should be neglected if the soil is not covered by floor slabs or pavement. If future plans call for the removal of the soil providing resistance, the passive resistance should not be considered. Furthermore, the recommended passive pressures are based on the assumption that the wall will be able to translate horizontally a distance equivalent to about 1 percent of the wall depth during a strong motion earthquake.

We recommend that an allowable coefficient of friction between concrete and soil of 0.4, applied to vertical dead loads only, be used to calculate the resistance to sliding at the base of foundation elements bearing on undisturbed fill, glacial drift, or well-compacted imported granular fill. However, if passive and frictional resistance are considered together, one half the recommended passive soil resistance value should be used since larger strains are required to mobilize the passive soil resistance as compared to frictional resistance. A safety factor of about 1.5 is included in the base friction design value. We do not recommend increasing the coefficient of friction to resist seismic or wind loads.

For the seismic case, lateral earth pressures due to the design earthquake can be assumed as a uniform pressure of 14H pounds per square foot (psf; H is the wall height in feet), assuming at-rest conditions. The seismic earth pressures would act only in one direction (i.e., only on one side of the structure), which is the same direction as the inertial forces. As such, there will be unbalanced seismic forces on the subgrade walls. Refer to Figure 4.

The combination of the seismic earth pressures and the inertial forces will be resisted by the friction at the base of foundation elements and/or additional lateral earth pressures (in addition to the existing at-rest pressure) on the opposite side of the structure. As shown on Figure 4, the earth pressures on the opposite side of the structure will increase from an at-rest pressure value to a value that is greater than the at-rest pressures, but less than or equal to passive pressures of 295 and 140 pcf above and below the design groundwater elevation, respectively.

3.11 CONSTRUCTION DEWATERING

The need for construction dewatering systems will depend on the final configurations and elevations of the planned improvements and the groundwater level at the time of construction. Based on the subsurface conditions observed at the project site, dewatering will likely be required within the excavation for proposed ABs 3 and 4. Lesser dewatering efforts may be necessary at the RAS mixing box and at the reclaimed water facility. At the proposed ABs location, the glacial till encountered below the groundwater table should be expected to yield small to moderate amounts of water. Overlying recessional outwash, fill, and portions of the glacial till above the groundwater table may contain perched zones that will also require dewatering. Groundwater seepage will tend to destabilize excavation slopes and increase lateral loads on shoring systems.

We recommend that the temporary excavations be dewatered such that the groundwater level is maintained at least 2 ft below the bottoms of the excavations. In our opinion, a combination of sumps and pumps and/or wells could effectively dewater excavations that extend below the groundwater level. It is also our opinion that the contractor should be responsible for the design, installation, monitoring, and maintenance of all required temporary excavation dewatering systems. The contractor should be required to submit its dewatering plans, prepared by a qualified professional engineer or registered geologist with hydrogeology specialty, to the Engineer for review prior to construction. Regardless of the dewatering technique used, it should be installed and operated such that natural soils are prevented from being removed along with the groundwater.

Excavation dewatering will result in a lowering of the water table adjacent to the excavation. Lowering the water table could lead to settlement of the surrounding soil. However, the existing structures are founded at or about the same elevation as the proposed excavations and the soils beneath the existing structures were presumably previously dewatered at the time of their construction. Therefore, it is our opinion that excavation dewatering for the proposed structures will have limited impact on existing surrounding structures. However, before the dewatering system is implemented, the contractor, or his consultant, should evaluate the possible effects the system could have on surrounding existing structures.

Dewatering wells, if used, should be operated continuously for as long as they are needed in a given area. Turning the wells off at night and turning them back on the next day is not recommended because it causes rapid drawdown conditions in the soil and tends to increase caving and sloughing of excavation slopes. Dewatering should continue until the structures have been backfilled and are capable of resisting hydrostatic forces.

3.12 DESIGN GROUNDWATER ELEVATION

The results of the subsurface investigations conducted at the project site by Hong West & Associates and Landau Associates suggest that groundwater elevations throughout the site are somewhat variable. In addition to local on-site variations, it is anticipated that groundwater conditions will vary depending on the season, local subsurface conditions, and other factors.

Based on the available groundwater data for the project site, we recommend designing ABs 3 and 4 and the RAS mixing box based on a groundwater elevation that coincides with the ground surface in the vicinity of these structures.

3.13 BUOYANCY AND UPLIFT CONSIDERATIONS

Buried tank-like structures, such as the proposed aeration basins, will experience an upward buoyant force when the groundwater level around the outside of the structure is higher than the fluid level inside the structure. These upward forces may potentially damage the bottom of the structure if it is not properly designed to resist such forces. The weight of the structure, the weight of soil directly above the extended base of the structure (if any), and the soil friction on the walls of a structure without an extended base will act to resist uplift forces due to hydrostatic pressure acting on the base of the structure. Extending the base of the structure beyond the outside of its perimeter would increase the uplift resistance of the structure.

If the below-grade structures will not have an extended base and they are backfilled with properly compacted granular fill, the uplift resistance provided by the soil friction on the walls of the structures can be determined using the following formula:

$$F_s = 0.012H_1^2 + 0.024H_1H_2 + 0.006H_2^2$$

Where: F_s = shearing resistance of soil to wall (in kips per foot of wall)
H_1 = distance between ground surface and top of groundwater table (in feet)
H_2 = distance between top of groundwater table and bottom of structure (in feet).

To compute the resisting force provided by properly compacted granular backfill material surrounding a structure with an extended base, the weight of the soil directly above the extended base can be added directly to the shearing resistance of the soil. Soil unit weights of 125 pcf and 63 pcf should be assumed above and below the groundwater elevation, respectively. The uplift resistance provided by the shearing resistance of the soil can be determined using the following formula:

$$F_{sb} = 0.018H_1^2 + 0.036H_1H_2 + 0.009H_2^2$$

Where: F_{sb} = shearing resistance of soil (in kips per foot of wall)

H_1 = distance between ground surface and top of groundwater table (in feet)

H_2 = distance between top of groundwater table and bottom of structure (in feet).

Uplift pressures on the proposed below-grade structures could be reduced by providing an under-drain system and a means for dewatering prior to emptying the structures. A system consisting of a gravel under-drain, sumps, and sump pumps may be adequate for this purpose. Several sumps and sump pumps may be needed at various locations around the perimeters of the tanks due to the depth of draw-down required. It is also recommended that the sumps be monitored to confirm the groundwater level prior to emptying the tanks. It may also be feasible to install pressure relief valves at the bottom of the tanks that allow groundwater to discharge into the tanks as they are being emptied.

3.14 CORROSION CONSIDERATIONS

Buried structures such as steel tanks and metallic piping can be subject to corrosion, particularly in soils with low resistivity and low pH. In order to determine the likelihood for corrosion of underground elements at the project site, others (Hong West & Associates 1995) obtained soil samples at various locations throughout the site for determination of soil pH and minimum resistivity. In the vicinity of the proposed reclaimed water facility, two silt/clay soil samples collected at depths of 6 to 11 ft reportedly had pH values ranging from 7.6 to 7.8 and minimum resistivity readings ranging from 3,100 to 3,800 ohm/cm. In the vicinity of the proposed ABs and RAS mixing box, a single silty sand soil sample collected at a depth of 8 ft reportedly had a a pH of 6.8 and a minimum resistivity of 15,000 ohm/cm.

The test results presented above can be used by the designer in selecting appropriate construction materials and thicknesses. The test data can also be used by the designer to determine if cathodic protection will be required. We understand that these results indicate that the on-site soils have a "moderate" to "severe" potential for sulfate attack. Consequently, sulfate-resisting Portland cement (Type V) should be used to construct the proposed below-grade concrete structures.

4.0 GEOTECHNICAL CONSULTATION AND CONSTRUCTION MONITORING

Landau Associates recommends that a geotechnical engineer familiar with the project design review the earthwork and foundation portions of the design drawings and specifications. The purpose of the review is to verify that the recommendations presented in this report have been properly interpreted and incorporated in the design and specifications.

We recommend that geotechnical construction monitoring services be provided. These services should include observation by geotechnical personnel during removal of existing topsoil and other loose soil from within the proposed building areas. Observation by geotechnical personnel is also recommended during subgrade preparation operations to verify that design subgrade conditions are obtained beneath the proposed structures and during fill placement/compaction activities. We also recommend that periodic in-place density testing be performed to verify that an appropriate degree of compaction is obtained. In addition, all building areas and footing excavations should be observed by geotechnical personnel prior to concrete placement, to verify that subgrade conditions are in accordance with the recommendations presented in this report.

The purpose of the services recommended above would be to observe compliance with the design concepts, specifications, and recommendations of this report, and in the event subsurface conditions differ from those anticipated before the start of construction, provide revised recommendations appropriate to the conditions revealed during construction. Landau Associates would be pleased to provide these services for you.

5.0 USE OF THIS REPORT

Landau Associates prepared this report for the exclusive use of Kitsap County and Brown and Caldwell for specific application to the design of the proposed Central Kitsap Wastewater Treatment Plant Phase IV Upgrades project in Kitsap County, Washington. Use of this report by others or for another project is at the user's sole risk. Within the limitations of scope, schedule, and budget, our services have been conducted in accordance with generally accepted practices of the geotechnical engineering profession; no other warranty, express or implied, is made as to the professional advice included in this report.

The conclusions and recommendations contained in this report are based in part upon the subsurface data obtained from the explorations completed by others at the site and the explorations we completed for this study. There may be some variation in subsurface soil and groundwater conditions at the project site, and the nature and extent of the variations may not become evident until construction. Accordingly, a contingency for unanticipated conditions should be included in the construction budget and schedule.

If variations in subsurface conditions are encountered during construction, Landau Associates should be notified for review of the recommendations of this report, and revision of such if necessary. If there is a substantial lapse of time between submission of this report and the start of construction, or if conditions change due to construction operations at or adjacent to the project site, we recommend that we review this report to determine the applicability of the conclusions and recommendations contained herein.

We appreciate the opportunity to provide geotechnical services on this project and look forward to assisting Brown and Caldwell and Kitsap County during the construction phase of the project. If you have any questions or comments regarding the information contained in this report, or if we may be of further service, please call.

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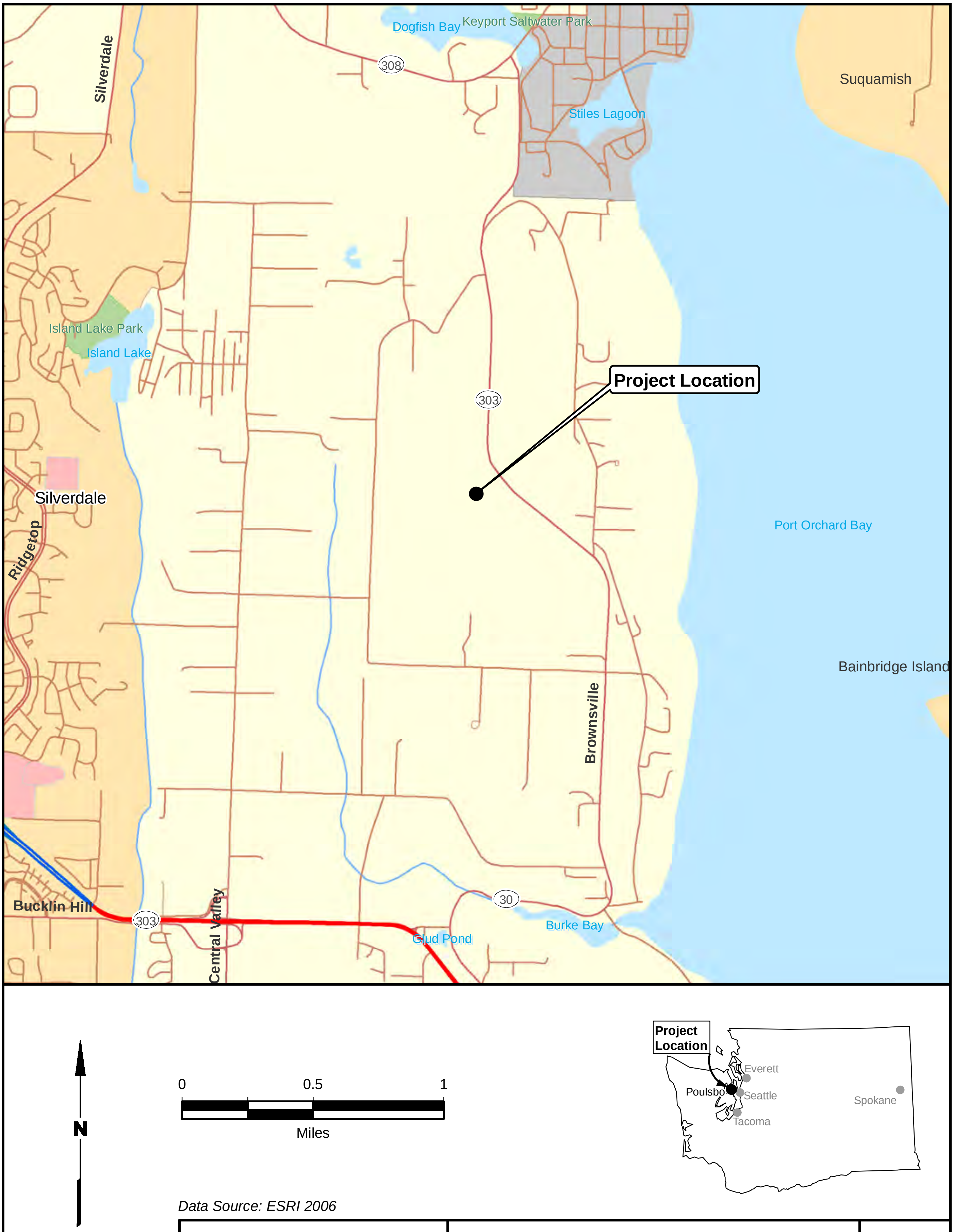

Data Source: ESRI 2006

Y:\Projects\080003\010\Fig1.mxd 5/27/2011

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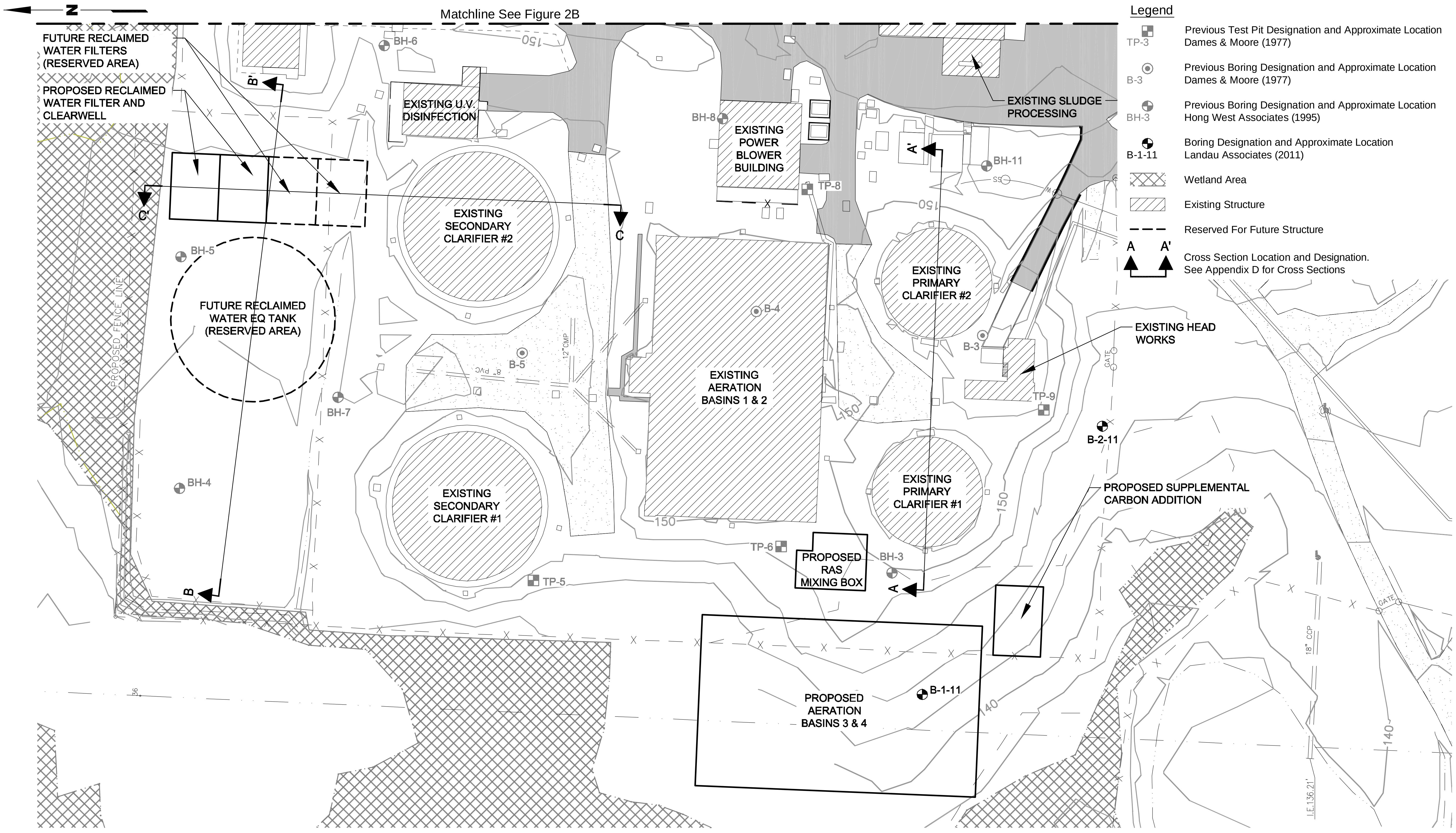
Central Kitsap WWTP
Phase IV Upgrades
Kitsap County, Washington

Vicinity Map

Figure
1



Base map source: Brown & Caldwell (May 2011)

0 60 120
Scale in Feet

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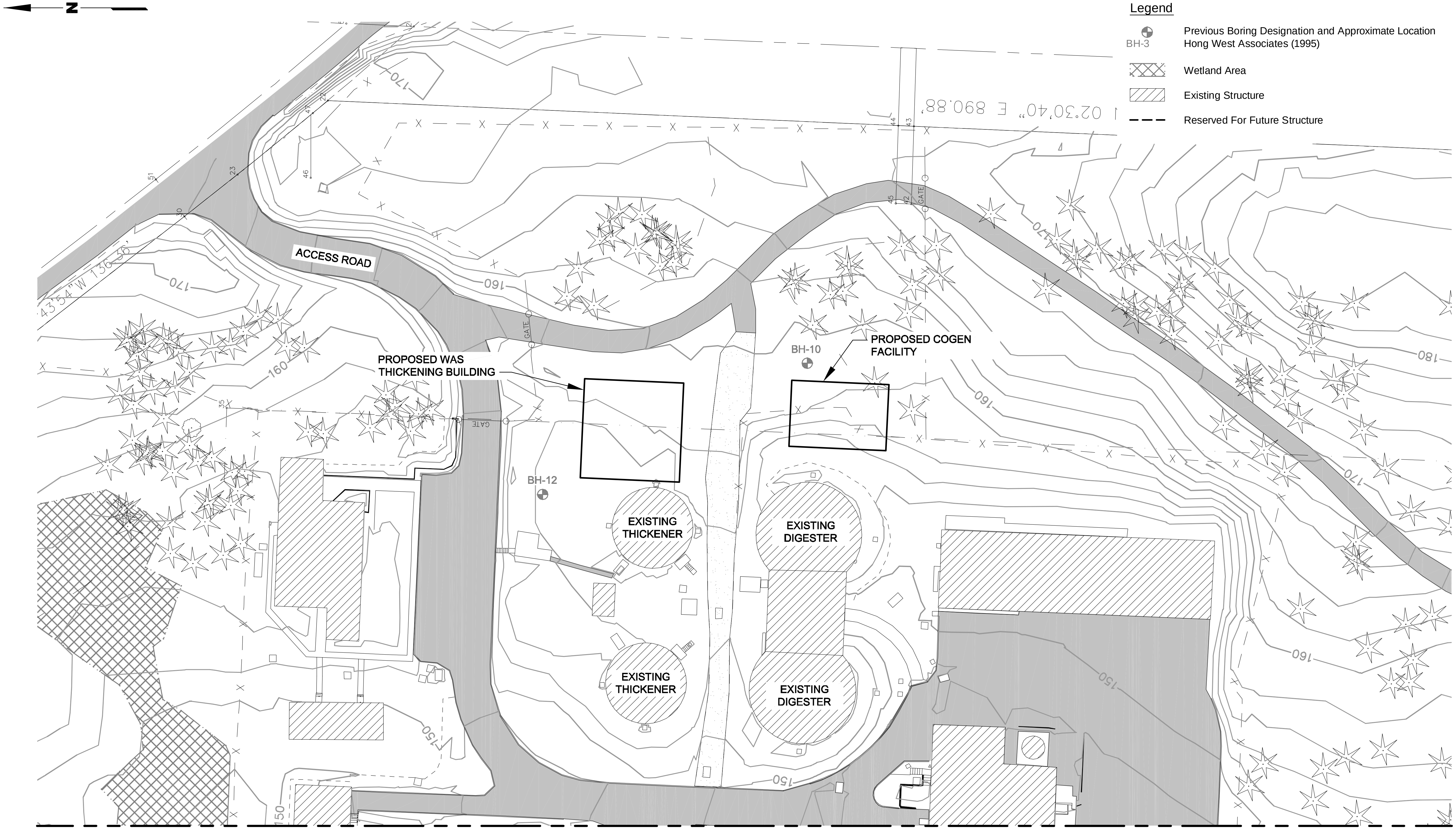
Central Kitsap WWTP
Phase IV Upgrades
Kitsap County, Washington

Site and Exploration Plan

Figure
2A

LANDAU ASSOCIATES, INC. | V:\080\030\010\Figure 2A-2B.dwg (A) "Figure 2A" 7/22/2011



Matchline See Figure 2A

Base map source: Brown & Caldwell (May 2011)

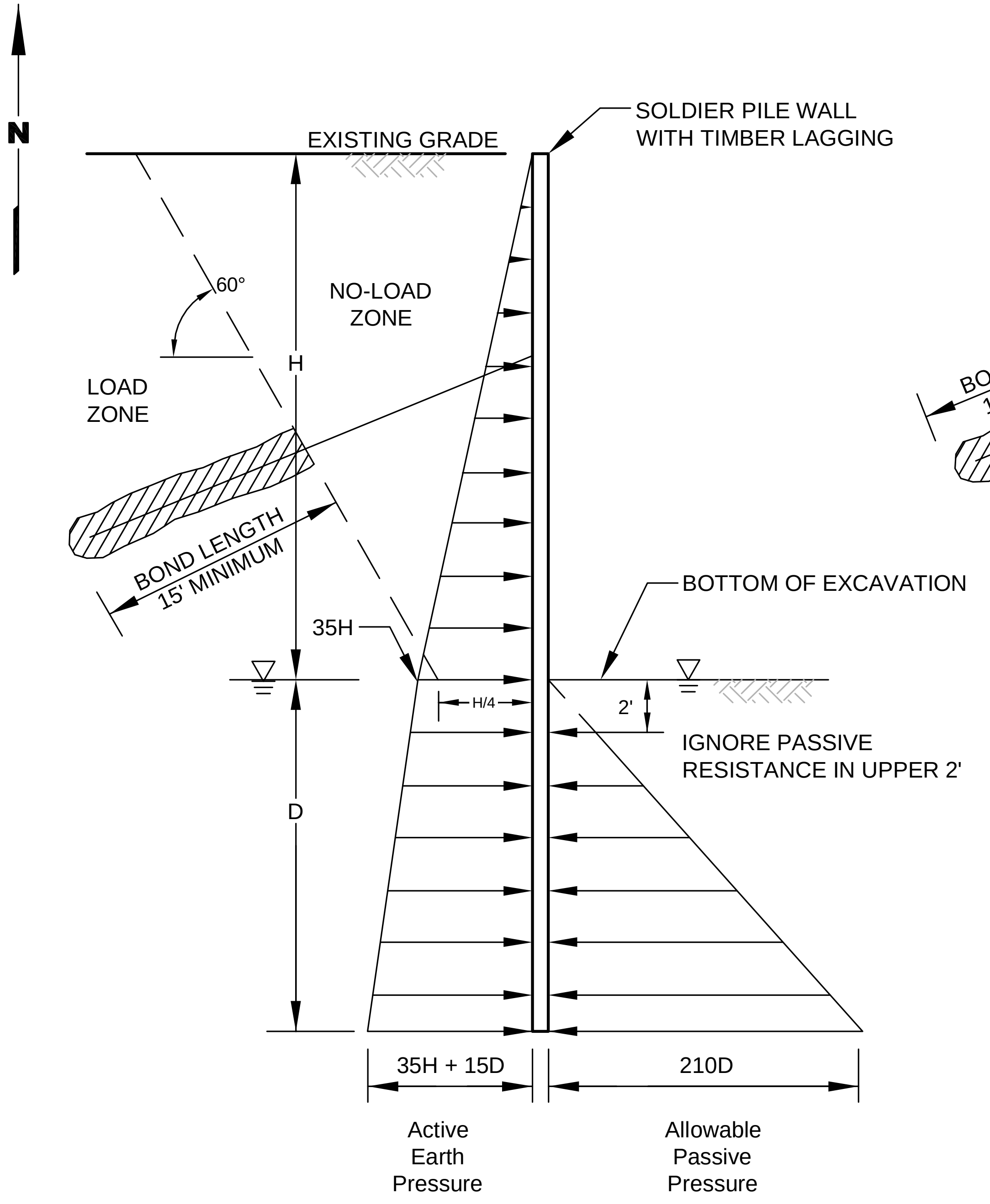
LANDAU ASSOCIATES

Central Kitsap WWTP
Phase IV Upgrades
Kitsap County, Washington

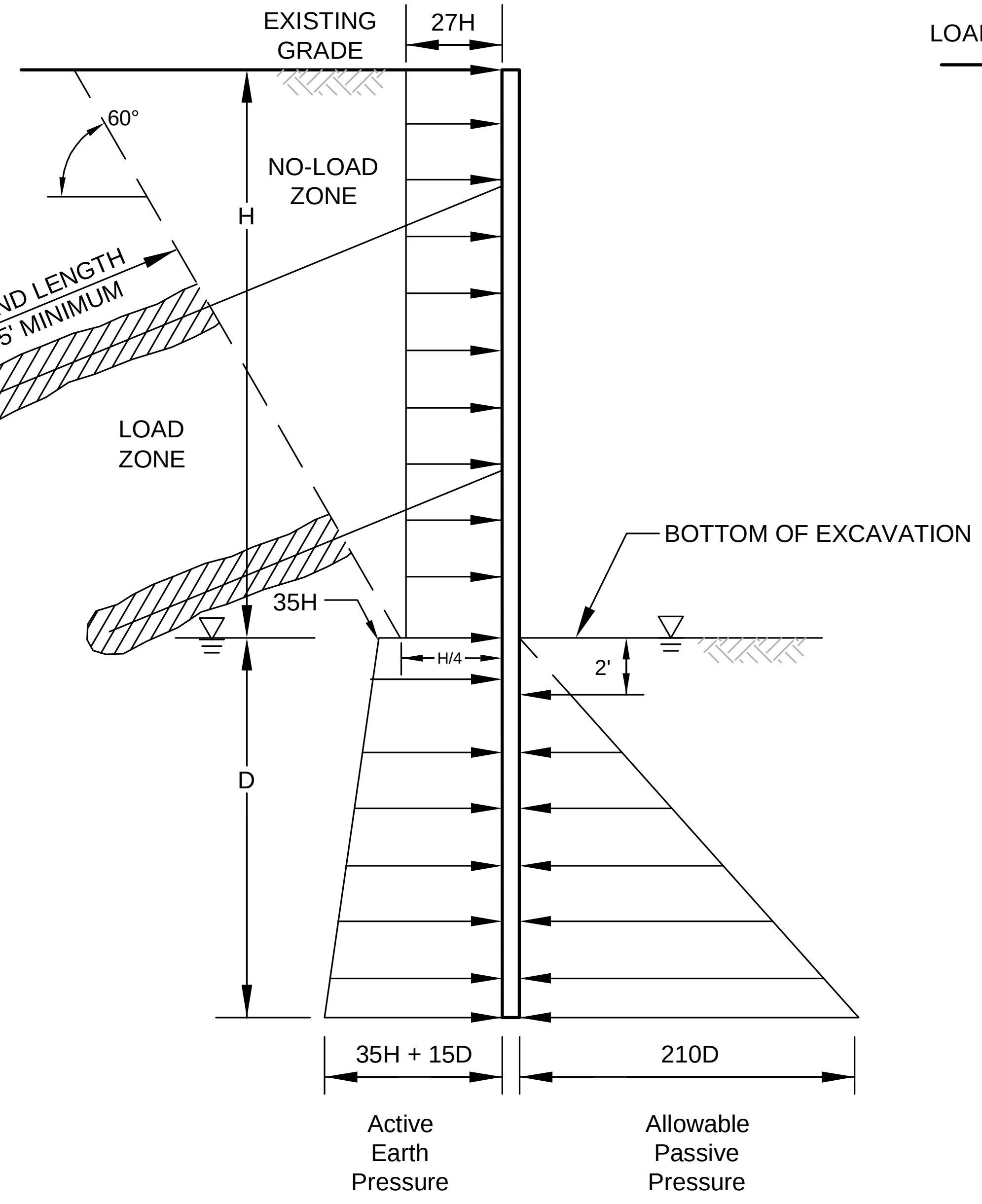
Site and Exploration Plan

Figure
2B

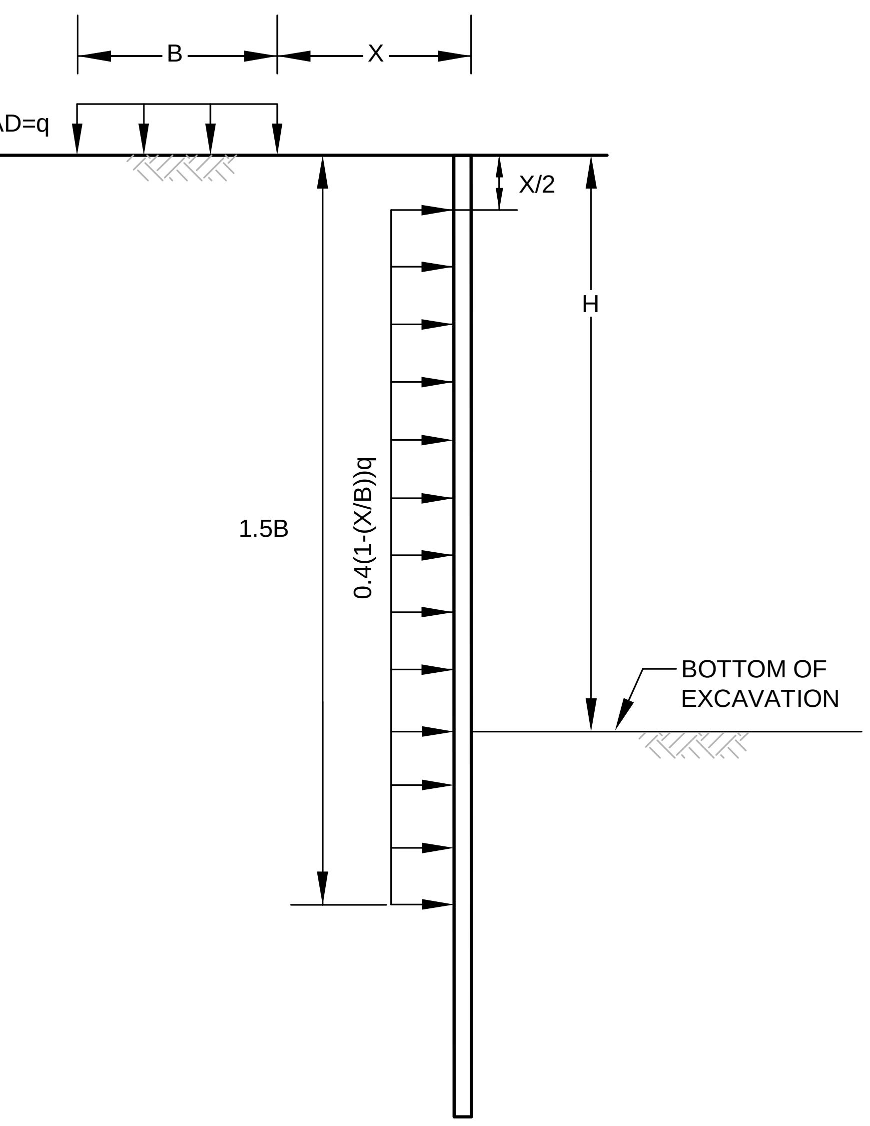
LANDAU ASSOCIATES, INC. | V:\080\030\010\Figure 2A-2B.dwg (A) "Figure 2B" 7/22/2011



RECOMMENDED EARTH PRESSURES
CANTILEVER/SINGLE LEVEL OF BRACING



RECOMMENDED EARTH PRESSURES
MULTIPLE LEVELS OF BRACING



RECOMMENDED LATERAL PRESSURES
FROM UNIFORMLY DISTRIBUTED SURCHARGE

Notes

1. HEIGHT (H) AND DEPTH (D) MEASURED IN FEET.
2. ACTIVE AND PASSIVE PRESSURES ARE IN TERMS OF POUNDS PER SQUARE FOOT (PSF)
3. LOAD (q) IN PSF
4. PRESSURES FOR CONSTRUCTION LOADING SHOULD BE ADDED TO EITHER OF THE TWO DIAGRAMS
5. RECOMMENDED PASSIVE RESISTANCE INCLUDES A FACTOR OF SAFETY OF 1.5
6. REFER TO REPORT TEXT FOR DISCUSSION OF DESIGN GROUNDWATER LEVEL
7. APPLY ACTIVE PRESSURE OVER WALL AREA OVER HEIGHT OF LAGGING AND OVER DRILLED SHAFT DIAMETER BELOW LAGGING
8. APPLY PASSIVE PRESSURE OVER 2 TIMES WIDTH OF DRILLED SHAFT FOR PILE
9. THE PASSIVE PRESSURE PRESENTED IS AN ALLOWABLE VALUE AND INCLUDES A FACTOR OF SAFETY OF ABOUT 1.5

Not to Scale

Central Kitsap WWTP | V:\080\030\010\Figure 3_4.dwg (A) "Figure 3" 5/27/2011

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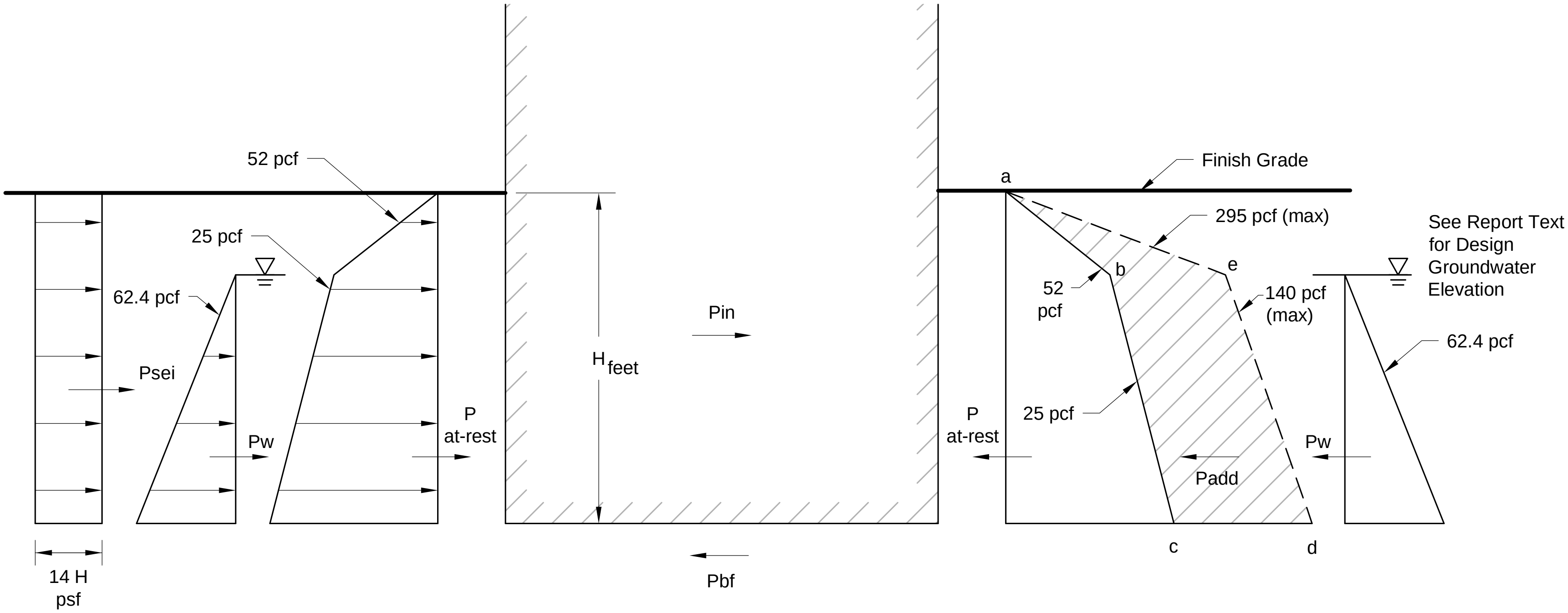
Central Kitsap WWTP
Phase IV Upgrades
Kitsap County, Washington

**Lateral Earth Pressures
For Temporary Shoring**

Figure
3



Pin = Inertial Force/ft

Pw = Water Force/ft

Psei = Seismic Force/ft

Pbf = Resistance Force by Base Friction/ft

Pat-rest = At-rest Force/ft

Padd = Additional Lateral Force/ft

Presisting = Pat-rest + Padd ≤ Ppassive

Pat-rest + Pw + Psei + Pin = Pat-rest + Pw + Padd

Padd is defined by "a", "b", "c", "d", & "e"

Not to Scale

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Central Kitsap WWTP
Phase IV Upgrades
Kitsap County, Washington

Lateral Earth Pressures on Subgrade Walls

Figure
4

APPENDIX A

Field Explorations

APPENDIX A
FIELD EXPLORATIONS

Subsurface conditions at the project site were explored on April 26, 2011. The exploration program consisted of advancing and sampling 2 exploratory borings (B-1-11 and B-2-11) at the approximate locations illustrated on the Site and Exploration Plans (Figures 2A and 2B of this report). The exploratory borings were advanced to depths ranging from about 16.3 to 25.7 ft below the existing ground surface using a track-mounted drill rig and the hollow-stem auger drilling technique. Holocene Drilling, Inc. of Puyallup, Washington advanced the borings under subcontract to Landau Associates. The explorations were located approximately in the field by hand taping from existing physical features and referenced to a base map provided by Brown and Caldwell. The ground surface elevations at the exploratory boring locations were estimated based on topographic information shown on the above referenced base map.

The field exploration program was coordinated and monitored by a Landau Associates geotechnical engineer who also obtained representative soil samples, maintained a detailed record of the subsurface soil and groundwater conditions, and described the soil encountered by visual and textural examination. Each representative soil type observed in our exploratory borings was described using the soil classification system shown on Figure A-1, in general accordance with American Society for Testing and Materials (ASTM) D2488, *Standard Recommended Practice for Description of Soils (Visual-Manual Procedure)*. Logs of the exploratory borings are presented on Figures A-2 and A-3. These logs represent our interpretation of subsurface conditions identified during the field exploration program. The stratigraphic contacts shown on the summary logs represent the approximate boundaries between soil types; actual transitions may be more gradual. The soil and groundwater conditions depicted are only for the specific date and locations reported and, therefore, are not necessarily representative of other locations and times. A further discussion of the soil and groundwater conditions observed is contained in the text portion of this report.

Disturbed samples of the soil encountered in the exploratory borings were obtained at selected intervals using a 1.5-inch inside-diameter Standard Penetration Test split-spoon sampler. The sampler was driven up to 18 inches into the undisturbed soil ahead of the drill bit with a 140-lb hammer falling a distance of approximately 30 inches. The number of blows required to drive the sampler for the final 12 inches of soil penetration, or part thereof, is noted on the boring logs, adjacent to the appropriate sample notation. Samples collected in the manner were taken to our laboratory for further examination and testing. A discussion of laboratory test procedures and the laboratory test results are presented in Appendix B. Upon completion of drilling and sampling, the boreholes were abandoned in general accordance with the requirements of Washington Administrative Code (WAC) 173-160.

Soil Classification System

MAJOR DIVISIONS			GRAPHIC SYMBOL	USCS LETTER SYMBOL[1]	TYPICAL DESCRIPTIONS [2][3]
COARSE-GRAINED SOIL (More than 50% of material is larger than No. 200 sieve size)	GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (Little or no fines)	▨	**GW**	Well-graded gravel; gravel/sand mixture(s); little or no fines
			▨	**GP**	Poorly graded gravel; gravel/sand mixture(s); little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)	▨	**GM**	Silty gravel; gravel/sand/silt mixture(s)
			▨	**GC**	Clayey gravel; gravel/sand/clay mixture(s)
	SAND AND SANDY SOIL (More than 50% of coarse fraction passed through No. 4 sieve)	CLEAN SAND (Little or no fines)	▨	**SW**	Well-graded sand; gravelly sand; little or no fines
			▨	**SP**	Poorly graded sand; gravelly sand; little or no fines
		SAND WITH FINES (Appreciable amount of fines)	▨	**SM**	Silty sand; sand/silt mixture(s)
			▨	**SC**	Clayey sand; sand/clay mixture(s)
FINE-GRAINED SOIL (More than 50% of material is smaller than No. 200 sieve size)	SILT AND CLAY (Liquid limit less than 50)		▨	**ML**	Inorganic silt and very fine sand; rock flour; silty or clayey fine sand or clayey silt with slight plasticity
			▨	**CL**	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay
			▨	**OL**	Organic silt; organic, silty clay of low plasticity
	SILT AND CLAY (Liquid limit greater than 50)		▨	**MH**	Inorganic silt; micaceous or diatomaceous fine sand
			▨	**CH**	Inorganic clay of high plasticity; fat clay
			▨	**OH**	Organic clay of medium to high plasticity; organic silt
	HIGHLY ORGANIC SOIL		▨	**PT**	Peat; humus; swamp soil with high organic content

OTHER MATERIALS	GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
PAVEMENT	■ ▨	**AC** or **PC**	Asphalt concrete pavement or Portland cement pavement
ROCK	▨	**RK**	Rock (See Rock Classification)
WOOD	▨	**WD**	Wood, lumber, wood chips
DEBRIS	▨	**DB**	Construction debris, garbage

Notes:

1. USCS letter symbols correspond to symbols used by the Unified Soil Classification System and ASTM classification methods. Dual letter symbols (e.g., SP-SM for sand or gravel) indicate soil with an estimated 5-15% fines. Multiple letter symbols (e.g., ML/CL) indicate borderline or multiple soil classifications.
2. Soil descriptions are based on the general approach presented in the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), outlined in ASTM D 2488. Where laboratory index testing has been conducted, soil classifications are based on the Standard Test Method for Classification of Soils for Engineering Purposes, as outlined in ASTM D 2487.
3. Soil description terminology is based on visual estimates (in the absence of laboratory test data) of the percentages of each soil type and is defined as follows:

Primary Constituent:	> 50%	- "GRAVEL," "SAND," "SILT," "CLAY," etc.
Secondary Constituents:	> 30% and ≤ 50%	- "very gravelly," "very sandy," "very silty," etc.
	> 15% and ≤ 30%	- "gravelly," "sandy," "silty," etc.
Additional Constituents:	> 5% and ≤ 15%	- "with gravel," "with sand," "with silt," etc.
	≤ 5%	- "with trace gravel," "with trace sand," "with trace silt," etc., or not noted.

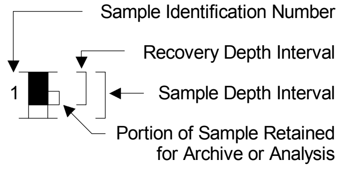
4. Soil density or consistency descriptions are based on judgement using a combination of sampler penetration blow counts, drilling or excavating conditions, field tests, and laboratory tests, as appropriate.

Drilling and Sampling Key

SAMPLER TYPE

Code	Description
a	3.25-inch O.D., 2.42-inch I.D. Split Spoon
b	2.00-inch O.D., 1.50-inch I.D. Split Spoon
c	Shelby Tube
d	Grab Sample
e	Single-Tube Core Barrel
f	Double-Tube Core Barrel
g	2.50-inch O.D., 2.00-inch I.D. WSDOT
h	3.00-inch O.D., 2.375-inch I.D. Mod. California
i	Other - See text if applicable
1	300-lb Hammer, 30-inch Drop
2	140-lb Hammer, 30-inch Drop
3	Pushed
4	Vibrocore (Rotosonic/Geoprobe)
5	Other - See text if applicable

SAMPLE NUMBER & INTERVAL



Field and Lab Test Data

Code	Description
PP = 1.0	Pocket Penetrometer, tsf
TV = 0.5	Torvane, tsf
PID = 100	Photoionization Detector VOC screening, ppm
W = 10	Moisture Content, %
D = 120	Dry Density, pcf
-200 = 60	Material smaller than No. 200 sieve, %
GS	Grain Size - See separate figure for data
AL	Atterberg Limits - See separate figure for data
GT	Other Geotechnical Testing
CA	Chemical Analysis

Groundwater

▽	Approximate water level at time of drilling (ATD)
▼	Approximate water level at time other than ATD

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Soil Classification System and Key

Figure
A-1

B-1-11

LAI Project No: 0080003.030

Drilling Method: Hollow-Stem Auger
Ground Elevation (ft): 142
Drilled By: Holocene Drilling Inc.
Logged By: EGN Date: 04/26/11

SAMPLE DATA

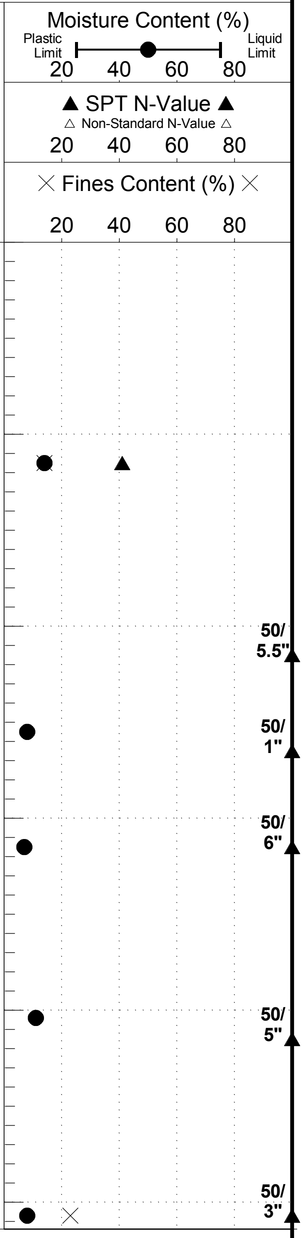
Depth (ft)	Elevation (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data
5		S-1	b2	41	W = 14 GS
10		S-2	b2	50/ 5.5"	
		S-2A	b2	50/ 1"	W = 8
15		S-3	b2	50/ 6"	W = 7
20		S-4	b2	50/ 5"	W = 11
25		S-5	b2	50/ 3"	W = 8 GS

Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35
Elevation (ft): 140, 135, 130, 125, 120

SOIL PROFILE

USCS Symbol	Description	Groundwater
SM SP-SM	Dark brown, gravelly, silty, medium to coarse SAND with abundant organic soil, roots and rootlets (loose to medium dense, moist to wet) **(TOPSOIL)** Brownish gray, fine to coarse SAND with silt and gravel (dense, moist) **(RECESSIONAL OUTWASH)**	
SM	Gray, gravelly, silty, fine to medium SAND (very dense, moist to wet) **(GLACIAL TILL)**	
	- becomes wet (perched water)	ATD
	- becomes moist	
	- refusal on cobble or boulder	

Boring Completed 04/26/11
Total Depth of Boring = 25.7 ft.



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

80003.03 7/22/11 N:\PROJECTS\0080003.GPJ SOIL BORING LOG WITH GRAPH

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Log of Boring B-1-11

Figure
A-2

B-2-11

LAI Project No: 0080003.030

SAMPLE DATA

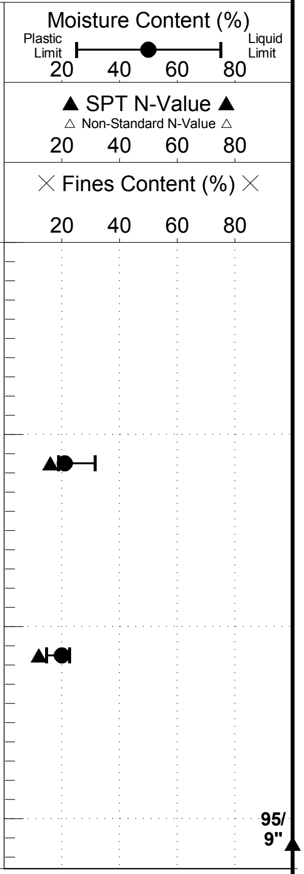
SOIL PROFILE

Drilling Method: Hollow-Stem Auger
Ground Elevation (ft): 144
Drilled By: Holocene Drilling Inc.
Logged By: EGN Date: 04/26/11

Sample Number & Interval	Sampler Type	Blows/Foot	Test Data
S-1	b2	16	W = 21 AL
S-2	b2	12	W = 20 AL
S-3	b2	95/ 9"	

USCS Symbol	Description
ML	Gray, non-plastic, gravelly, sandy SILT, standing water at the surface (loose to medium dense, wet) **(ALLUVIUM)**
ML/ CL	Gray, sandy, silty CLAY with gravel, seams of orange, oxidized soil (medium dense to very dense, damp)
SM/ ML	(no recovery) very dense soil, soil unit is inferred from SPT result and drill action (very dense, moist to wet) **(GLACIAL TILL)**

Groundwater: Groundwater Not Encountered



Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35
Elevation (ft): 140, 135, 130

Boring Completed 04/26/11
Total Depth of Boring = 16.3 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

80003.03 7/22/11 N:\PROJECTS\0080003.GPJ SOIL BORING LOG WITH GRAPH

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Log of Boring B-2-11

Figure
A-3

APPENDIX B

Laboratory Soil Testing

APPENDIX B
LABORATORY SOIL TESTING

Soil samples obtained from the exploratory borings were taken to our laboratory for further examination and testing. Laboratory tests were performed on representative soil samples to characterize certain engineering and index properties of the soils in the vicinity of the proposed improvements. The laboratory testing program, which was performed in general accordance with the American Society for Testing and Materials (ASTM) standard test procedures noted below, was limited to visual inspection to confirm our field soil descriptions and determination of natural moisture content, grain size distribution, and certain Atterberg Limits. A brief description of the testing performed is presented below.

NATURAL MOISTURE CONTENT

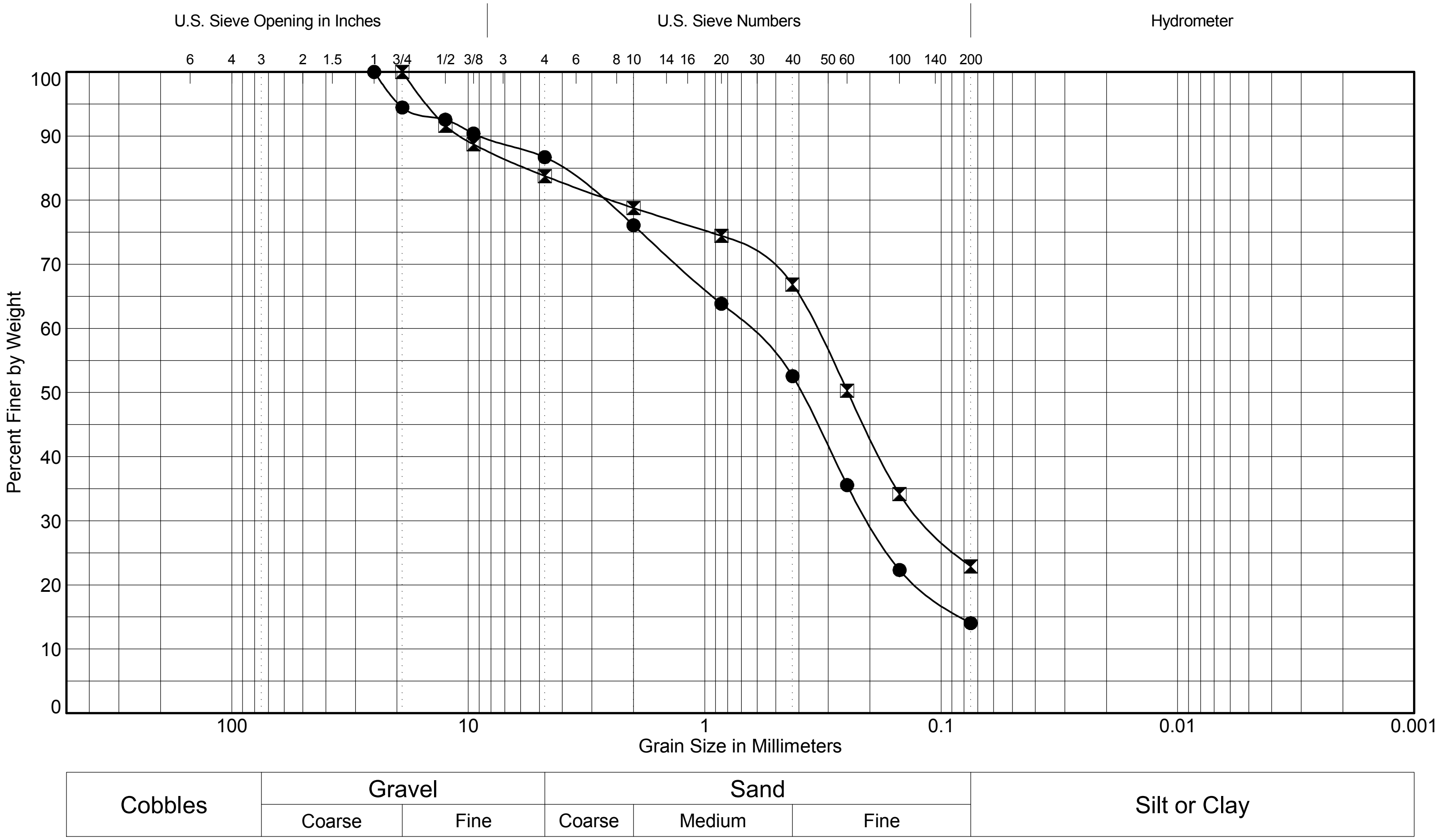
The natural moisture content of selected soil samples obtained from the exploratory borings was determined in general accordance with ASTM D2216 test procedures. The results from the moisture content determinations are indicated adjacent to the corresponding samples on the summary boring logs presented in Appendix A.

GRAIN SIZE ANALYSIS

Grain size analyses were conducted on selected soil samples obtained from the exploratory borings in general accordance with ASTM D422 test procedures. The results are presented in the form of grain size distribution curves on Figure B-1.

ATTERBERG LIMITS

The Atterberg limits of two selected soil samples obtained from the exploratory borings were determined in general accordance with ASTM D4318 test procedures. The Atterberg limits test results are presented graphically adjacent to the corresponding samples on the summary logs in Appendix A. The test results are also presented on Figure B-2.



Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B-1-11	S-1	5.0	14	Fine to coarse SAND with silt and gravel	SP-SM
⧗	B-1-11	S-5	25.0	8	Gravelly, silty, fine to medium SAND	SM

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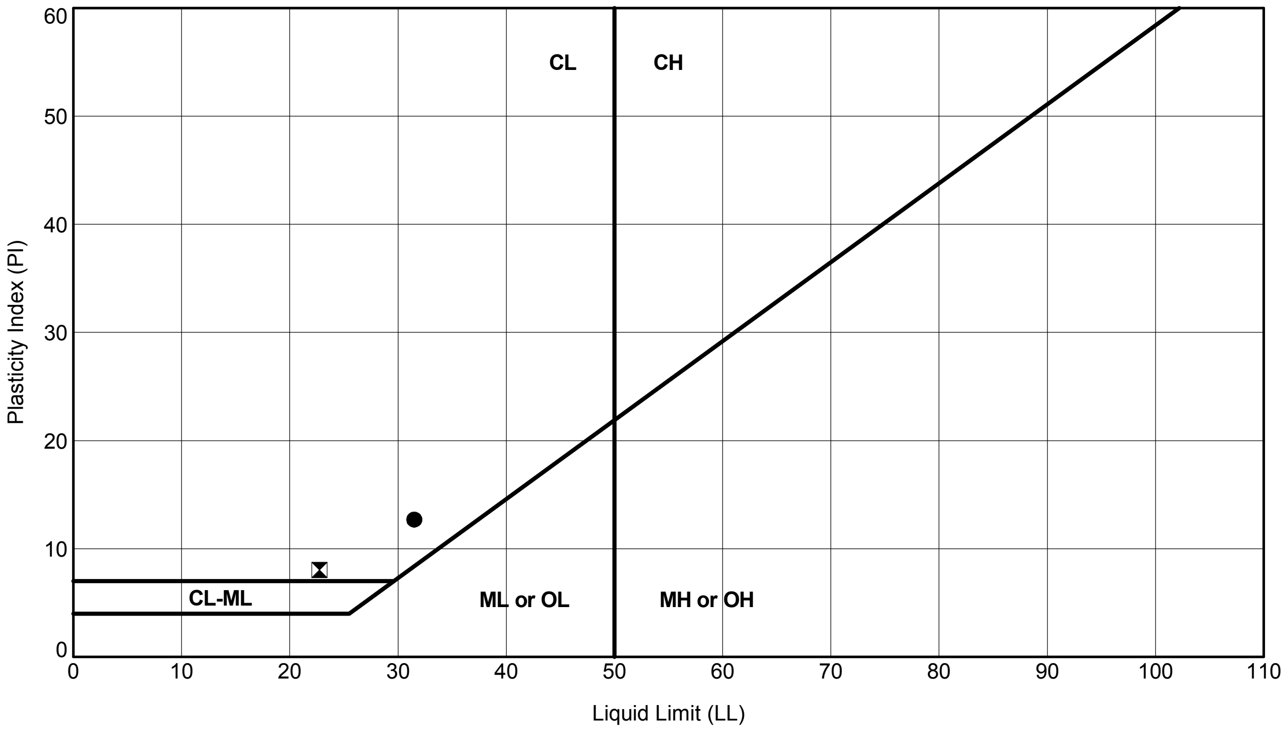
Grain Size Distribution

Figure
B-1



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B-2-11	S-1	5.0	32	19	13	21	Low plasticity CLAY	CL
⧗	B-2-11	S-2	10.0	23	15	8	20	Low plasticity CLAY	CL

ASTM D 4318 Test Method

80003.03 7/22/11 N:\PROJECTS\0080003.GPJ ATTERBERG LIMITS FIGURE

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Plasticity Chart

Figure
B-2

APPENDIX C

Logs of Pertinent Previous Explorations

APPENDIX C
LOGS OF PERTINENT PREVIOUS EXPLORATIONS

Landau Associates reviewed the results of the geotechnical investigation performed during execution of a previous design effort for the project (i.e., the Phase I and II Improvements project). Pertinent boring and test pit logs from the previous investigation are included in this appendix. The approximate borehole and test pit locations are presented on the Site and Exploration Plan (Figures 2A and 2B of this report). These summary logs are provided for background information only, as conditions may have changed since the time of exploration.

REFERENCE

Hong West & Associates, Inc. 1995. *Geotechnical Engineering Investigation, Central Kitsap Wastewater Treatment Facilities, Phase I and II Improvements Project, Kitsap County, Washington.* Last revised June 28.

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N-VALUE

COHESIONLESS SOILS			COHESIVE SOILS		
Density	N (blows/ft)	Approximate Relative Density(%)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psi)
Very Loose	0 to 4	0 - 15	Very Soft	0 to 2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	35 - 65	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	over 30	>4000

TEST SYMBOLS

GS	Grain Size Distribution
%F	Percent Fines
CN	Consolidation
TUU	Triaxial Unconsolidated Undrained
TCU	Triaxial Consolidated Undrained
TCD	Triaxial Consolidated Drained
UC	Unconfined Compression
DS	Direct Shear
K	Permeability
PP	Pocket Penetrometer Approximate Compressive Strength (tsf)
TV	Torvane Approximate Shear Strength (tsf)
CBR	California Bearing Ratio
MD	Moisture/Density Relationship
PID	Photoionization Device Reading
AL	Atterberg Limits PL Plastic Limit LL Liquid Limit

ASTM SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP DESCRIPTIONS	
Coarse Grained Soils More than 50% Retained on No. 200 Sieve Size	Gravel and Gravelly Soils More than 50% of Coarse Fraction Retained on No. 4 Sieve	Clean Gravel (little or no fines)	GW	Well-graded GRAVEL
			GP	Poorly-graded GRAVEL
		Gravel with Fines (appreciable amount of fines)	GM	Silty GRAVEL
			GC	Clayey GRAVEL
	Sand and Sandy Soils 50% or More of Coarse Fraction Passing on No. 4 Sieve	Clean Sand (little or no fines)	SW	Well-graded SAND
			SP	Poorly-graded SAND
		Sand with Fines (appreciable amount of fines)	SM	Silty SAND
			SC	Clayey SAND
Fine Grained Soils 50% or More Passing No. 200 Sieve Size	Silt and Clay	Liquid Limit Less than 50%	ML	SILT
			CL	Lean CLAY
			OL	Organic SILT/Organic CLAY.
	Silt and Clay	Liquid Limit 50% or More	MH	Elastic SILT.
			CH	Fat CLAY
			OH	Organic Silt/Organic Clay.
Highly Organic Soils			PT	PEAT

SAMPLE TYPE SYMBOLS

☒	2.0" OD Split Spoon (SPT) (140 lb. hammer with 30 in. drop)
I	Shelby Tube
▣	3.0" OD Split Spoon with Brass Rings
▚	Disturbed Bulk Sample (cuttings)
▯	Core Run
⧄	Non-standard Penetration Test (with split spoon sampler)

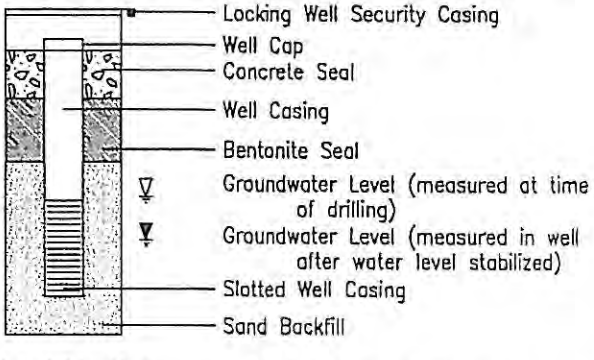
COMPONENT PROPORTIONS

DESCRIPTIVE TERMS	RANGE OF PROPORTION
Trace	0 - 5%
Few	5 - 10%
Little	15 - 25%
Some	30 - 45%
Mostly	50 - 100%

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5 mm) to No. 200 (0.074 mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074mm)

GROUNDWATER WELL COMPLETIONS



NOTES: Soil classifications presented on exploration logs are based on visual and laboratory observation in general accordance with ASTM D 2487 and ASTM D 2488. Soil descriptions are presented in the following general order:

Density/consistency, color, modifier (if any) GROUP NAME, additions to group name (if any), moisture content. Proportion, gradation, and angularity of constituents, additional comments. (GEOLOGIC INTERPRETATION)

Please refer to the discussion in the report text as well as the exploration logs for a more complete description of subsurface conditions.

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
MOIST	Damp but no visible water.
WET	Visible free water, usually soil is below water table.

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& ASSOCIATES, INC.

CENTRAL KITSAP WWTP

LEGEND OF TERMS AND SYMBOLS USED ON EXPLORATION LOGS

PROJECT NO.: 94127 FIGURE: A-1

C:\JOBS\94127\94127009.DWG

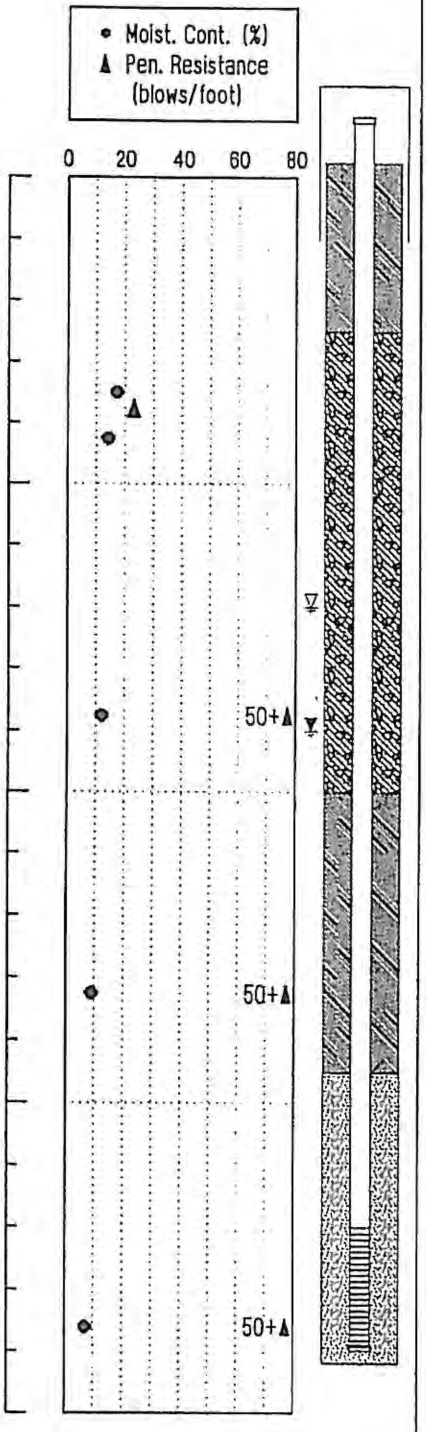
HONG WEST & ASSOCIATES, INC.

BORING LOG

DRILLING COMPANY: Soil Sampling Service
DRILLING METHOD: Mobile Drill B-61 CFHS Auger
SAMPLING METHOD: SPT

TOTAL DEPTH: 19.2 Feet
SURFACE ELEVATION: 150± Feet
MEASURING POINT EL.: Feet

DEPTH (feet)	SAMPLES	PEN. RESISTANCE (blows/6 inches)	N-VALUE (blows/ft)	MOIST. CONT. (%)	SYMBOL	SOIL CLASS. (USCS)	DESCRIPTION
0							Sod over loose, gray, silty SAND, moist. (FILL)
							Medium dense, gray, poorly graded SAND, moist. Some fine gravel to 3.5 feet; sand fine to medium grained; contains thin beds of silt. (RECESSIONAL OUTWASH)
	☒	8-11-12	23	17			
				14			Medium dense to dense, gray SILT, moist. Trace of fine to coarse gravel. (WEATHERED GLACIAL TILL)
5							
						SM	Dense to very dense, olive gray, silty SAND, moist. Trace of gravel. (GLACIAL TILL)
	☒	16-50/6"	50+	12			
10							
							Very dense, brown gray, sandy SILT, moist. Trace of gravel; sand fine to medium grained; cobbles encountered between 11 and 12 feet.
	☒	50/6"	50+	9			
15							Cobbles between 15 and 18 feet.
	☒	6-14-50/3"	50+	7			
20							



Bottom of boring at 19.2 feet. Groundwater observed at a depth of 7 feet at time of drilling; stabilized at 9 feet.

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated.

PROJECT: CENTRAL KITSAP WWTP

BORING: BH-3

LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/16/94
LOGGED BY: Rod Faubion

PROJECT NUMBER: 94127

PAGE: 1 OF 1

Figure A-4

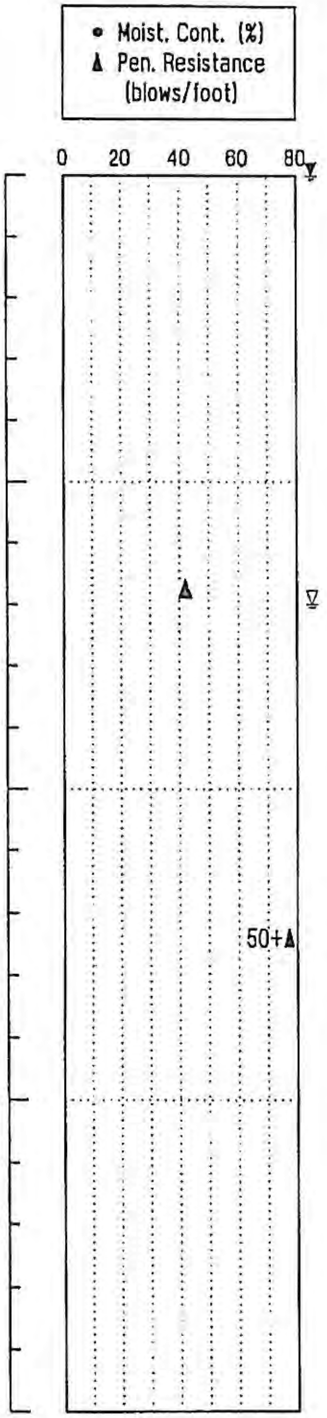
HONG WEST & ASSOCIATES, INC.

BORING LOG

DRILLING COMPANY: Soil Sampling Service
DRILLING METHOD: Musk Ox w/Mobile Drill B-50 Mud Rotary
SAMPLING METHOD: SPT, D&M, BULK

TOTAL DEPTH: 31.0 Feet
SURFACE ELEVATION: 144± Feet
MEASURING POINT EL.: Feet

DEPTH (feet)	SAMPLES	PEN. RESISTANCE (blows/6 inches)	N-VALUE (blows/ft)	MOIST. CONT. (%)	SYMBOL	SOIL CLASS. (USCS)	DESCRIPTION
0							2" of duff over soft, mottled rust brown and gray CLAY, moist. Trace of fine to medium sand and fine gravel. (RECENT ALLUVIUM)
							Grades to stiff; gray.
5		7-16-18					
							Hard, brownish gray, SILT, moist.
		7-9-33	42				
							Dense, gray, well graded SAND with gravel to well graded GRAVEL with sand, wet. Trace of silt, some cobbles. (RECESSIONAL OUTWASH)
10							
							Very dense, gray, silty SAND with gravel, moist. Sand predominately fine to medium grained; gravel subangular to subrounded.
		4/3"-50/6	50+				(GLACIAL TILL)
15							
							(No sample attempted due to gravelly nature of unit.)
20							



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated.

PROJECT: CENTRAL KITSAP WWTP

BORING: BH-4

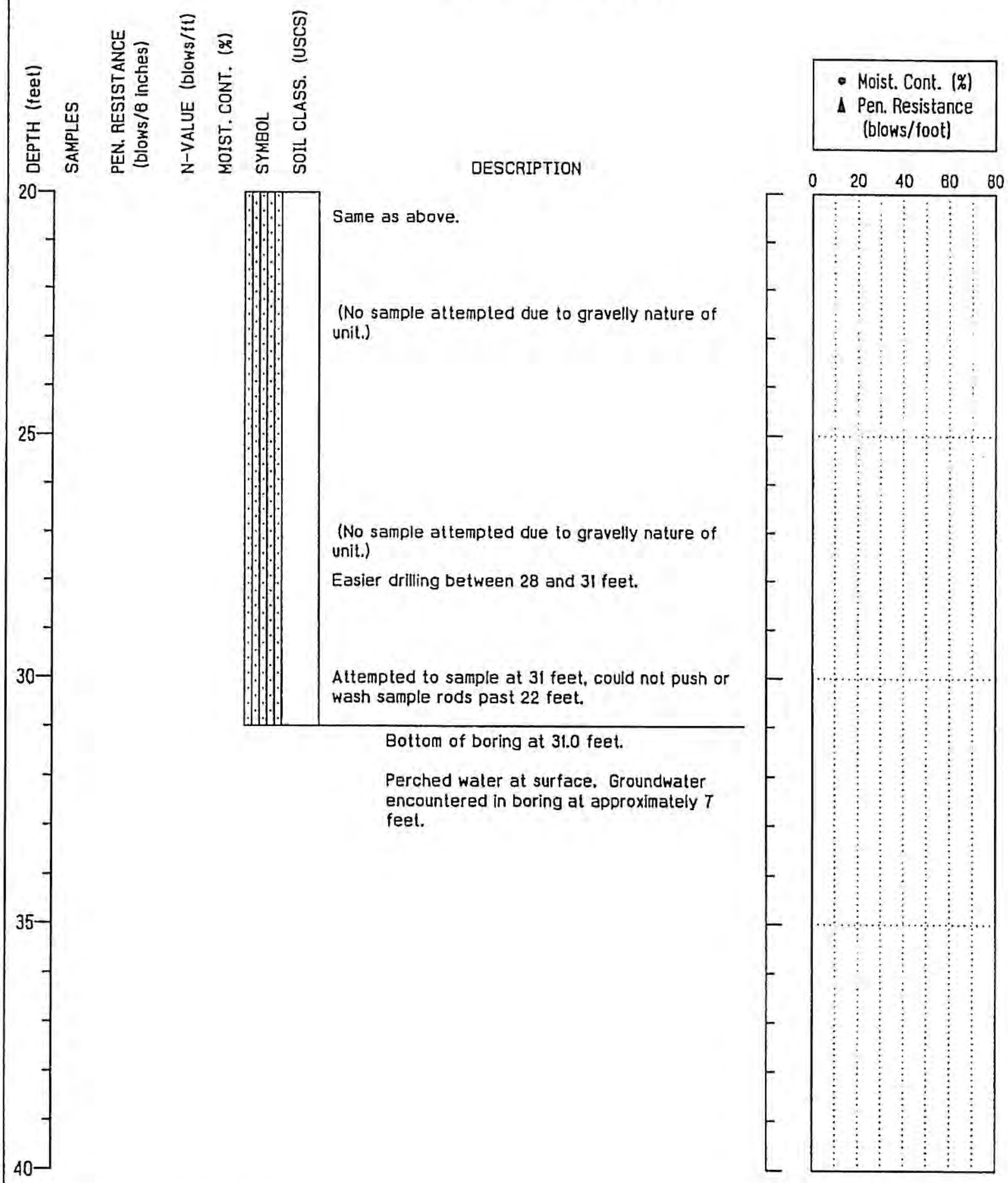
LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/15/94
LOGGED BY: Rod Faubion

PROJECT NUMBER: 94127

PAGE: 1 OF 2

Figure A-5

HONG WEST & ASSOCIATES, INC.
BORING LOG



Same as above.

(No sample attempted due to gravelly nature of unit.)

(No sample attempted due to gravelly nature of unit.)

Easier drilling between 28 and 31 feet.

Attempted to sample at 31 feet, could not push or wash sample rods past 22 feet.

Bottom of boring at 31.0 feet.

Perched water at surface. Groundwater encountered in boring at approximately 7 feet.

PROJECT: CENTRAL KITSAP WWTP

BORING: BH-4

LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/15/94
LOGGED BY: Rod Faubion

PROJECT NUMBER: 94127

PAGE: 2 OF 2

Figure A-6

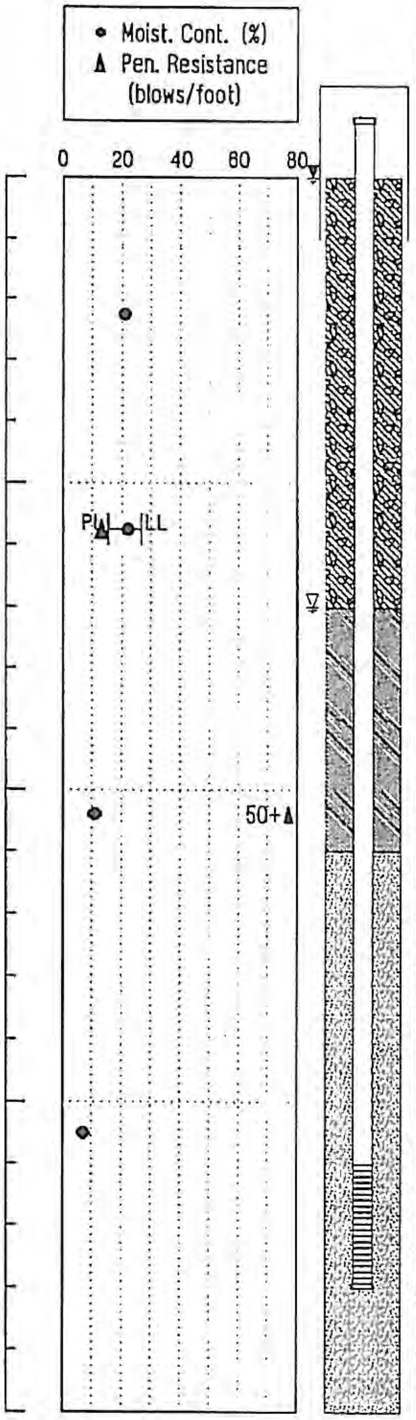
HONG WEST & ASSOCIATES, INC.

BORING LOG

DRILLING COMPANY: Soil Sampling Service
DRILLING METHOD: Musk Ox with Mobile Drill B-50
SAMPLING METHOD: SPT, D&M, BULK

TOTAL DEPTH: 21.5 Feet
SURFACE ELEVATION: 145± Feet
MEASURING POINT EL.: Feet

DEPTH (feet)	SAMPLES	PEN. RESISTANCE (blows/6 inches)	N-VALUE (blows/ft)	MOIST. CONT. (%)	SYMBOL	SOIL CLASS. (USCS)	DESCRIPTION
0							2" of duff over 6" of soft, dark brown PEAT, wet.
						CL	Soft to medium stiff, mottled rust brown & gray, sandy CLAY and CLAY, moist. Trace of coarse gravel.
				21			(RECENT ALLUVIUM)
5							Becomes stiff at about 5 feet.
		8-7-8	13	22			
						SM	Very dense, dark gray, silty SAND with gravel, moist. Clasts subangular to subrounded; contains thin interbeds of fine sand. (RECESSIONAL OUTWASH)
10		15/3"-33/6"	50+	11			
							Numerous cobbles and coarse gravel below 11 feet.
							Very dense, gray, sandy SILT with gravel, moist. Clasts subangular to subrounded. (GLACIAL TILL)
15		4-28-180		7			
20							



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated.

PROJECT: CENTRAL KITSAP WWTP

BORING: BH-5

LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/14/94
LOGGED BY: Rod Faubion

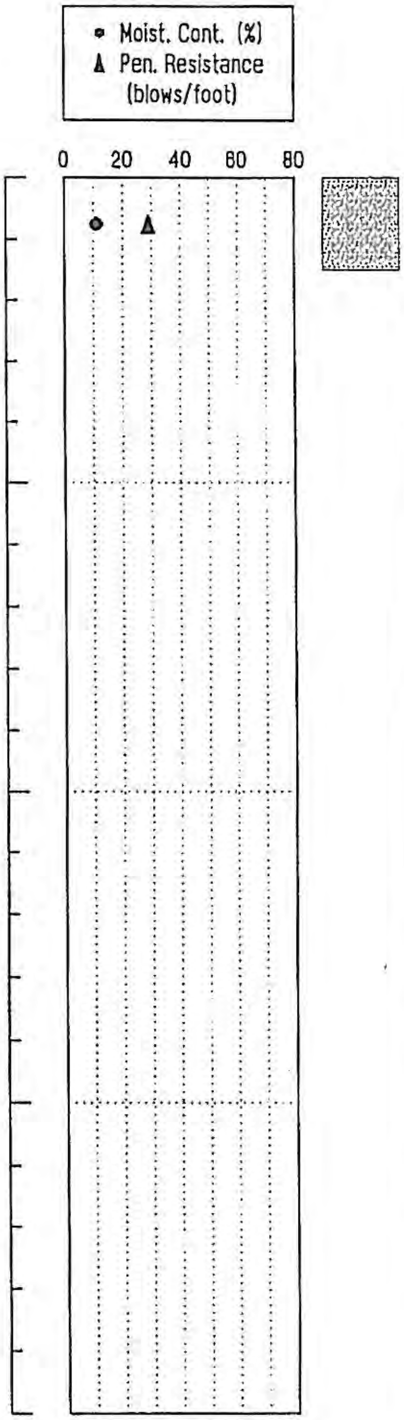
PROJECT NUMBER: 94127

PAGE: 1 OF 2

Figure A-7

HONG WEST & ASSOCIATES, INC.
BORING LOG

DEPTH (feet)	SAMPLES	PEN. RESISTANCE (blows/6 inches)	N-VALUE (blows/ft)	MOIST. CONT. (%)	SYMBOL	SOIL CLASS. (USCS)	DESCRIPTION
20	☒	13-15-14	29	11	▥		Same as above.
							Bottom of boring at 21.5 feet. Perched water at surface. Groundwater observed at a depth of 7 feet at time of drilling.
25							
30							
35							
40							



PROJECT: CENTRAL KITSAP WWTP

BORING: BH-5

LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/14/94
LOGGED BY: Rod Faubion

PROJECT NUMBER: 94127

PAGE: 2 OF 2

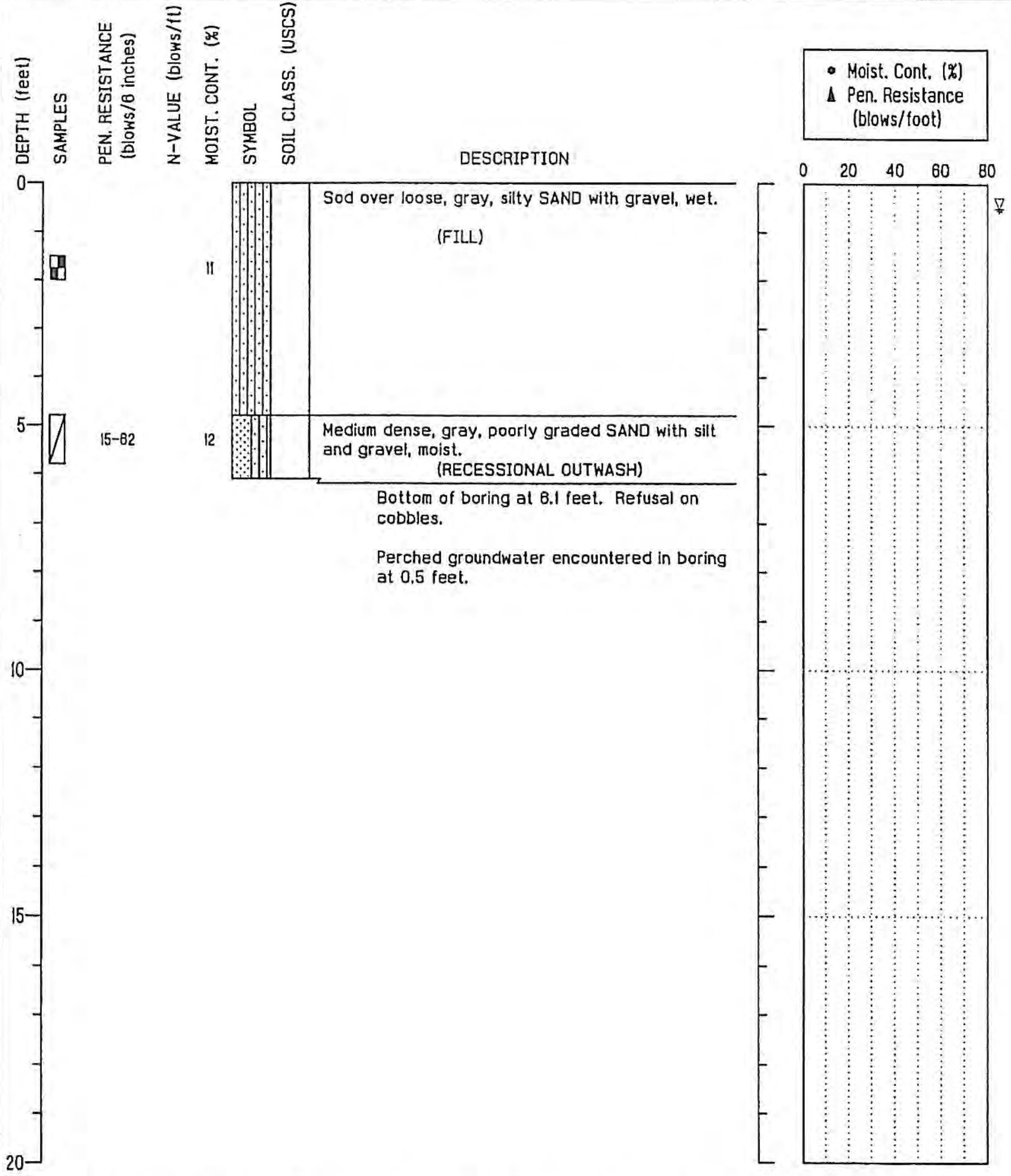
Figure A-8

HONG WEST & ASSOCIATES, INC.

BORING LOG

DRILLING COMPANY: HWA
DRILLING METHOD: Hand Auger
SAMPLING METHOD: PORTER, BULK

TOTAL DEPTH: 6.1 Feet
SURFACE ELEVATION: 148± Feet
MEASURING POINT EL.: Feet



DEPTH (feet)	SAMPLES	PEN. RESISTANCE (blows/6 inches)	N-VALUE (blows/ft)	MOIST. CONT. (%)	SYMBOL	SOIL CLASS. (USCS)	DESCRIPTION
0							Sod over loose, gray, silty SAND with gravel, wet. (FILL)
	▦			11			
5	▧	15-82		12			Medium dense, gray, poorly graded SAND with silt and gravel, moist. (RECESSIONAL OUTWASH)

Bottom of boring at 6.1 feet. Refusal on cobbles.

Perched groundwater encountered in boring at 0.5 feet.

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated.

PROJECT: CENTRAL KITSAP WWTP

BORING: BH-6

LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/20/94
LOGGED BY: Rod Faubion

PROJECT NUMBER: 94127

PAGE: 1 OF 1

Figure A-9

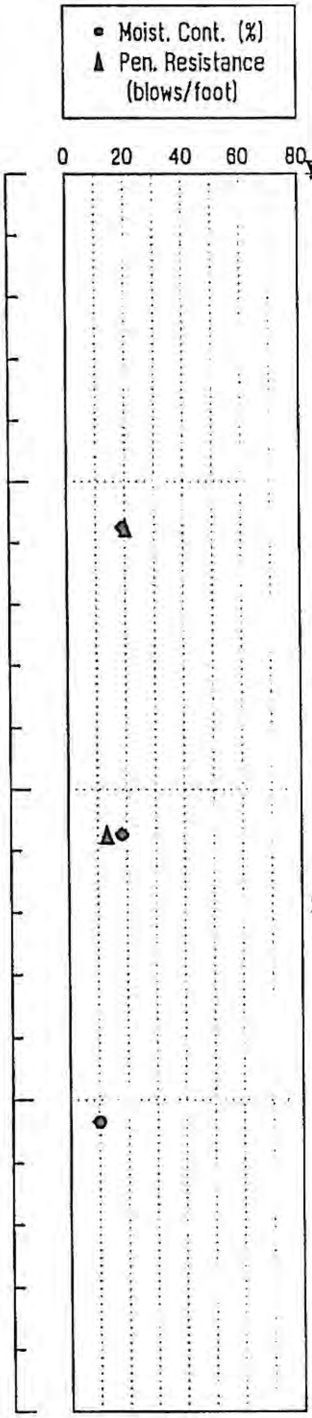
HONG WEST & ASSOCIATES, INC.

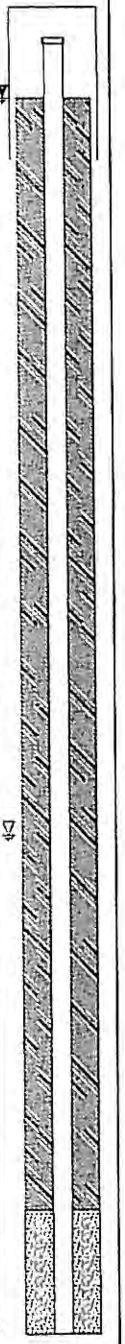
BORING LOG

DRILLING COMPANY: Soil Sampling Service
DRILLING METHOD: Musk Ox w/Mobile Drill B-50 Auger
SAMPLING METHOD: SPT, D&M

TOTAL DEPTH: 25.1 Feet
SURFACE ELEVATION: 144± Feet
MEASURING POINT EL.: Feet

DEPTH (feet)	SAMPLES	PEN. RESISTANCE (blows/6 inches)	N-VALUE (blows/ft)	MOIST. CONT. (%)	SYMBOL	SOIL CLASS. (USCS)	DESCRIPTION
0							Sod over soft to medium stiff, mottled rust brown and gray, lean CLAY with fine gravel, moist. (RECENT ALLUVIUM)
							Stiff to very stiff, mottled rust brown and gray, sandy SILT with some lean CLAY, moist. Trace of fine gravel; numerous organics (roots).
5	☒	3-9-11	20	19			
							Stiff, brownish gray, lean CLAY, moist.
10	☒	3-7-8	13	18			Grades to gray.
							Very dense, gray, silty SAND, moist. Trace of gravel. (GLACIAL TILL)
15	▪	120-108/1"		10			Very hard drilling below 15.5 feet.
							Interbedded sand and gravel to 20 feet.
20							





NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated.

PROJECT: CENTRAL KITSAP WWTP

BORING: BH-7

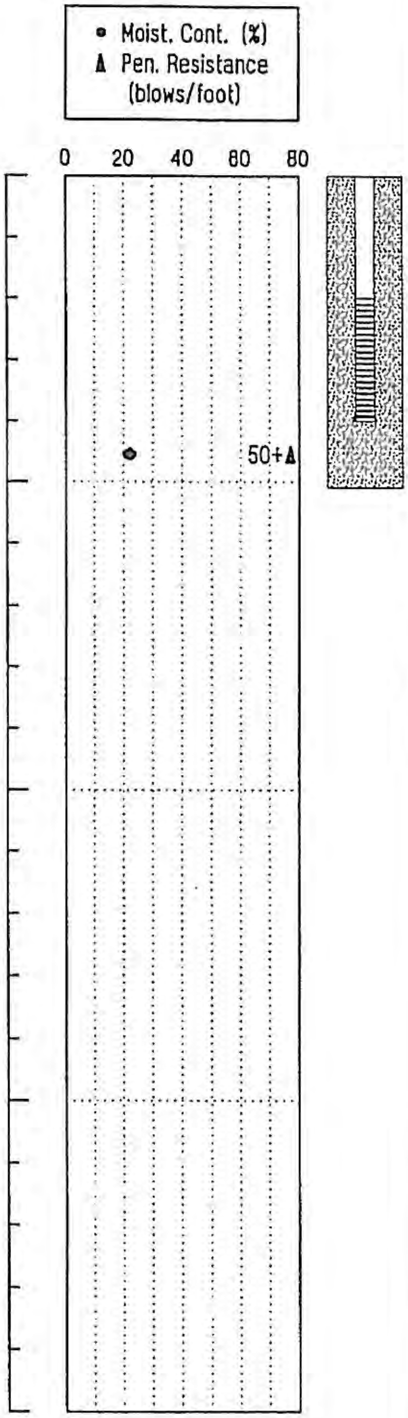
LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/16/94
LOGGED BY: Rod Faubion

PROJECT NUMBER: 94127
PAGE: 1 OF 2

Figure A-10

HONG WEST & ASSOCIATES, INC.
BORING LOG

DEPTH (feet)	SAMPLES	PEN. RESISTANCE (blows/6 inches)	N-VALUE (blows/ft)	MOIST. CONT. (%)	SYMBOL	SOIL CLASS. (USCS)	DESCRIPTION
20							Same as above. Becomes very gravelly and cobbly at about 24 feet.
	☒	3-38-19/1"	50+	22		SM	Very dense, dark gray, silty SAND, wet. (ADVANCE OUTWASH)
25							Bottom of boring at 25.1 feet. Perched water at surface. Groundwater encountered in boring at approximately 12 feet.
30							
35							
40							



PROJECT: CENTRAL KITSAP WWTP

BORING: BH-7

LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/16/94
LOGGED BY: Rod Faubion

PROJECT NUMBER: 94127

PAGE: 2 OF 2

Figure A-11

HONG WEST & ASSOCIATES, INC.

BORING LOG

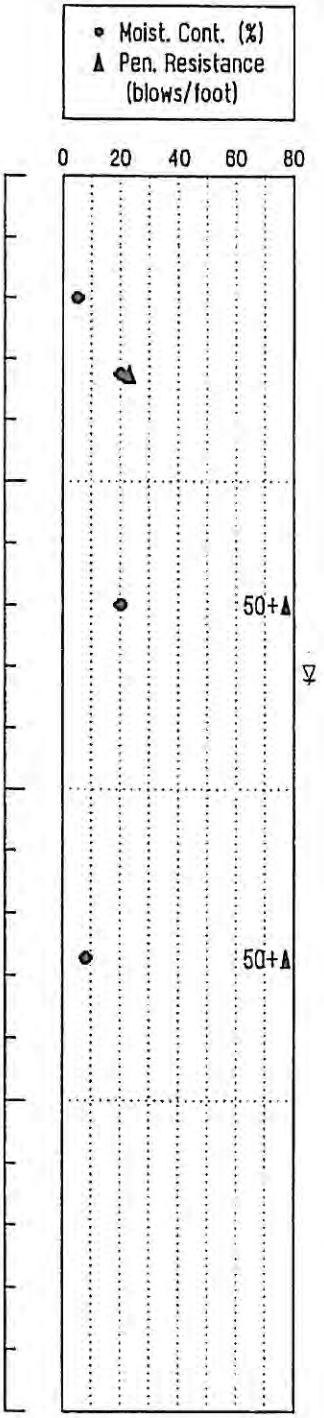
DRILLING COMPANY: Soil Sampling Service
DRILLING METHOD: Musk Ox ATV w/Mobile Drill B-50 Auger
SAMPLING METHOD: SPT, D&M, BULK

TOTAL DEPTH: 15.0 Feet
SURFACE ELEVATION: 149± Feet
MEASURING POINT EL.: Feet

SAMPLES	PEN. RESISTANCE (blows/6 inches)	N-VALUE (blows/ft)	MOIST. CONT. (%)	DESCRIPTION
▦			5	Two inches of 2" minus crushed rock over dense, gray, well graded SAND with gravel, moist. Clasts subangular to subrounded. (FILL)
☒	3-9-14	23	20	Very stiff, mottled brownish gray to gray, sandy SILT to SILT, moist. (RECENT ALLUVIUM)
☒	33-50	50+	20	Very dense, brown and gray, poorly graded GRAVEL with sand and silt, moist. Trace of clay. (RECESSIONAL OUTWASH)
☒	4/3"-50/6"	50+	8	Very dense, gray, silty SAND, moist. Some fine, subangular to subrounded gravel. (GLACIAL TILL)

Bottom of boring at 15.0 feet.

Groundwater encountered in boring at approximately 8 feet.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated.

PROJECT: CENTRAL KITSAP WWTP

BORING: BH-8

LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/14/94
LOGGED BY: Rod Faubion

PROJECT NUMBER: 94127

PAGE: 1 OF 1

Figure A-12

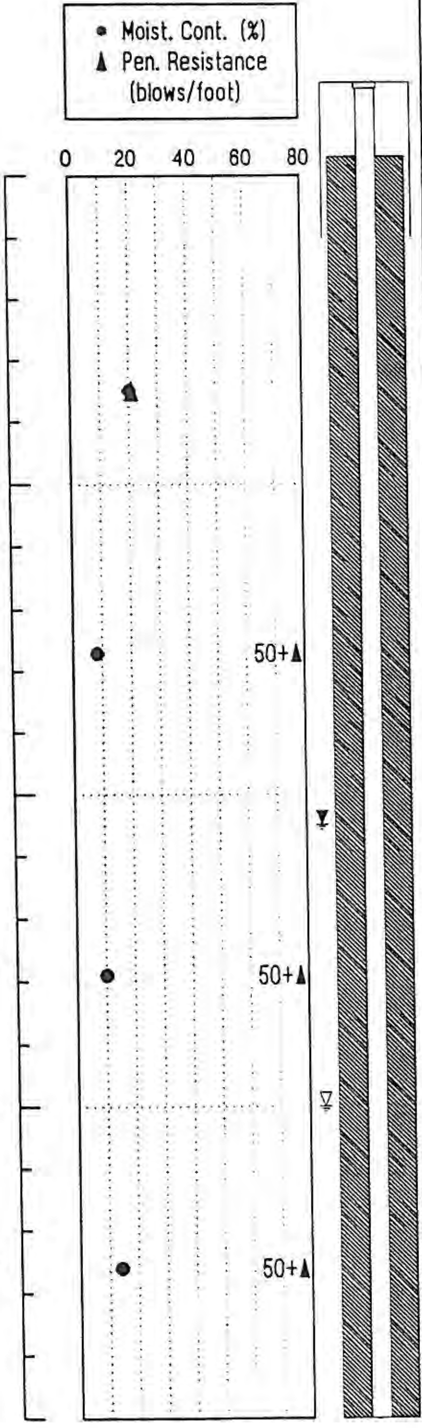
HONG WEST & ASSOCIATES, INC.

BORING LOG

DRILLING COMPANY: Soil Sampling Service
DRILLING METHOD: Mobile Drill B-61 CFHS Auger
SAMPLING METHOD: SPT, D&M

TOTAL DEPTH: 42.8 Feet
SURFACE ELEVATION: 159± Feet
MEASURING POINT EL.: Feet

SAMPLES	PEN. RESISTANCE (blows/6 inches)	N-VALUE (blows/ft)	MOIST. CONT. (%)	DESCRIPTION
				Two inches of 5/8" minus crushed rock over medium dense, gray, poorly graded GRAVEL with sand, moist. (FILL)
☒	4-14-7	21	20	Medium dense, brown, poorly graded SAND with silt and gravel, wet. Cobbles at 3 feet. (RECESSIONAL OUTWASH)
☒	50/5"	50+	8	Very dense, gray, silty SAND with gravel, moist. Trace of cobbles. (GLACIAL TILL)
☒	18-50/3"	50+	10	Very dense, gray, well graded SAND with gravel and silt. Gravel is predominately fine; scattered thin beds of fine sand. (ADVANCE OUTWASH)
☒	50/2½"	50+	14	Very dense, gray, poorly graded SAND, moist. Interbeds of fine to medium SAND with silt; trace of gravel.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated.

PROJECT: CENTRAL KITSAP WWTP

BORING: BH-10

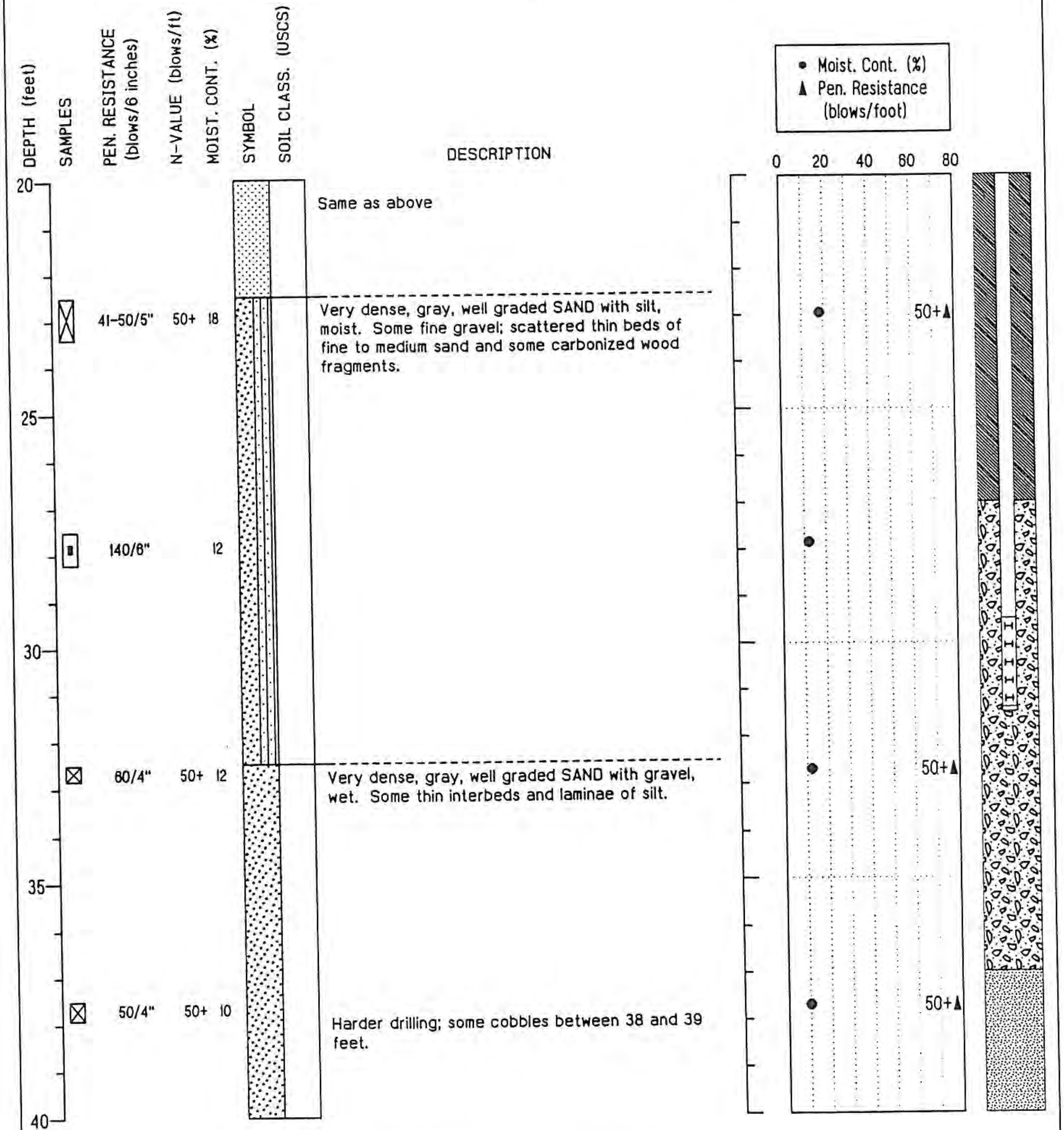
LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/17/94
LOGGED BY: Rod Faubion

PROJECT NUMBER: 94127

PAGE: 1 OF 3

Figure A-15

HONG WEST & ASSOCIATES, INC.
BORING LOG



DEPTH (feet)	SAMPLES	PEN. RESISTANCE (blows/6 inches)	N-VALUE (blows/ft)	MOIST. CONT. (%)	DESCRIPTION
20					Same as above
	☒	41-50/5"	50+	18	Very dense, gray, well graded SAND with silt, moist. Some fine gravel; scattered thin beds of fine to medium sand and some carbonized wood fragments.
25					
	▣	140/6"		12	
30					
	☒	60/4"	50+	12	Very dense, gray, well graded SAND with gravel, wet. Some thin interbeds and laminae of silt.
35					
	☒	50/4"	50+	10	Harder drilling; some cobbles between 38 and 39 feet.
40					

PROJECT: CENTRAL KITSAP WWTP

BORING: BH-10

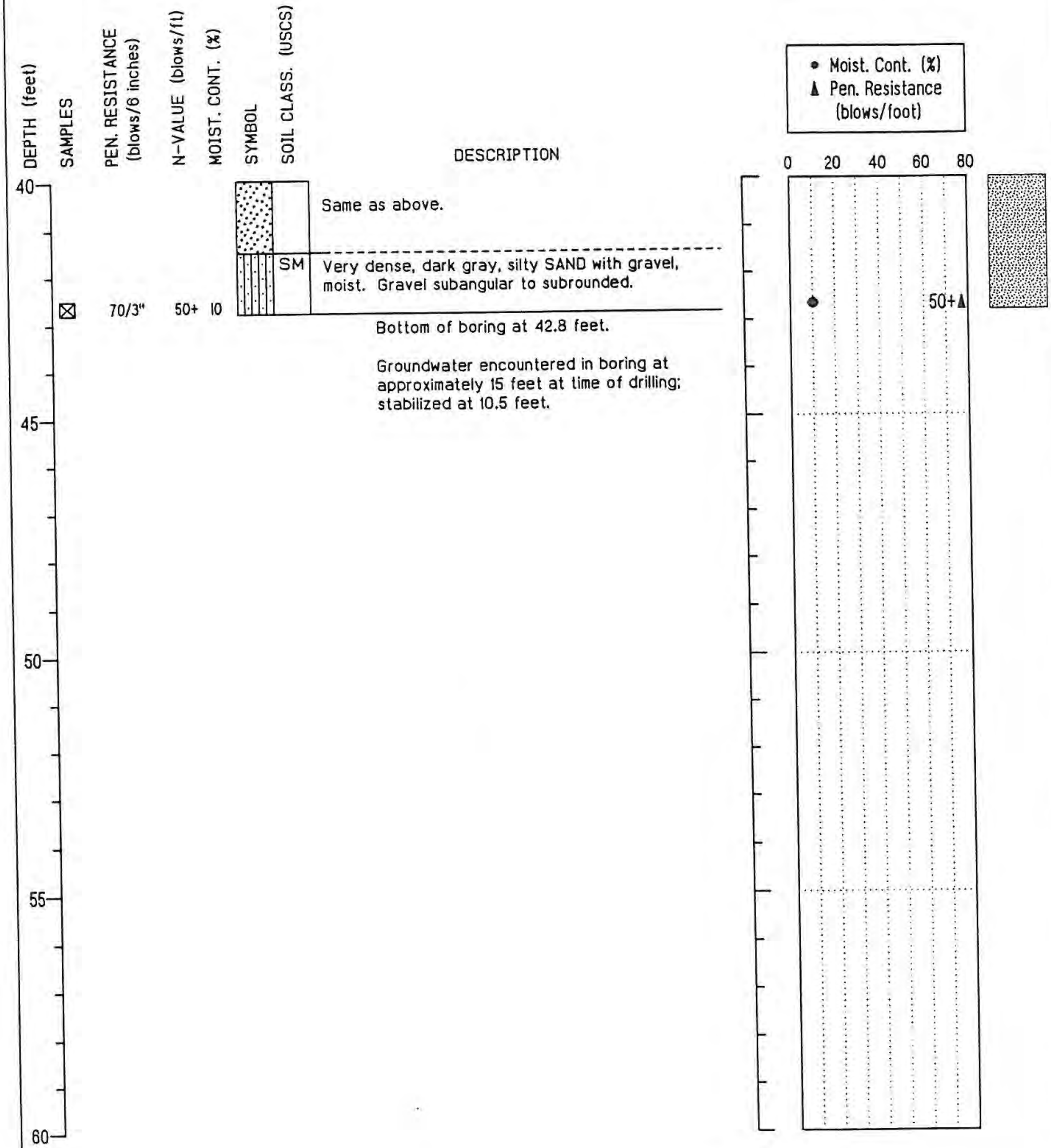
LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/17/94
LOGGED BY: Rod Faubion

PROJECT NUMBER: 94127

PAGE: 2 OF 3

Figure A-16

HONG WEST & ASSOCIATES, INC.
BORING LOG



Same as above.

Very dense, dark gray, silty SAND with gravel, moist. Gravel subangular to subrounded.

Bottom of boring at 42.8 feet.

Groundwater encountered in boring at approximately 15 feet at time of drilling; stabilized at 10.5 feet.

PROJECT: CENTRAL KITSAP WWTP

BORING: BH-10

LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/17/94
LOGGED BY: Rod Faubion

PROJECT NUMBER: 94127

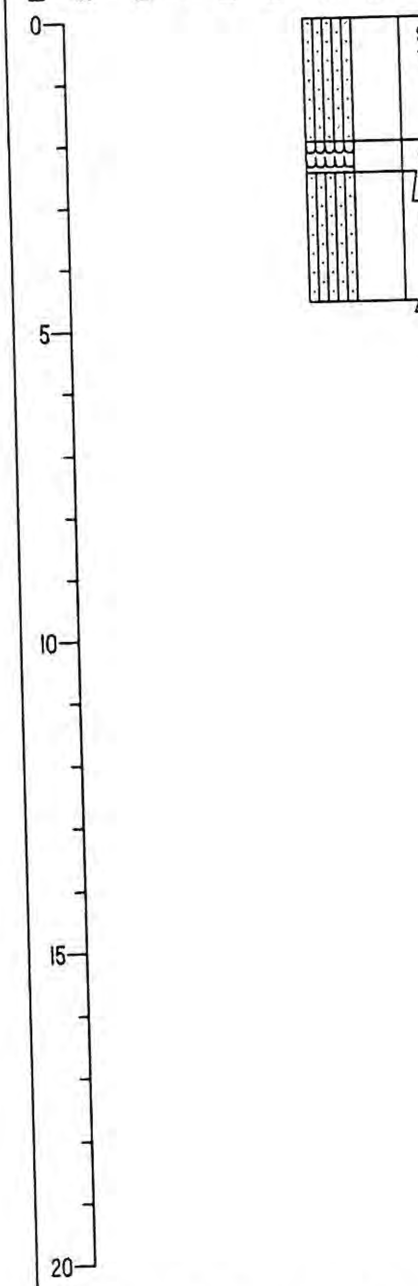
HONG WEST & ASSOCIATES, INC.

BORING LOG

DRILLING COMPANY: HWA
DRILLING METHOD: Hand Auger
SAMPLING METHOD:

TOTAL DEPTH: 4.6 Feet
SURFACE ELEVATION: 156± Feet
MEASURING POINT EL.: Feet

DEPTH (feet) | SAMPLES | PEN. RESISTANCE (blows/6 inches) | N-VALUE (blows/ft) | MOIST. CONT. (%) | SYMBOL | SOIL CLASS. (USCS) | DESCRIPTION



Sod over loose, brown to gray, silty SAND, wet. Trace of gravel.

(FILL)

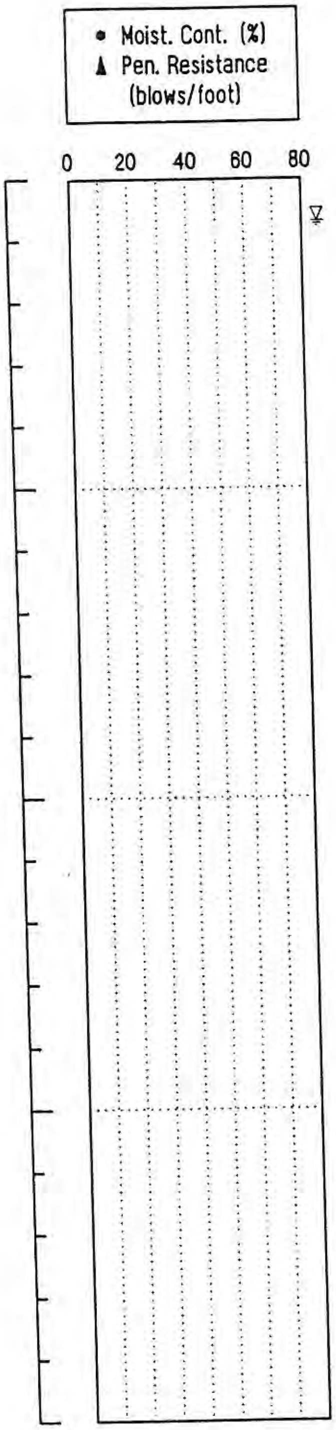
Soft, dark brown, ORGANIC SOIL, wet. Some to little roots. (REMNANT TOPSOIL)

Loose to medium dense, brown, silty SAND, moist. Trace of gravel and cobbles.

(RECESSIONAL OUTWASH)

Bottom of boring at 4.6 feet. Refusal on cobbles.

Perched groundwater encountered in boring at 0.7 feet at time of drilling.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated.

PROJECT: CENTRAL KITSAP WWTP

BORING: BH-12

LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/20/94
LOGGED BY: Rod Faubion

PROJECT NUMBER: 94127

PAGE: 1 OF 1

Figure A-19

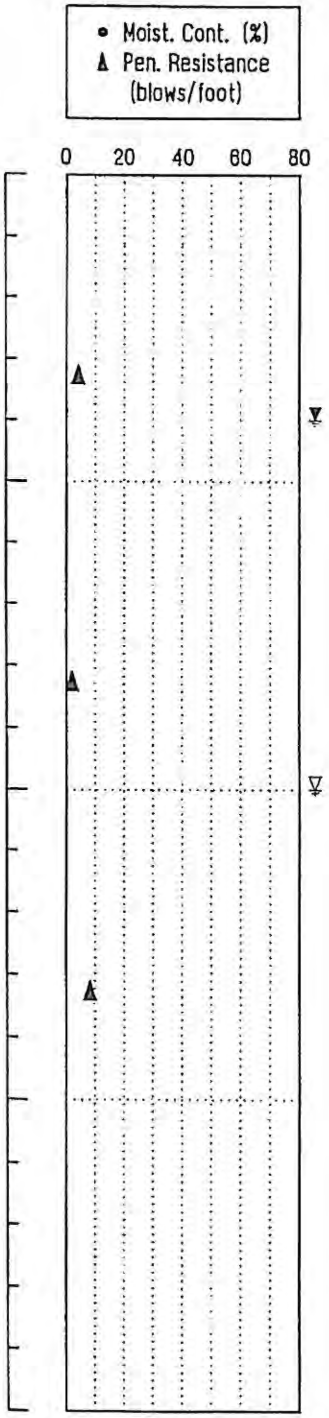
HONG WEST & ASSOCIATES, INC.

BORING LOG

DRILLING COMPANY: Soil Sampling Service
DRILLING METHOD: Mobile Drill B-61 CFHS Auger
SAMPLING METHOD: SPT

TOTAL DEPTH: 17.0 Feet
SURFACE ELEVATION: 148± Feet
MEASURING POINT EL.: Feet

DEPTH (feet)	SAMPLES	PEN. RESISTANCE (blows/6 inches)	N-VALUE (blows/ft)	MOIST. CONT. (%)	SYMBOL	SOIL CLASS. (USCS)	DESCRIPTION
0							3 inches of bark over very loose to loose, gray, poorly graded GRAVEL with sand to poorly graded SAND with gravel, wet. (FILL)
	☒	1-1-3	4				
5							
	☒	1-1-1	2				
10							
	☒	1-3-5	8				
15							
							Bottom of boring at 17.0 feet. Refusal on in-place underground fuel tank support concrete slab. Groundwater encountered in boring at approximately 10 feet at time of drilling; stabilized at 4 feet.
20							



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated.

PROJECT: CENTRAL KITSAP WWTP

BORING: BH-11

LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/16/94
LOGGED BY: Rod Faubion

PROJECT NUMBER: 94127

PAGE: 1 OF 1

Figure A-18

HONG WEST & ASSOCIATES, INC.

TEST PIT LOG

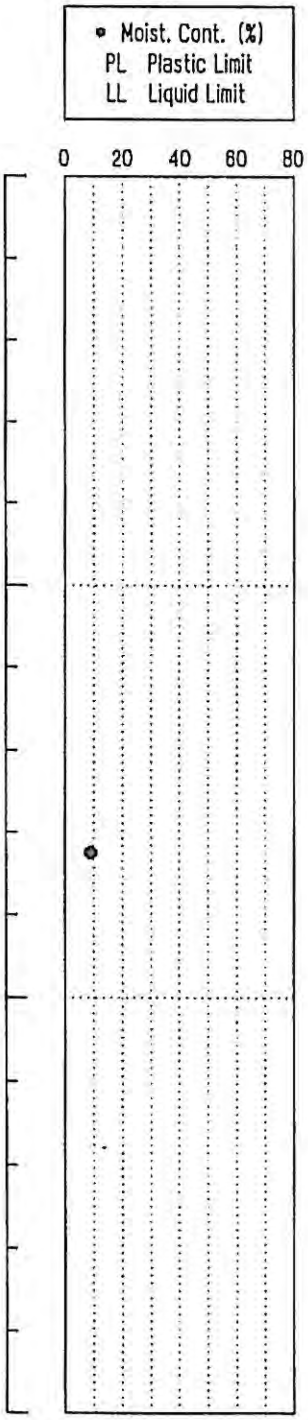
EXCAVATION COMPANY: Kitsap County
EXCAVATION METHOD: JCB 1400B Extradig Backhoe
SAMPLING METHOD: BULK

TOTAL DEPTH: 9.0 Feet
SURFACE ELEVATION: 152± Feet

DEPTH (feet)	SAMPLES	MOIST. CONT. (%)	SYMBOL	SOIL CLASS. (USCS)	DESCRIPTION
0					Grass over loose, gray, sandy SILT, moist. Trace of gravel. (FILL)
					Loose to medium dense, brown, silty SAND, moist. Some subrounded to rounded gravel; trace of silt and cobbles; numerous decayed roots. (RECESSIONAL OUTWASH)
5					Medium dense, rust brown to gray, poorly graded SAND with gravel, moist. Sand is fine to coarse grained; gravel well graded with subangular to subrounded clasts; trace of cobbles.
					Dense, gray, sandy SILT, wet. Some well rounded gravel. (GLACIAL TILL)
	▨	9		SM	Very dense, grayish brown, silty SAND, moist. Trace of gravel.
10					
15					

Bottom of test pit at 9.0 feet.

No groundwater encountered in test pit.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated.

PROJECT: CENTRAL KITSAP WWTP

TEST PIT: TP-5

LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/06/94
LOGGED BY: Rod Faubion

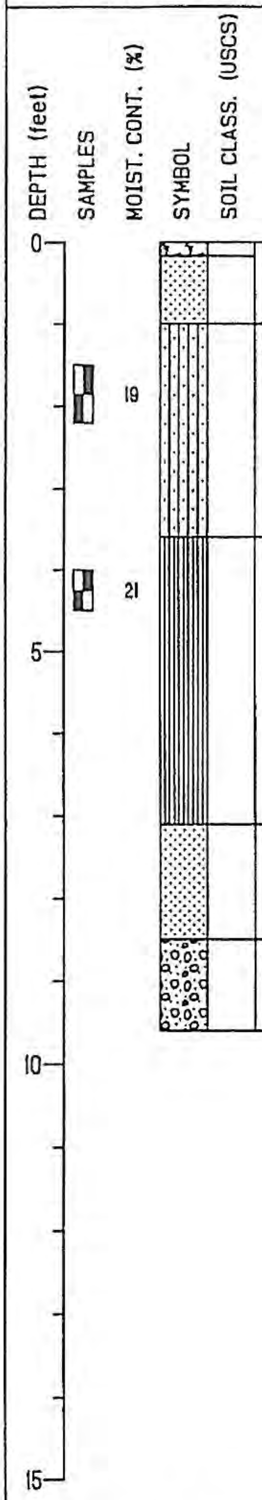
PROJECT NUMBER: 94127

HONG WEST & ASSOCIATES, INC.

TEST PIT LOG

EXCAVATION COMPANY: Kitsap County
EXCAVATION METHOD: JCB 1400B Extradig Backhoe
SAMPLING METHOD: BULK

TOTAL DEPTH: 9.6 Feet
SURFACE ELEVATION: 154± Feet



DESCRIPTION

2" of duff over loose, brown, poorly graded SAND, moist. Some organics (roots).

(FILL?)

Loose, light brown, silty SAND, moist. Trace of subrounded to rounded gravel; sand fine to medium grained.

Grades to mottled brown and gray.

Stiff, gray, sandy SILT, moist. Trace of gravel.

(RECENT ALLUVIUM)

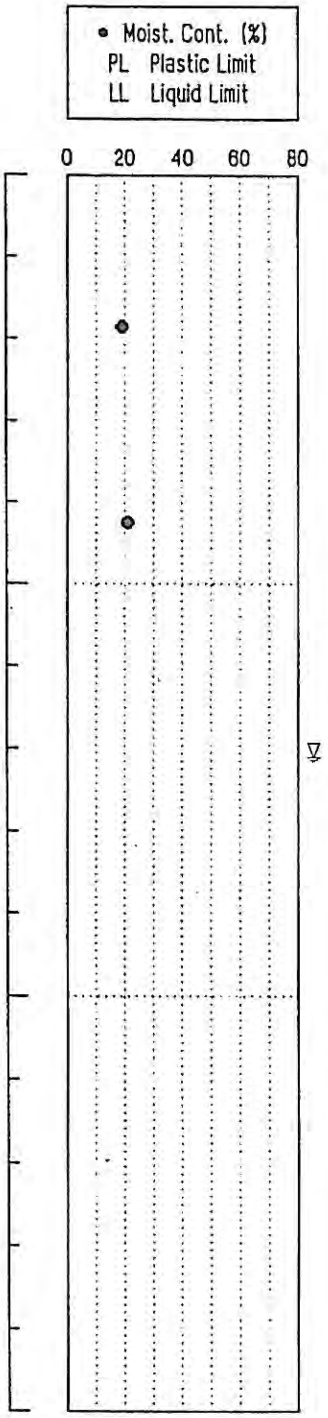
Dense, brown and gray, poorly graded SAND, moist.

(RECESSIONAL OUTWASH)

Dense, brownish gray, well graded GRAVEL with sand, wet. Trace of cobbles; sand is medium to coarse grained; clasts subrounded to rounded.

Bottom of test pit at 9.6 feet.

Groundwater encountered in test pit at 7.1 feet.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated.

PROJECT: CENTRAL KITSAP WWTP

TEST PIT: TP-6

LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/07/94
LOGGED BY: Rod Faubion

PROJECT NUMBER: 94127

PAGE: 1 OF 1

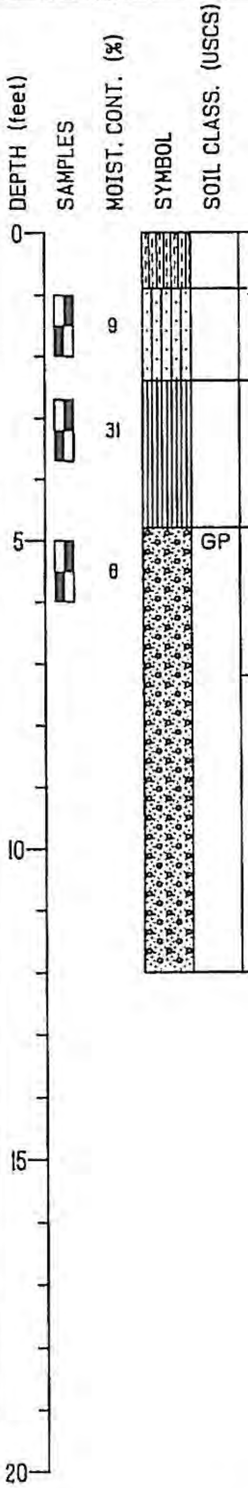
Figure A-25

HONG WEST & ASSOCIATES, INC.

TEST PIT LOG

EXCAVATION COMPANY: Kitsap County
EXCAVATION METHOD: JCB 1400B Extradig Backhoe
SAMPLING METHOD: BULK

TOTAL DEPTH: 12 Feet
SURFACE ELEVATION: 140± Feet



DESCRIPTION

Loose, brown, sandy, ORGANIC SOIL, moist.
(FILL)

Medium dense, gray, silty SAND, moist. Trace of gravel, cobbles, and basalt "quarry spalls".

Stiff to hard, mottled brown and gray SILT, moist.

(RECENT ALLUVIUM)

Medium dense to dense, dark grayish brown, poorly graded GRAVEL with sand, moist. Subangular to rounded clasts; some cobbles.

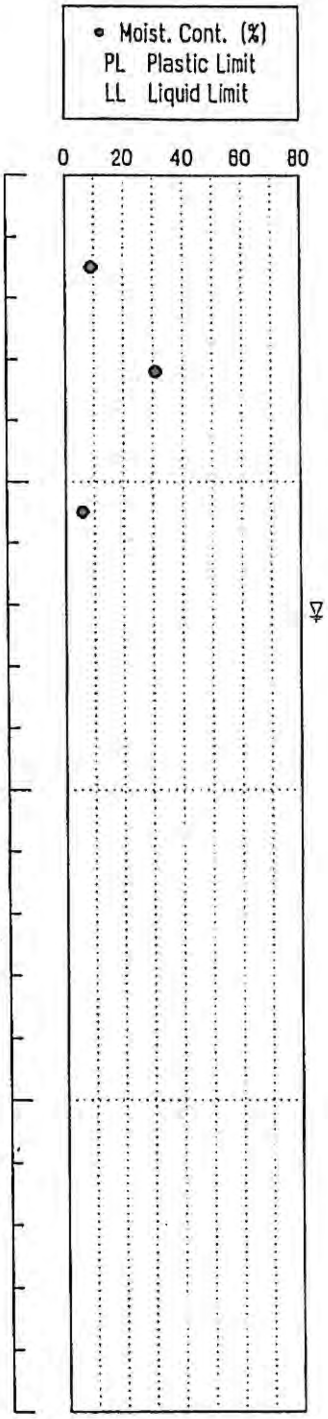
(RECESSIONAL OUTWASH)

Seepage below 7.2 feet; wall of test pit caves.

Grades to gray below 11.5 feet.

Bottom of test pit at 12.0 feet.

Groundwater seepage encountered in test pit at 7.2 feet.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated.

PROJECT: CENTRAL KITSAP WWTP

TEST PIT: TP-8

LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/06/94
LOGGED BY: Rod Faubion

PROJECT NUMBER: 94127

PAGE: 1 OF 1

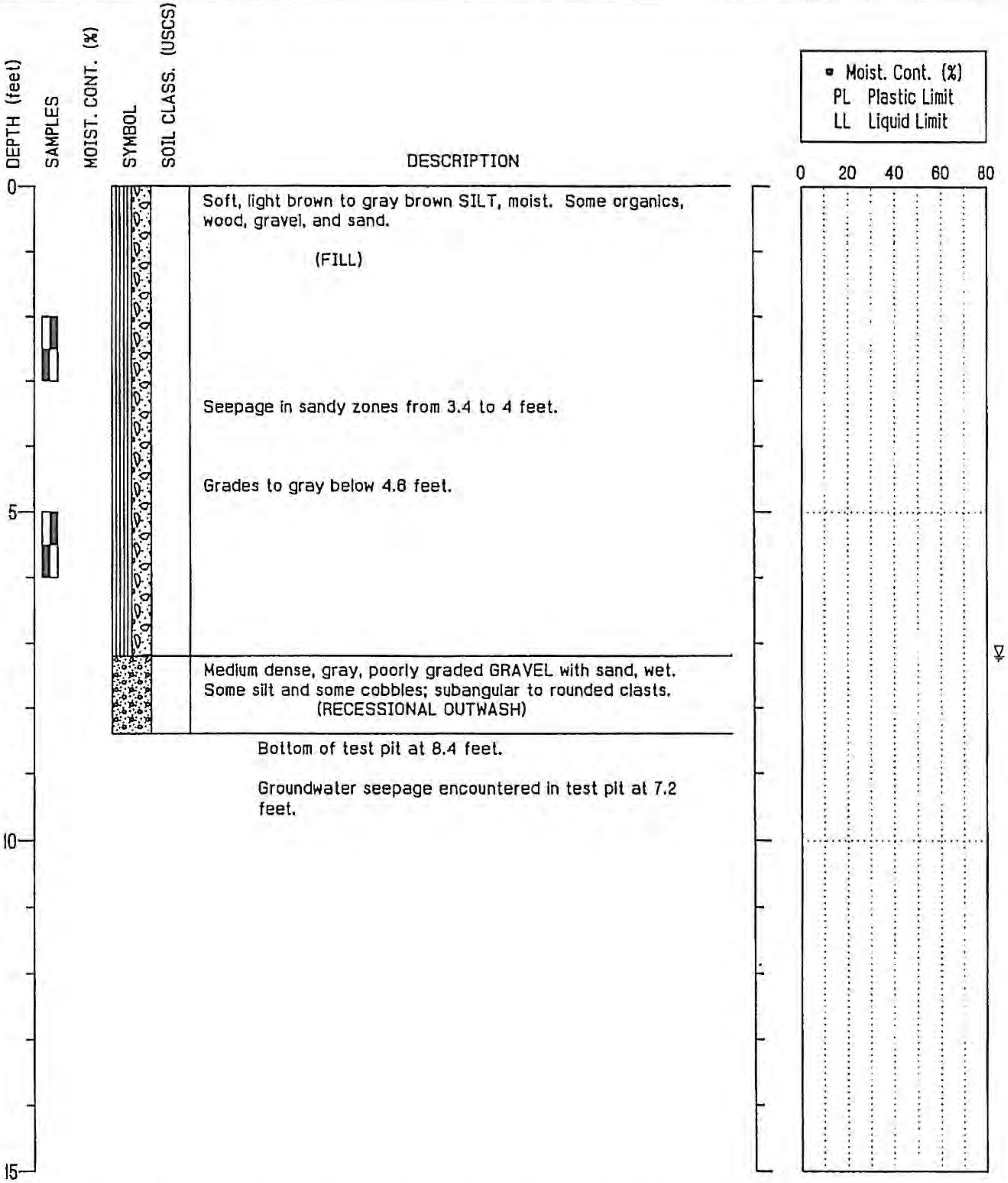
Figure A-27

HONG WEST & ASSOCIATES, INC.

TEST PIT LOG

EXCAVATION COMPANY: Kitsap County
EXCAVATION METHOD: JCB 1400B Extradig Backhoe
SAMPLING METHOD: BULK

TOTAL DEPTH: 8.4 Feet
SURFACE ELEVATION: 140± Feet



Soft, light brown to gray brown SILT, moist. Some organics, wood, gravel, and sand.

(FILL)

Seepage in sandy zones from 3.4 to 4 feet.

Grades to gray below 4.6 feet.

Medium dense, gray, poorly graded GRAVEL with sand, wet. Some silt and some cobbles; subangular to rounded clasts.
(RECESSIONAL OUTWASH)

Bottom of test pit at 8.4 feet.

Groundwater seepage encountered in test pit at 7.2 feet.

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated.

PROJECT: CENTRAL KITSAP WWTP

TEST PIT: TP-9

LOCATION: Kitsap County, Washington
DATE COMPLETED: 12/06/94
LOGGED BY: Rod Faubion

PROJECT NUMBER: 94127

PAGE: 1 OF 1

Figure A-28

APPENDIX D

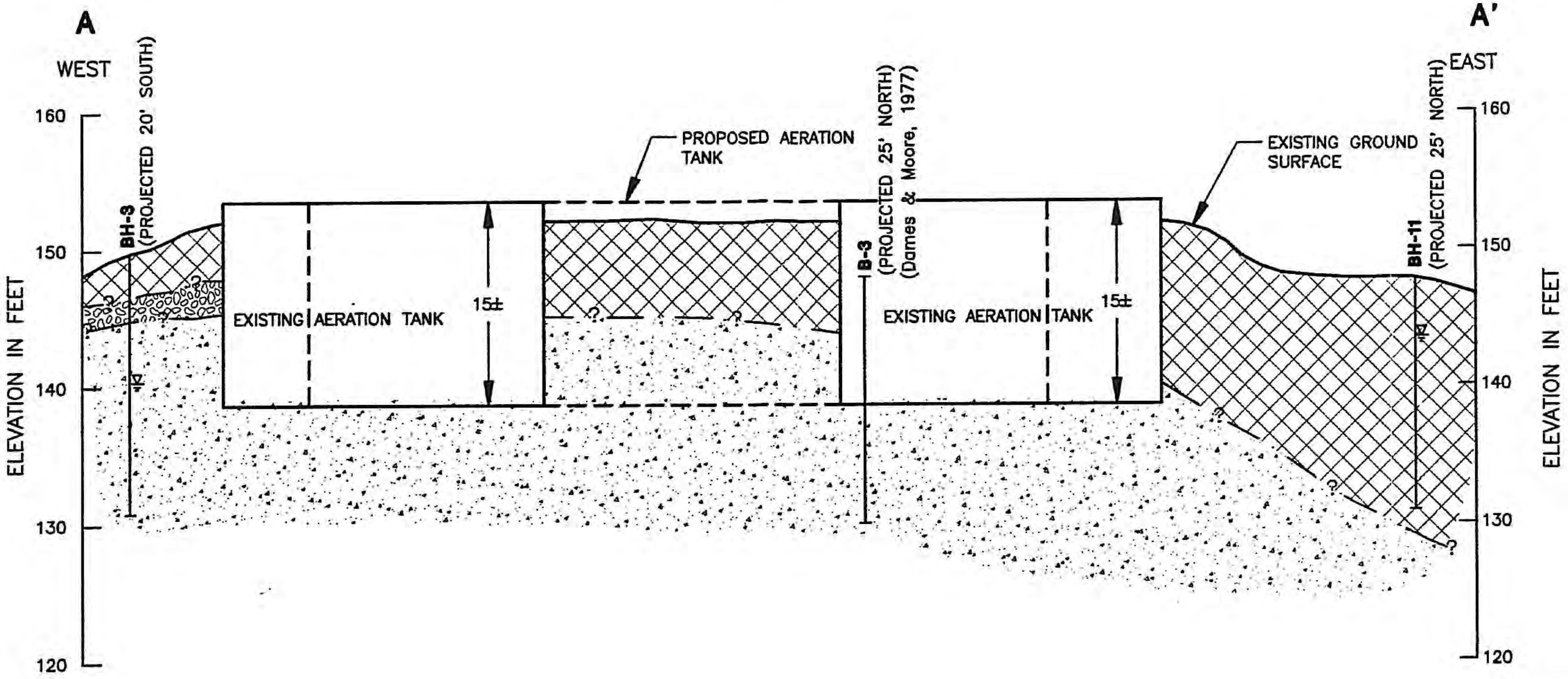
Pertinent Previous Geologic Cross Sections

APPENDIX D
PERTINENT PREVIOUS GEOLOGIC CROSS SECTIONS

As part of their study for previous improvement projects at the Central Kitsap Wastewater Treatment Plant, Hong West & Associates developed generalized geologic cross sections across the site at the locations shown on the Site and Exploration Plan (Figure 2 of this report).. Copies of these cross sections are included in this appendix for background information only. It should be noted that the extrapolation of subsurface conditions between exploration locations is for illustrative purposes only; actual conditions between explorations may vary significantly from those shown. The boring and test pit logs in Appendices A and C provide more detail relative to soil conditions encountered at specific locations.

REFERENCE

Hong West & Associates, Inc. 1995. *Geotechnical Engineering Investigation, Central Kitsap Wastewater Treatment Facilities, Phase I and II Improvements Project, Kitsap County, Washington.* Last revised June 28.



LEGEND

BH-3 — BORING DESIGNATION AND APPROXIMATE LOCATION

APPROXIMATE WATER LEVEL OBSERVED AT TIME OF DRILLING

BOTTOM OF BORING

— ?— ?— INFERRED GEOLOGIC CONTACT

▨ FILL: Very Loose to Loose, Gray, Silty Sand to Poorly Graded Gravel with Sand.

▩ RECESSIONAL OUTWASH: Medium Dense to Very Dense, Gray, Sand to Silty Sand with Gravel.

░ TILL: Dense to Very Dense, Gray, Sandy Silt to Silty Sand with Gravel.

NOTES

1. THE SUBSURFACE CONDITIONS SHOWN ON THE CROSS SECTION ARE BASED ON INTERPOLATION BETWEEN WIDELY SPACED BORINGS AND SHOULD BE CONSIDERED APPROXIMATE.
2. REFER TO FIGURE 2 FOR LOCATION OF CROSS SECTION A–A'.
3. THE DEPTHS AND CONFIGURATIONS SHOWN FOR THE EXISTING AND PROPOSED IMPROVEMENTS ARE BASED ON PRELIMINARY INFORMATION AND ARE FOR ILLUSTRATIVE PURPOSES ONLY; ACTUAL DEPTHS AND CONFIGURATIONS MAY BE DIFFERENT.

0 30' 60'

HORIZONTAL SCALE: 1" = 30'
VERTICAL EXAGGERATION: 3x

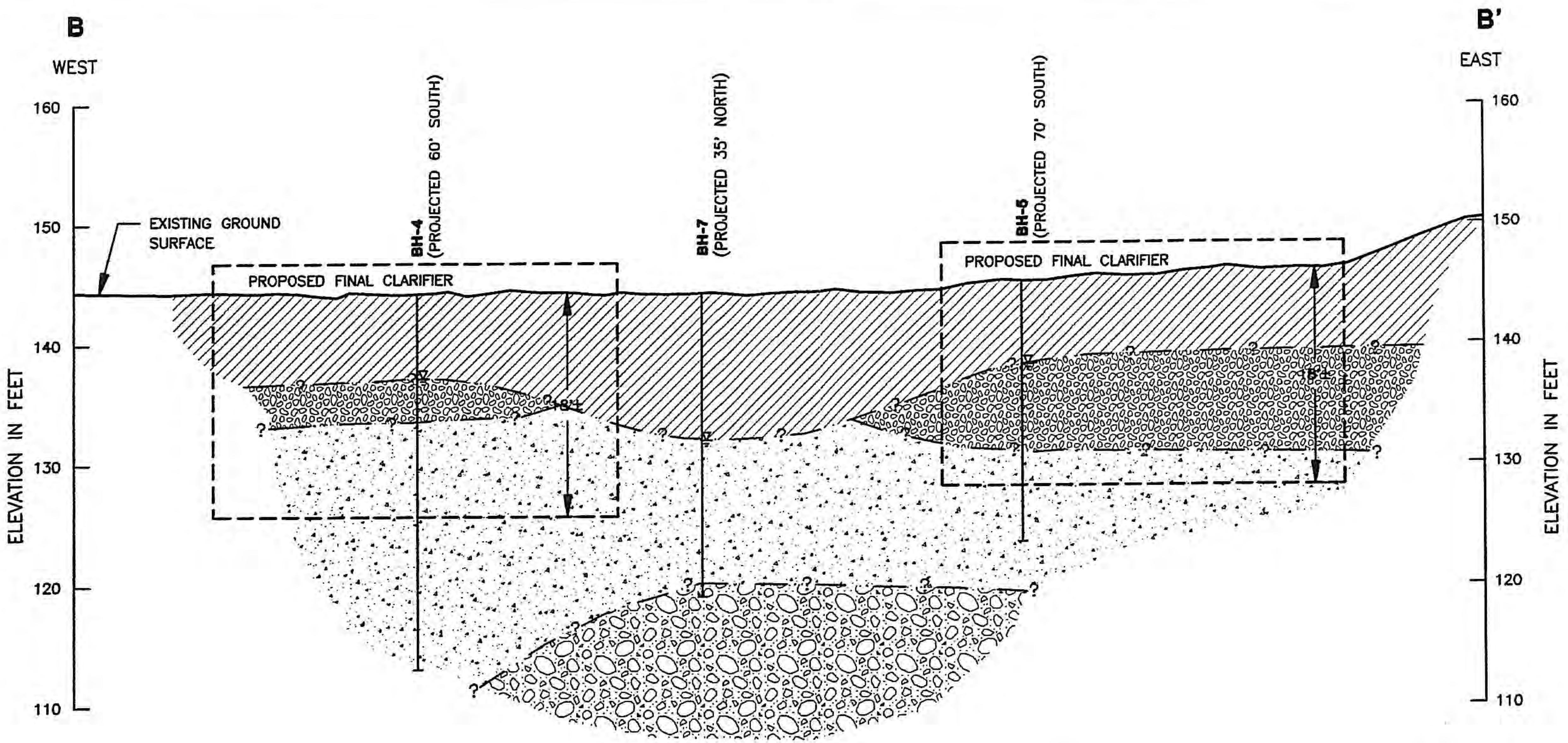
HWA
HONGWEST & ASSOCIATES, INC.

CENTRAL KITSAP WWTP

GENERALIZED GEOLOGIC CROSS SECTION A–A'

PROJECT NO.: 94127 FIGURE: 3

C:\JOBS\94127\94127003.DWG



▨ RECENT ALLUVIUM: Soft to Very Stiff, Brown to Gray, Silt to Sandy Silt with Interbeds of Lean Clay.

▨ RECESSIONAL OUTWASH: Medium Dense to Very Dense, Gray, Sand to Silty Sand with Gravel.

▨ TILL: Dense to Very Dense, Gray, Sandy Silt to Silty Sand with Gravel.

▨ ADVANCE OUTWASH: Very Dense, Gray to Dark Gray, Silty Sand to Sand with Silt and/or Gravel.

LEGEND

BH-4	BORING DESIGNATION AND APPROXIMATE LOCATION
▽	APPROXIMATE WATER LEVEL OBSERVED AT TIME OF DRILLING
⊥	BOTTOM OF BORING
— ?— ?—	INFERRED GEOLOGIC CONTACT

NOTES

1. THE SUBSURFACE CONDITIONS SHOWN ON THE CROSS SECTION ARE BASED ON INTERPOLATION BETWEEN WIDELY SPACED BORINGS AND SHOULD BE CONSIDERED APPROXIMATE.
2. REFER TO FIGURE 2 FOR LOCATION OF CROSS SECTION B–B'.
3. THE DEPTHS AND CONFIGURATIONS SHOWN FOR THE EXISTING AND PROPOSED IMPROVEMENTS ARE BASED ON PRELIMINARY INFORMATION AND ARE FOR ILLUSTRATIVE PURPOSES ONLY; ACTUAL DEPTHS AND CONFIGURATIONS MAY BE DIFFERENT.

0 30' 60'

HORIZONTAL SCALE: 1" = 30'
VERTICAL EXAGGERATION: 3x

HWA
HONGWEST
& ASSOCIATES, INC.

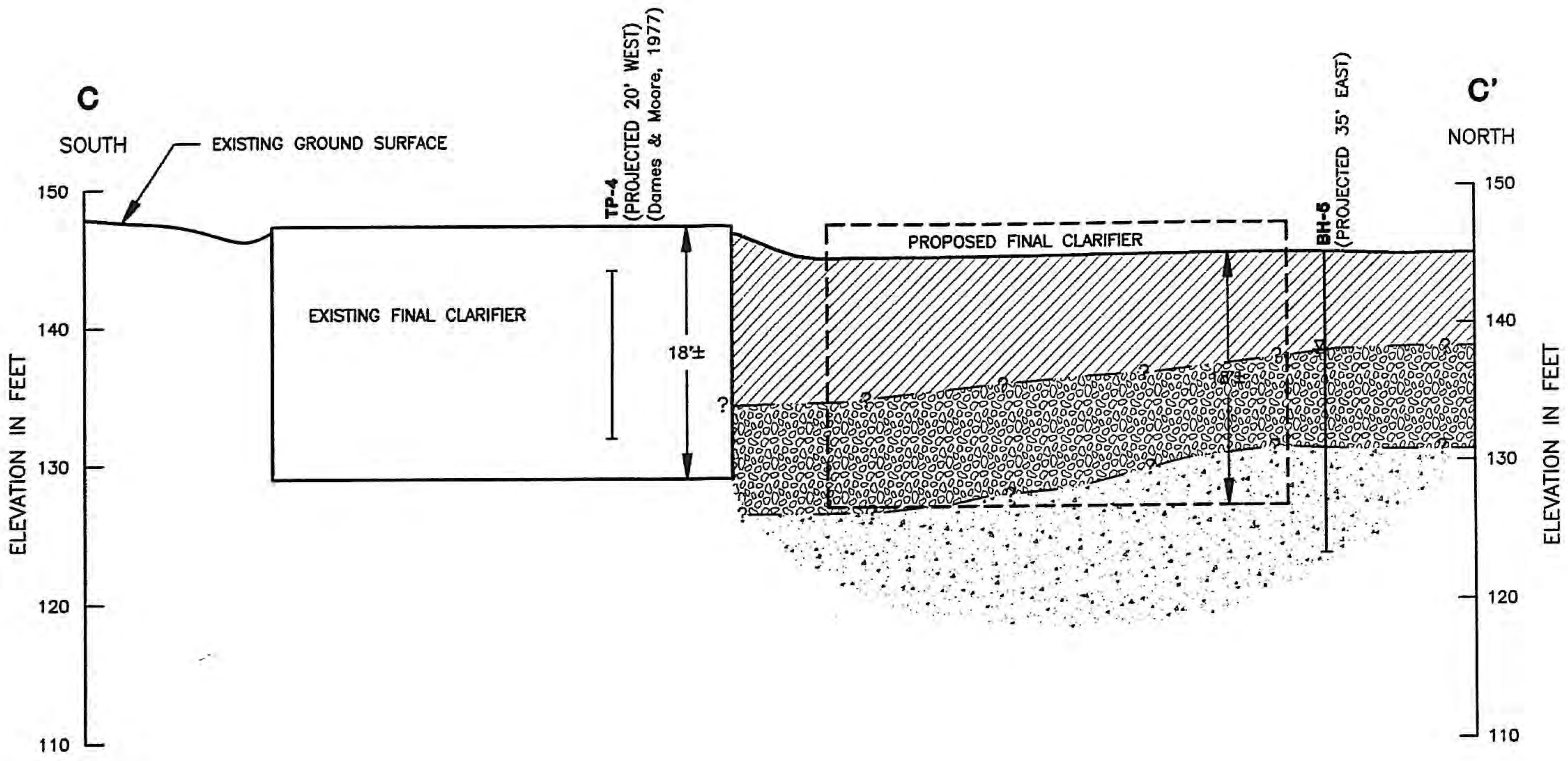
CENTRAL KITSAP WWTP

GENERALIZED GEOLOGIC
CROSS SECTION B–B'

PROJECT NO.: 94127

FIGURE: 4

C:\JOBS\94127\94127004.DWG



LEGEND

▨	RECENT ALLUVIUM: Soft to Very Stiff, Brown to Gray, Silt to Sandy Silt with Interbeds of Lean Clay.
▩	RECESSIONAL OUTWASH: Medium Dense to Very Dense, Gray, Sand to Silty Sand with Gravel.
░	TILL: Dense to Very Dense, Gray, Sandy Silt to Silty Sand with Gravel.

BH-5	BORING DESIGNATION AND APPROXIMATE LOCATION
▽	APPROXIMATE WATER LEVEL OBSERVED AT TIME OF DRILLING
⊥	BOTTOM OF BORING
— ?— ?—	INFERRED GEOLOGIC CONTACT

NOTES

1. THE SUBSURFACE CONDITIONS SHOWN ON THE CROSS SECTION ARE BASED ON INTERPOLATION BETWEEN WIDELY SPACED BORINGS AND SHOULD BE CONSIDERED APPROXIMATE.
2. REFER TO FIGURE 2 FOR LOCATION OF CROSS SECTION C–C'.
3. THE DEPTHS AND CONFIGURATIONS SHOWN FOR THE EXISTING AND PROPOSED IMPROVEMENTS ARE BASED ON PRELIMINARY INFORMATION AND ARE FOR ILLUSTRATIVE PURPOSES ONLY; ACTUAL DEPTHS AND CONFIGURATIONS MAY BE DIFFERENT.

0 30' 60'

HORIZONTAL SCALE: 1" = 30'
VERTICAL EXAGGERATION: 3x

HWA
HONGWEST
& ASSOCIATES, INC.

CENTRAL KITSAP WWTP

GENERALIZED GEOLOGIC
CROSS SECTION C–C'

PROJECT NO.: 94127 FIGURE: 5

C:\JOBS\94127\94127005.DWG

Wiltermood
Associates, Inc.

May 25, 2011

Moe Leavitt
Brown and Caldwell
701 Pike Street, Suite 1200
Seattle, WA 98101

Re: Mitigation Options for the Central Kitsap Treatment Plant

Dear Moe:

Bob Wiltermood and I walked the treatment plant site with you on May 12, 2011 to identify the wetland fill areas and to identify viable locations for mitigation of the proposed direct wetland impacts. Our main focus for mitigation is the undeveloped area at the very south end of the plant property where there are existing wetlands. We also looked through the chain link fence across the south property line onto the adjacent south 40 acre parcel to see if mitigation areas exist there as another option since we understand that Kitsap County is planning purchasing that property for mitigation. We are unclear about the main goal of the purchase for mitigation however we understand it may be available for mitigation of the current wetland impacts but the property is not yet owned by the county so we were instructed to determine if there are any potential onsite areas for mitigation within the existing CKTP boundaries.

The total area of identified wetland impact proposed for the current upgrade plan is about 0.4 acres (~17,424 square feet) most of which has been disturbed by past activities. Regardless of the level of disturbance, the wetland meets the criteria for a Category II system and mitigation is required at a ratio of 3:1 when proposing creation or reestablishment as compensation. The amount of area needed for creation of wetland is 1.2 acres (52,272 square feet) at the required ratio. We found a ditch near the northern fence that may be considered wetland by the Army Corps of Engineers so it will be delineated for inclusion with the mitigation. The addition of this area will bring the total area of wetland impact fill closer to the ½ acre threshold for Nationwide Permits and the amount of area needed for mitigation will increase after the ditch area is delineated. The ratios increase to 12:1 for wetland enhancement and 6:1 for wetland rehabilitation as compensation so we would need 4.8 acres (209,088 square feet) of existing wetland to conduct enhancement or 3.2 acres (136,392 square feet) of wetland for rehabilitation. Compensation for wetland impacts can also be conducted in combinations at different ratios. Creation or re-establishment can be conducted on a 1:1 ratio when rehabilitation at a ratio of 4:1 or when accompanied by enhancement at a ratio of 8:1. These combination ratios allow sites containing both wetland and upland communities to be viable mitigation options particularly when there is not enough upland on the mitigation site to conduct creation at the 3:1 ratio.

The mitigation options described above are defined as follows:
Creation is the actual creation of wetland from a non-wetland or upland site.
Re-establishment occurs in an area that was historically wetland but was converted to upland through filling or draining. It would involve removal of the fill or reducing the drainage so that the area would function as a wetland again. Re-establishment was formerly referred to as restoration because it involves removal of the fill for instance, that would allow the area to once again become wetland.
Rehabilitation and Enhancement are similar in that they involve improvement of a disturbed wetland (pasture wetland for instance) that retains wetland features but is not a highly desirable in terms of function. Rehabilitation is typically some improvement of a wetland that benefits the entire watershed (perhaps creating a pond that would improve the system's ability to store flood water) and Enhancement is an activity that improves the conditions of a single disturbed wetland that does not necessarily benefit an entire watershed. Enhancement is most often conducted in pasture wetlands where improvement of conditions would involve installation of plants to increase plant species diversity or habitat functions.

The south end of the treatment plant property is composed mostly of forest with a detention pond at the west end next to Steele Creek and its associated wetlands. The forest is composed of upland between two fingers of wetland that were last delineated in 2009. Immediately west of the wetland there is an area of grassland that extends to the detention pond berm. We examined the area between the wetland and detention pond and determined that part of this area could be used to create wetland as compensation for the proposed wetland fill. This area does not appear large enough area to create the 1.2 acres of wetland currently needed for mitigation. The wetlands were previously enhanced so they are not disturbed to the point where enhancement is feasible. The largest area available for mitigation is the forested upland between the two wetland fingers where 1.56 acres is available for wetland creation. The only trouble with mitigating in this location is that we would have to remove the existing forest to dig out the soils and replant with native plants. We don't ordinarily like to mitigate in existing forest because it involves taking the plant community back to its earliest successional stage but it will be necessary to do this if mitigation is to be conducted on the site as there are few non-developed upland areas available on the plant site. Areas north of the treatment plant were examined during past delineations and mitigation plans and were deemed unusable for mitigation because of significant stands of trees and topographic conditions.

The property south of the treatment plant is composed of pasture with patches of shrubby vegetation in the northeast corner and forest in the northwest corner. Based on our cursory view of the property, it appears to contain both wetland and upland so it will probably be suitable for creation of wetland from upland and enhancement or rehabilitation of wetland in combination with creation. The site requires delineation to determine the extent of wetlands on the property and to determine the suitability of the site for mitigation. We also feel that since it is being purchased for mitigation and we are unsure of what the future may hold for the treatment plant needs in terms of wetland impacts, it may be most feasible to develop a master plan for that property before proposing any mitigation. By developing a master plan, the site can be used to its best potential and to avoid having the site become a patchwork of different wetland types that are not suited to one another. The wetland impacts currently proposed on the plant site can easily be mitigated on the adjacent property but since it is not yet owned by the county and no studies have been conducted as of yet, it will be best to conduct the mitigation on site.

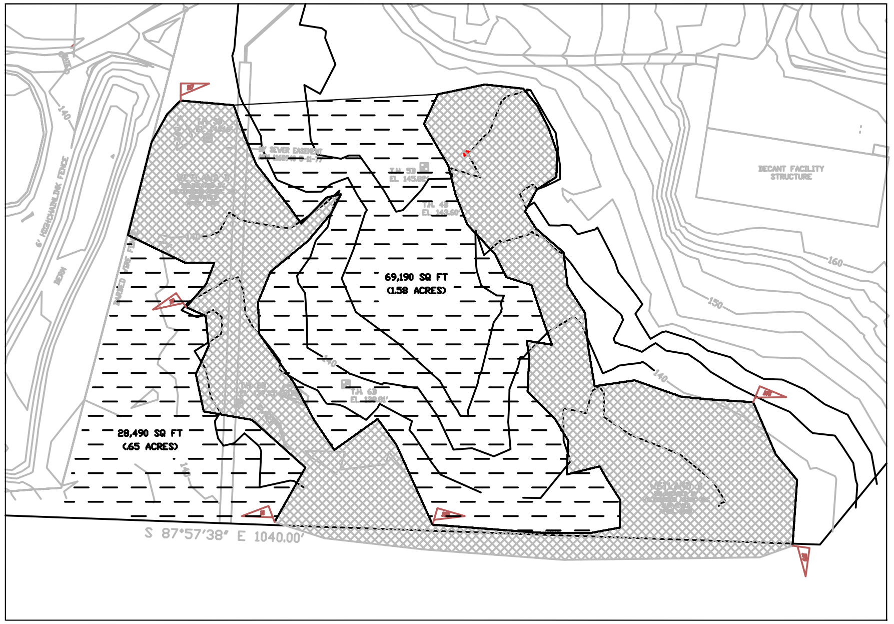
In closing, we are ready at any time to complete the mitigation of proposed onsite impacts in the existing forest on the south end of the treatment plant property. Since there are no other viable options for onsite mitigation on the current treatment plant property additional mitigation would need to occur on the adjacent 40 acre parcel. The 40 acre parcel to the south appears to be a prime location for all types of mitigation but its suitability cannot be accurately determined without a delineation and categorization. A master plan is best completed prior to initiating mitigation on the adjacent property to avoid patchwork usage of different areas.

If there are any questions or concerns that arise as a result of this letter, please give us a call or email.

Sincerely,

Joanne Bartlett

Joanne Bartlett, PWS
Wetland Biologist

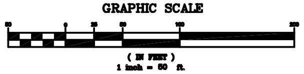


NORTH

AREA AVAILABLE FOR WETLAND CREATION
ONSITE = 2.23 ACRES (97,680 SQ FT)
NO ONSITE POTENTIAL FOR REHABILITATION
OR ENHANCEMENT.

CURRENT PROPOSED WETLAND
IMPACT = .4 ACRES (17,424 SQ FT)

CURRENT MITIGATION AREA NEEDED
@ 3:1 RATIO = 1.2 ACRES (52,272 SQ FT)



CKTP
ON SITE
WETLAND MITIGATION AREAS

Wiltermood Associates, Inc.
1015 S.W. Harper Road Port Orchard, WA 98367 (360) 876-2403