Kitsap County Suquamish WWTP Thickening Basis of Design Summary and Plant Capacity Assessment

Prepared for
Kitsap County, Washington
February 2014

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Brown AND Caldwell
701 Pike Street, Suite 1200
Seattle, Washington 98101

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List of Abbreviations

AAF	annual average flow
acfm	actual cubic foot/feet per minute
ACH	air change(s) per hour
ADF	average design flow
ADW	average dry weather
ADWF	annual dry weather flow
AMCA	Air Moving and Conditioning Association
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers Standards
AWG	American wire gauge
BEP	best efficiency point
BOD	biochemical oxygen demand
cfm	cubic foot/feet per minute
CFR	Code of Federal Regulations
CFU	colony forming unit(s)
CKTP	Central Kitsap Treatment Plant
County	Kitsap County
EPA	U.S. Environmental Protection Agency
ERU	equivalent residential unit(s)
FD	Ferrous Deep and Function Deep
ft	foot/feet
gal	gallon(s)
GBT	gravity belt thickener
gpd	gallon(s) per day
gph	gallon(s) per hour
gpm	gallon(s) per minute
GUI	graphical user interface
hp	horsepower
HVAC	heating, ventilation, and air conditioning
Hz	hertz
IBC	International Building Code
IFC	International Fire Code
I/I	infiltration and inflow
IMC	International Mechanical Code
I/O	input/output
IPC	International Plumbing Code
JIC	Joint Industry Council
lb/d	pound(s) per day
LID	low impact development
LS	lift station
MCC	motor control center
Mgal	millon gallon(s)
mgd	million gallon(s) per day
mg/L	milligram(s) per liter
MMF	maximum month flow
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Administration
PDF	peak day flow
PHF	peak hour flow
PLC	programmable logic controller
POR	preferred operating range
PPE	personal protective equipment
psi	pound(s) per square inch
psig	pound(s) per square inch gauge
PVC	polyvinyl chloride
RDT	rotary drum thickener
RS	raw sewage
SBR	sequencing batch reactor
scfm	standard cubic foot/feet per minute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SOR	standard oxygen requirement
TDH	total dynamic head
TS	total solids / thickened solids
TSS	total suspended solids
TWAS	thickened waste activated sludge
UV	ultraviolet
V	volt(s)
VFD	variable frequency drive
VSS	volatile suspended solids
WAS	waste activated sludge
WWTP	wastewater treatment plant

Executive Summary

The purpose of this Basis of Design Summary for the Suquamish Wastewater Treatment Plant (WWTP) is to assess the nominal capacity of the existing WWTP and evaluate replacement of the existing gravity belt thickener (GBT) with a new thickening device. A preliminary assessment of the two influent lift stations is also included. The need for the capacity assessment is driven largely by the Suquamish Tribe's intent to expand the Suquamish Clearwater Casino, which will increase the wastewater flow and loading to the WWTP. The existing GBT system is about 15 years old and in poor physical condition as a result of being in a highly corrosive environment, and has limited capacity to process even existing flows.

Capacity and Condition Assessment: In order to assess the WWTP's capacity to treat flows over a 20-year planning horizon, future flows and loadings were projected accounting for population growth, infiltration and inflow (I/I) reduction measures, and casino expansion. The design capacity of each major component of the WWTP process was then compared to these projected flows to determine when each capacity "bottleneck" would occur. This analysis also incorporated a visual condition assessment of major equipment to approximate the remaining service life. The results of this analysis are shown in Figure ES-1 below.

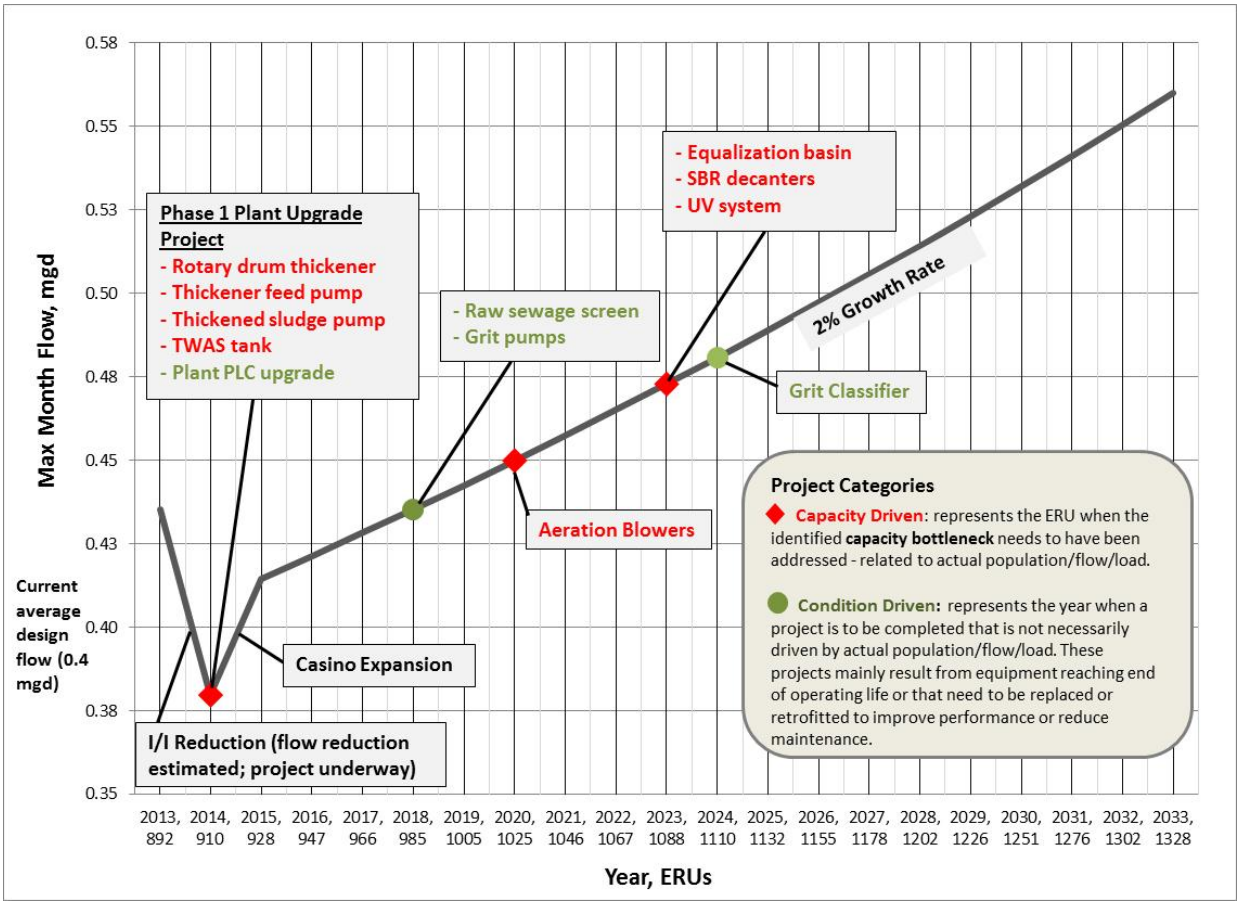

Figure ES-1. Results of plant capacity analysis

The first capacity bottleneck is anticipated in the solids handling system in 2014. The first liquids stream capacity bottleneck is projected to be in 2020, when additional aeration blower capacity will be required. Over the next 7-10 years, the raw sewage screen, grit pumps, and grit classifier will likely require replacement or refurbishment to reduce maintenance costs and increase reliability.

Solids Thickening: To address the solids stream capacity limitations identified above, the solids handling system was evaluated. The recommendations from this evaluation include the following improvements to the solids handling system: replace GBT with a rotary drum thickener (RDT), replace feed and thickened sludge pump, and incorporate a new thickened waste activated sludge (TWAS) storage tank. The WWTP currently does not have a dedicated thickened sludge storage tank, but instead employs recuperative thickening using a single tank for WAS and TWAS. A separate thickened sludge storage tank will allow thicker solids to be hauled to the Central Kitsap Treatment Plant (CKTP), thereby reducing the number of truck trips. An initial and conservative life-cycle cost analysis showed a payback period of approximately 10 years to offset the cost of a new thickened sludge storage tank. The new RDT will be located in the same location as the existing GBT and the new thickened sludge storage tank will likely be located near the existing truck loadout facility. The next phase of the project will be to develop a detailed design of the recommended improvements.

Lift Station 53 and 54: In addition to the WWTP process capacity related evaluations, the condition of lift stations (LS) 53 and 54 and the WWTP control systems was evaluated. Both LS 53 and LS 54 experience clogging issues and the LS 54 VFDs have failed several times, leading to significant maintenance requirements and unreliable pumping. The County has determined that upgrades to both of these lift stations will be planned for as part of a future project.

PLC Systems: There are three main control systems at the WWTP: the plant control system, the SBR control system, and the solids thickening control system. The solids thickening control system will be upgraded as part of the thickening project. The plant control system is an obsolete system and its workstation operates on Windows 1995. The SBR control system is still viable, but its dated workstation is also operating on Windows 1995. It is recommended that the two workstations be replaced by a single new workstation to provide for a common SCADA interface and that the plant control system be replaced with a new Allen-Bradley control system (County standard).

Permit Compliance: As shown on Figure ES-1, the recommended improvements to remove the most immediate bottlenecks (either capacity or condition driven) will be part of the Phase 1 plant upgrade project. From a capacity standpoint, once the thickening system is upgraded, the plant is projected to have sufficient hydraulic and BOD and TSS treatment capacity to meet the effluent loading limits of the NPDES permit until approximately year 2020 when it is projected that the aeration blowers will be undersized. The plant is designed for a nominal average design flow of 0.4 mgd with hydraulic capacity of the headworks and piping designed for 2.0 mgd. Based on previous 1995 Suquamish facility planning documents, the average design flow is defined as being equivalent to the maximum month flow. Although the maximum month flow is projected to exceed 0.4 mgd with the expansion of the casino, the conditions of the NPDES permit are projected to be met and no hydraulic bottlenecks are identified until a maximum month flow of approximately 0.47 mgd. Therefore, no plant rerating will be necessary until the effluent concentrations or loadings approach the NPDES permit limits. This is not projected to occur until approximately year 2020, when the plant capacity is predicted to become limited by the aeration system capacity. It is recommended that the County monitor the impacts of the I/I project and the actual casino flow to refine the timing of plant rerating efforts.

Section 1

Flows and Loadings

This section includes a summary of the historical plant flow data analysis, projected influent flows and loadings, and calculated forecasted loadings to be used as design basis for the new sludge thickening system.

1.1 Historical Data Analysis

Plant data for the period 2009 to 2012 were reviewed to assess historical trends of flows and loadings received by the plant and to compare them with wastewater treatment plant (WWTP) design criteria values. The historical data are summarized in Table 1-1. Figure 1-1 shows the monthly average and peak day plant influent flows, and Figures 1-2 and 1-3 show the monthly average and maximum day loadings for biochemical oxygen demand (BOD) and total suspended solids (TSS), respectively. The Suquamish WWTP currently has an overall design average flow (ADF) of 0.4 mgd, while the headworks and piping were designed for a peak hour flow of 2.0 mgd. Based on previous 1995 Suquamish facility planning documents, the ADF is defined as being equivalent to the maximum month flow. Plant effluent quality and loading rates are limited by its National Pollution Discharge Elimination System (NPDES) permit, issued by the Region 10 office of the U.S. Environmental Protection Agency (EPA. The permit limits and design flow and loadings are summarized in Table 1-2 and also indicated on Figures 1-2 and 1-3. Figure 1-4 shows the monthly average effluent BOD and TSS concentrations from 2009 to 2012, which are all well below the permit limits.

Flow and loading data from 2009 to 2012 indicate that the plant flows have generally remained relatively constant over the 4-year period, with a few large spikes in flows on a daily basis. The monthly average flows have exceeded the current ADF of 0.4 million gallons per day (mgd) in 4 months during that period. The large peak flows suggest significant infiltration and inflow (I/I) in the collection system. Kitsap County (County) has recently completed an I/I study of the collection system and is in the process of designing I/I reduction projects that will be implemented within the next few years. Similar to flow, influent BOD and TSS loadings have also generally remained constant and well below the WWTP design loadings during the 4-year period. Maximum month loadings have typically occurred during the winter months. A few TSS spikes approached the design value, but the cause of these TSS spikes was not identified.

In order to estimate future plant flows and loadings including the planned Suquamish Clearwater Casino expansion, the current wastewater flows from the casino were established using casino flow data from 2009 to 2012. Because there is no flow meter dedicated to measuring the casino flows, these data were calculated from pump runtime records from the casino lift station. The calculated monthly average casino flows are plotted on Figure 1-5. The casino wastewater is not routinely sampled. Special samples were collected on 8 days in January and February 2013 and analyzed for BOD and TSS. Combined with the flow data, these data provide estimated BOD and TSS loadings associated with the casino wastewater. The casino wastewater sampling data are given in Appendix A.

Using historical plant data, flow data from the casino lift station, and the limited sampling data for the casino wastewater, the flows and loadings for the non-casino-related portion of the plant influent wastewater were estimated. When comparing these flows with the flow data given in the 1995 *Suquamish Wastewater Facilities Plan and Engineering Report* (Brown and Caldwell, September 1995),

it was found that the average dry weather flow (ADWF), which typically directly relates to population, has remained largely unchanged. In the Facilities Plan, the ADWF for 1992 (last year that data were used to develop the plan) was 0.13 mgd, while the current ADWF for the non-casino wastewater is approximately 0.14 mgd. The BOD and TSS loadings were also very similar.

Figure 1-6 shows the monthly total sludge production rates from 2009 to 2012. These rates represent the amount of thickened sludge that was trucked from the Suquamish WWTP to the Central Kitsap Treatment Plant (CKTP) each month for further treatment. The plot indicates that the sludge production rate has been fairly steady, except for a few high values in 2010 and 2011.

Table 1-1. Raw Wastewater Flows and Loadings from 2009 to 2012

Parameter	2009	2010	2011	2012	Average
Annual average flow (AAF), mgd	0.22	0.25	0.23	0.24	0.24
Average dry weather flow (ADWF), mgd [a]	0.18	0.19	0.18	0.17	0.18
Maximum month flow (MMF), mgd	0.36	0.42	0.42	0.45	0.41
	(Nov)	(Jan)	(Mar)	(Dec)	
Peak day flow (PDF), mgd	0.71	0.73	0.77	0.75	0.74
	(Nov)	(Dec)	(Mar)	(Nov)	
Minimum day flow, mgd	0.12	0.12	0.12	0.13	0.12
	(Aug)	(Oct)	(Sep)	(Aug)	
Peaking factors:					
ADWF/AAF	0.82	0.74	0.76	0.71	0.76
MMF/ADWF	1.97	2.28	2.38	2.61	2.31
PDF/MMF	2.00	1.72	1.84	1.68	1.81
Annual average BOD loading, lb/d	356	371	362	366	364
Average dry weather BOD loading, lb/d	345	363	333	354	349
Maximum month BOD loading, lb/d	404	433	411	392	410
	(Jan)	(Feb)	(Feb)	(Feb)	
Peak day BOD loading, lb/d	492	494	577	473	509
	(June)	(Mar)	(Nov)	(Nov)	
Peaking factors:					
Annual average/average dry weather	1.03	1.02	1.09	1.03	1.04
Maximum month/annual average	1.13	1.17	1.14	1.07	1.13
Peak day/maximum month	1.22	1.14	1.40	1.21	1.24
Annual average TSS loading, lb/d	313	360	359	357	347
Average dry weather TSS loading, lb/d	293	342	342	349	331
Maximum month TSS loading, lb/d	363	424	415	387	398
	(Nov)	(Mar)	(Feb)	(June)	
Peak day TSS loading, lb/d	665	543	683	463	588
	(June)	(Mar)	(Nov)	(Jan)	
Peaking factors:					
Annual average/average dry weather	1.07	1.05	1.05	1.02	1.05
Maximum month/annual average	1.16	1.18	1.16	1.09	1.14
Peak day/maximum month	1.83	1.28	1.64	1.20	1.49

a. Average dry weather (ADW) = May to October.

Table 1-2. WWTP Design Flows and Loadings and Permit Limits[a]		
Design criteria	Design quantity	
Average Design Flow [b]	0.4 mgd	
Peak hour flow [c]	1.0 mgd	
Max month BOD loading	580 lb/d	
Max month TSS loading	737 lb/d	
	Effluent limitations	
Parameter	Average monthly	Average weekly
BOD (5-day)	30 mg/L	40 mg/L
	100 lb/d	150 lb/d
TSS	30 mg/L	45 mg/L
	100 lb/d	150 lb/d
Fecal coliforms	200 CFU/100 mL	400 CFU/100 mL

CFU = Colony forming units

a. *Effluent limits given in NPDES Permit and Factsheet effective June 1, 2008. Average design flow and max month BOD and TSS loadings are the design values given in the plant design drawings for Kitsap County Wastewater Treatment Plant at Suquamish, Washington by Paramatrix, Inc., dated December 1995.*

b. *The nominal average design flow of 0.4 mgd was given in the design documents as the Phase 1 design. The design documents indicate that the hydraulic capacity of the headworks and all piping are designed for Phase 2 peak flow (2 mgd).*

c. *A peak design flow (PDF) of 1.0 mgd was given in the design documents. It was assumed that this corresponds to the peak hour flow, based on information provided in the Suquamish Wastewater Facilities Plan and Engineering Report dated September 1995. A design peak day flow value was not given.*

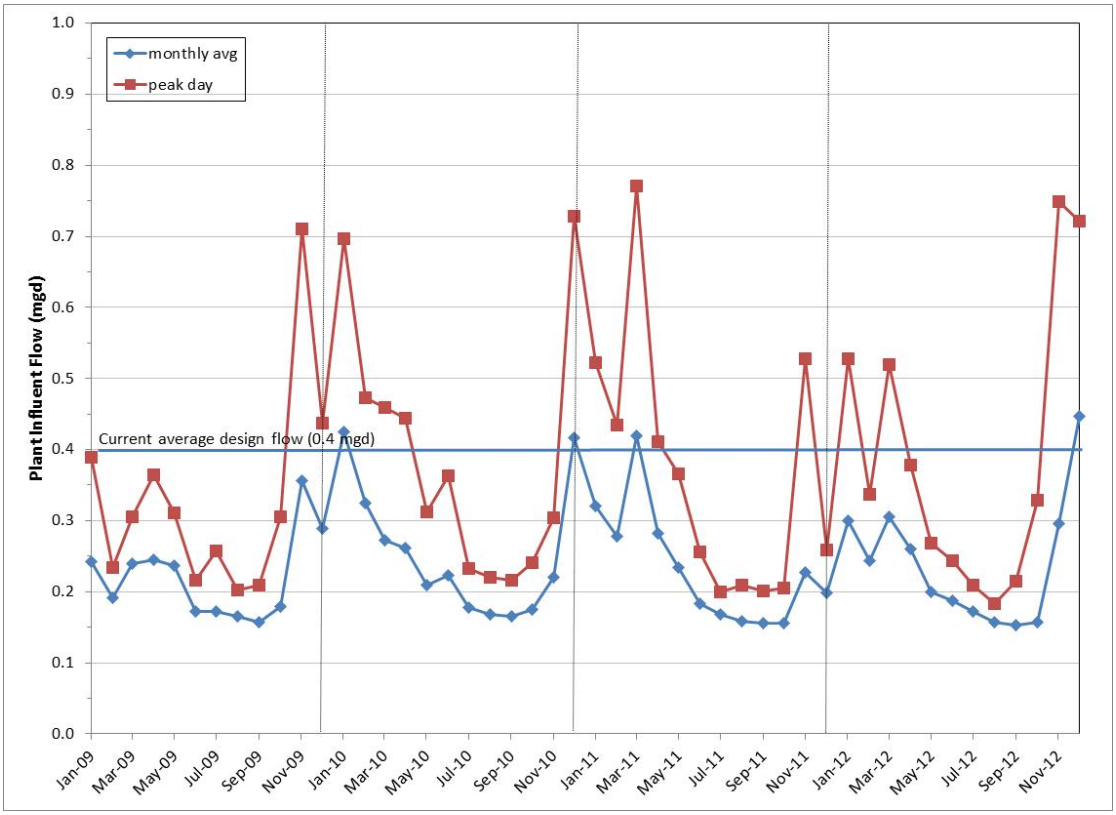

Figure 1-1. Monthly average and peak day influent flows from 2009 to 2012

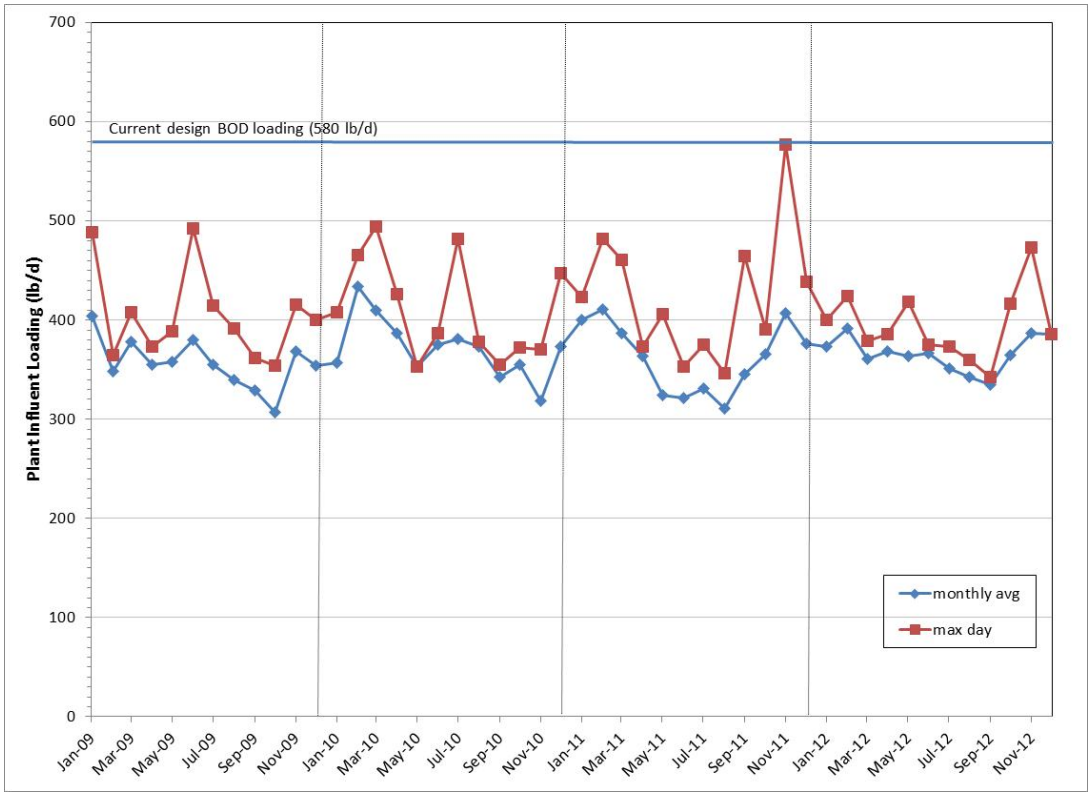

Figure 1-2. Monthly average and max day BOD loadings from 2009 to 2012

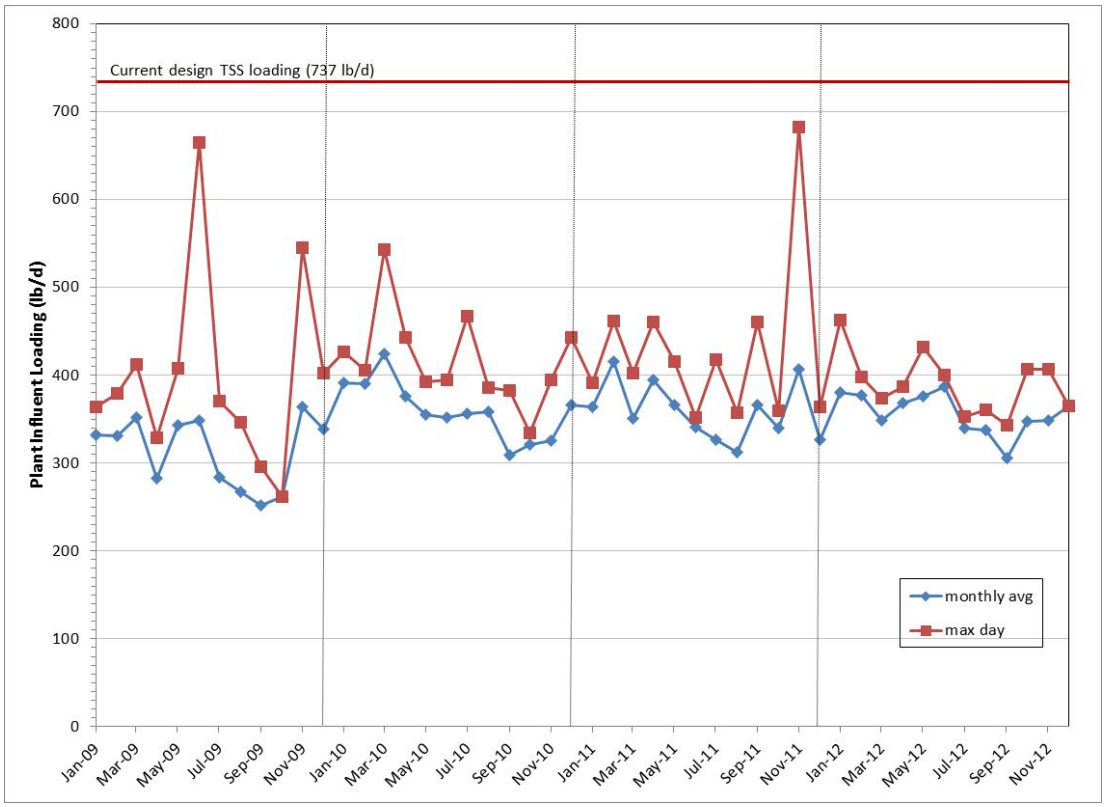

Figure 1-3. Monthly average and max day TSS loadings from 2009 to 2012

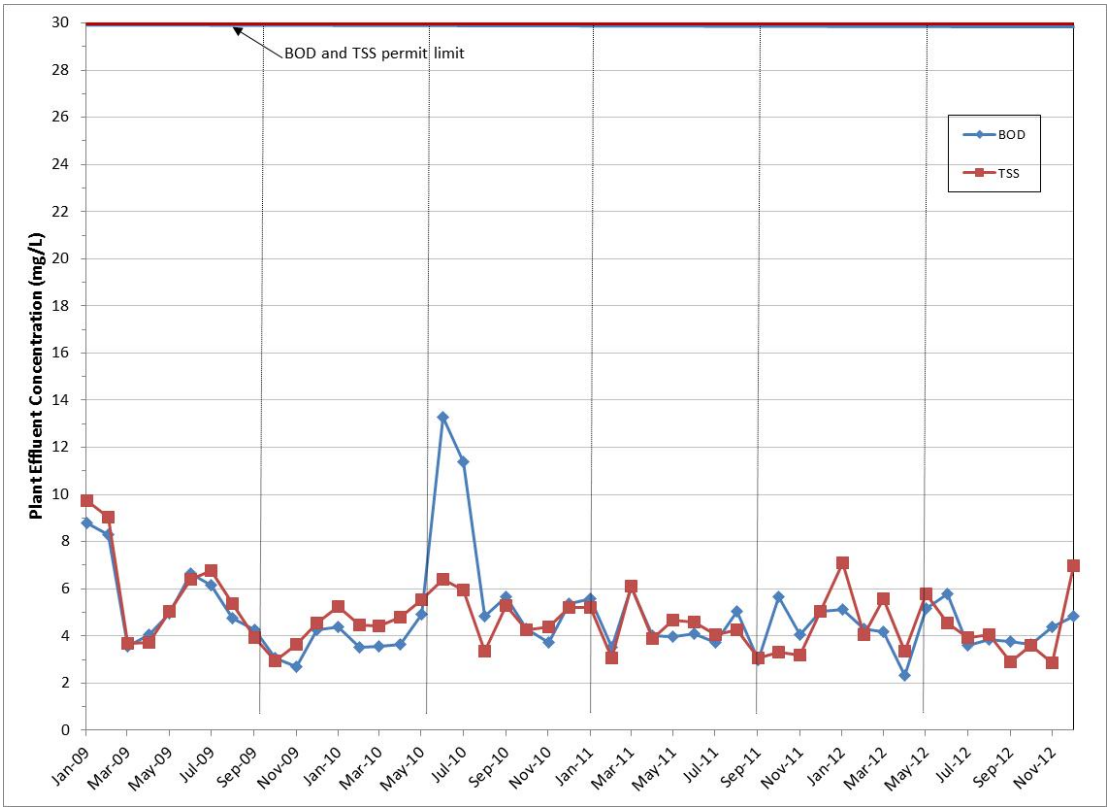

Figure 1-4. Monthly average effluent BOD and TSS concentrations from 2009 to 2012

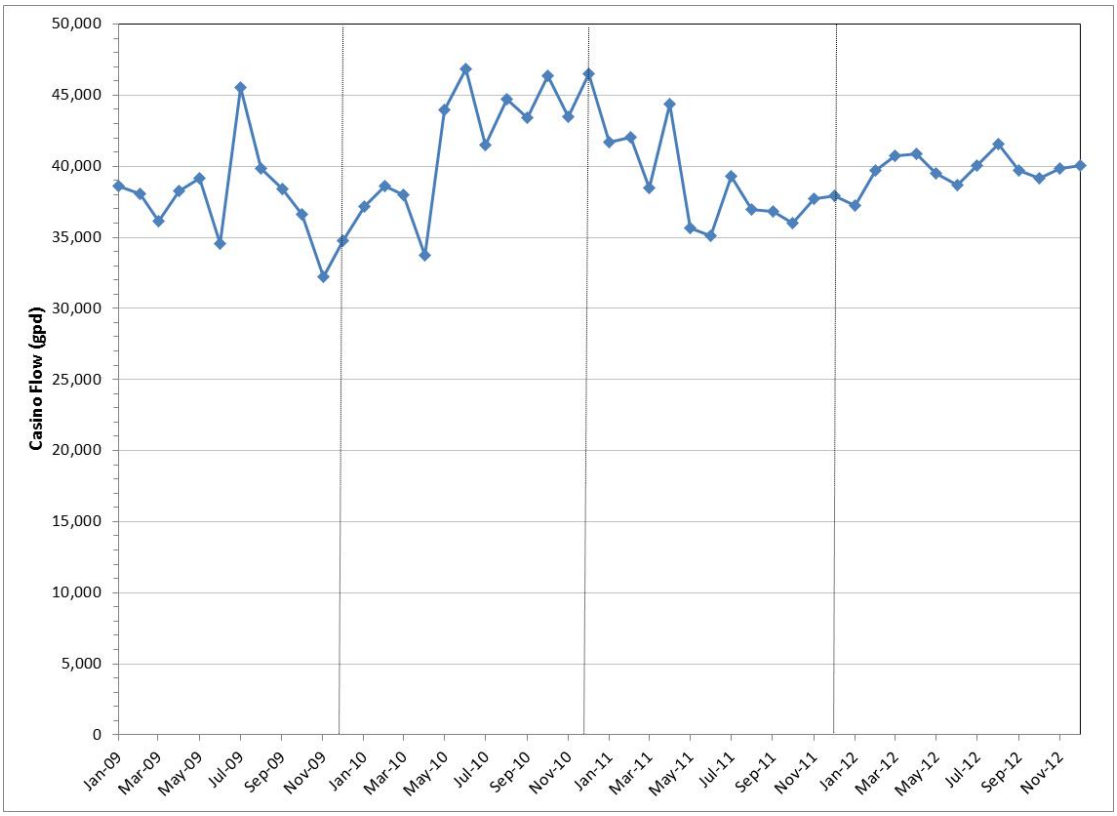

Figure 1-5. Monthly average casino flows from 2009 to 2012

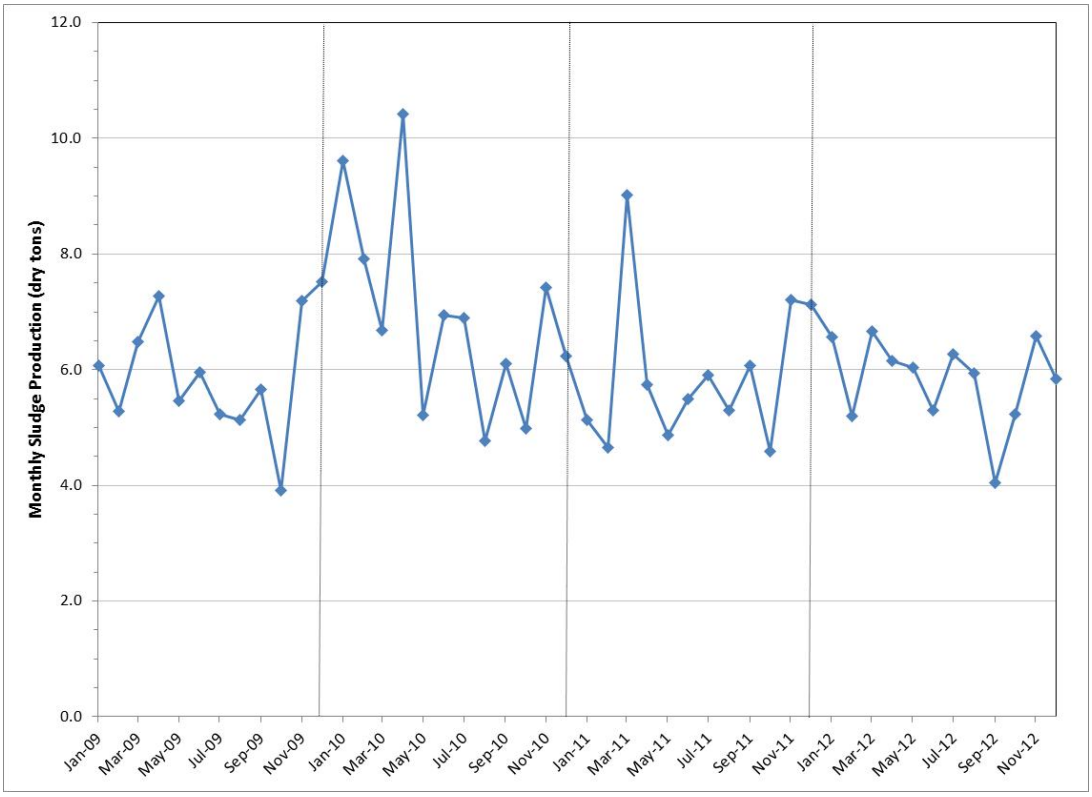

Figure 1-6. Monthly total sludge production rates from 2009 to 2012

1.2 Projected Plant Influent Flows and Loadings

Future plant flows and loadings were estimated for a 20-year horizon (for 2033). The projected flows and loadings are summarized in Table 1-3. Also included in the table are the two sets of startup conditions: 1) 2013 flows and loads without casino expansion and I/I reduction, and 2) 2014 flows and loads with casino expansion and I/I reduction. The former represents the scenario with the lowest base flows and loadings assuming minimal growth in population. The casino expansion results in a step increase in loadings from 2013 to 2014, while I/I reduction results in a decrease in maximum month and peak day flows. The future flows from the expanded casino were provided by the Suquamish Tribe staff (included in Appendix A). Assumptions used in calculating the total plant influent flow loadings include:

- Annual growth rate of 2 percent in population and thus the base flow (equivalent to ADWF) through the 20-year period is assumed. Although no specific growth rates for this service area have recently been published, discussions with the County indicated that 2 percent would be a reasonable assumption for this study.
- Average dry weather BOD and TSS concentrations of 195 and 238 milligrams per liter (mg/L), respectively, for the non-casino portion of the influent wastewater, based on historical data and estimated loadings for the current casino wastewater. These concentrations are assumed to remain unchanged throughout the 20-year period (i.e., not affected by future I/I reduction and/or water conservation).
- Loading peaking factors for BOD and TSS based on 2009 to 2012 data for the non-casino-related wastewater.
- Flow peaking factors that are somewhat lower (assumed to be about 15 percent lower) than those calculated from the 2009 to 2012 plant data as a result of the implementation of I/I reduction projects.
- A peak hour to peak day flow ratio of 1.25 was used. Hourly flow data are not available, so a peaking factor similar to that used for the CKTP flow projections was assumed.
- I/I reduction implemented in 2014.
- After the expansion, the casino flows will be 0.063 mgd on an annual average basis and 0.126 mgd on a peak day basis per input from the Suquamish Tribe (as shown in Appendix A).
- Constant BOD and TSS concentrations of 388 and 185 mg/L, respectively, for the casino wastewater based on the January and February 2013 sampling data.
- Constant casino flows and loads. It is assume that flows and loads will remain constant from year to year throughout the 20-year period after the expansion, but will vary daily and seasonally in each year.

Table 1-3. Projected Flows and Loadings at Suquamish WWTP

Parameter	2013 w/o casino expansion	2014 w/ casino expansion & I/I reduction	2033 w/ casino expansion & I/I reduction	Basis for calculation [a]
Average dry weather flow (ADWF), mgd	0.18	0.21	0.28	2013 ADWF, 2% annual growth
Annual average flow (AAF), mgd	0.24	0.27	0.37	ADWF/AAF (non-casino) = 0.70
Max month flow (MMF), mgd	0.44	0.41	0.56	MMF/ADWF (non-casino)[b] = 2.72, 2.29
Peak day flow (PDF), mgd	0.78	0.69	0.95	PDF/MMF (non-casino)[b] = 1.81, 1.70
Peak hour flow (PHF), mgd	0.98	0.87	1.19	PHF/PDF = 1.25
Average dry weather BOD load, lb/d	358	439	547	BOD = 195 /388 mg/L [c]
Annual average BOD load, lb/d	375	456	572	Ann avg/ADW (non-casino) = 1.07
Max month BOD load, lb/d	452	549	690	Max mo/ann avg (non-casino) = 1.21
Peak day BOD load, lb/d	627	789	963	Peak day/max mo (non-casino) = 1.24
Average dry weather TSS load, lb/d	344	386	518	TSS = 238 / 185 mg/L [c]
Annual average TSS load, lb/d	361	403	543	Ann avg/ADW (non-casino) = 1.06
Peak month TSS load, lb/d	430	480	647	Max mo/ann avg (non-casino) = 1.19
Peak day TSS load, lb/d	654	738	986	Peak day/max mo (non-casino) = 1.49

a. Concentrations and peaking factors from historical data and special sampling data for casino wastewaters, with adjustments made to some of the flow peaking factors to account for future I/I reduction.

b. Peaking factors for before and after I/I reduction. It was assumed that I/I reduction would be completed in 2014.

c. Concentrations for non-casino-related wastewater and casino wastewater.

1.3 Design Loadings to Sludge Handling System

The design flows and loadings given in Table 1-3 were used to calculate future solids and hydraulic loadings of the WAS from the sequencing batch reactors (SBRs) to the sludge handling system. A mass balance model was set up to simulate plant operation under different flow and loading conditions, accounting for removals in the different unit processes, estimated sludge yields, and recycle streams. The results are summarized in Table 1-4.

Table 1-4. Design WAS Loading Rates to Sludge Handling System

Parameter	2013 w/o casino expansion[a]	2014 w/ casino expansion	2033 w/ casino expansion	
	Annual avg. flow & load	Annual avg. flow and load	Annual avg. flow and load	Max month flow and load
Waste activated sludge				
Hydraulic load (gpd)[b]	10,800	13,100	16,500	20,900
Mass load (lb/d) [b]	400	490	610	780
TSS (mg/L) [c]	4,500	4,500	4,500	4,500
VSS/TSS	0.80	0.81	0.80	0.81

a. 2013 values shown in table are calculated values. Actual average WAS flow rate from May 2012 to April 2013 was 18,262 gpd on days sludge was wasted. The max day WAS flow was 30,000 gpd for that period. Plant data were available for up to April 2012 at the time this analysis was performed.

b. Hydraulic and mass loading rates assuming sludge is wasted from the SBRs every day. Currently, sludge wasting occurs on Monday to Friday only.

c. WAS TSS concentration assumed to be 4,500 mg/L. Plant data show a range from about 2,500 to 6,000 mg/L.

Section 2

Plant Capacity Assessment

A preliminary plant capacity assessment was conducted of the major unit processes using existing basis of design information. These "nameplate rating" capacities were compared with projected flows and loadings to determine when capacity bottlenecks are projected to occur as a result of the casino expansion and from population growth in the service area. This analysis also includes a condition assessment of the major equipment based on input from the plant staff.

2.1 Treatment Plant Overview

The Suquamish WWTP, located on the Port Madison Indian Reservation, has provided secondary treatment for the Suquamish service area since 1976. The plant was upgraded in 1998 to include a new headworks, SBRs for secondary treatment, ultraviolet (UV) system for disinfection, and a gravity belt thickener (GBT) for sludge thickening. Raw influent is screened with a rotary bar screen and then sent to a grit chamber for grit removal. The degritted flow is routed alternately between the two SBR basins. Effluent from each SBR flows to an equalization basin during the decant phase. The equalized secondary effluent is then routed to the UV channel for disinfection. Final effluent is discharged through an outfall into Port Madison Bay in Puget Sound. Sludge is wasted from the SBRs to a sludge holding tank prior to thickening in the GBT. The thickened sludge is returned to the holding tank and subsequently transported by tanker trucks to the CKTP for further treatment. Because only one holding tank is available, where both un-thickened WAS and thickened WAS are routed, some of the thickened sludge is re-thickened and the thickened sludge is also diluted by the un-thickened WAS, resulting in lower overall sludge concentration for the thickened sludge hauled from the plant. Figure 2-1 shows the plant process flow schematic.

The Suquamish WWTP was designed for an ADF of 0.4 mgd, with the headworks and all plant piping designed for 2 mgd. The effluent limits defined by the current NPDES permit are summarized in Table 1-2.

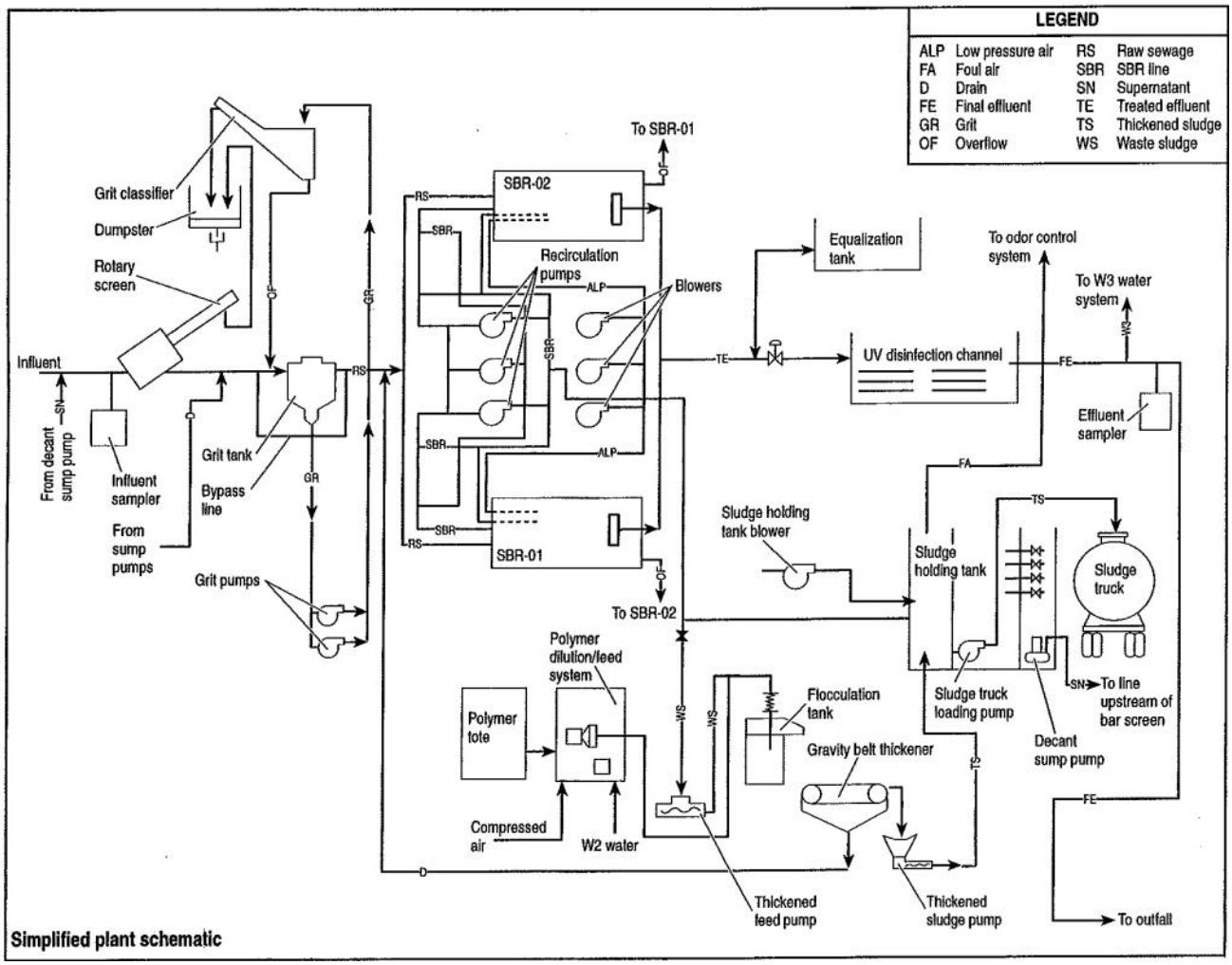

Figure 2-1. Suquamish WWTP Existing Process Schematic

2.2 Unit Process Capacity and Condition Assessment

A preliminary assessment of the unit process capacities was conducted using original design criteria or existing nameplate information. Biological process modeling and hydraulic profile analyses were not performed as part of this assessment. In addition, a condition assessment of the major equipment was performed based on input from the plant staff. The results of both assessments are combined and summarized in Table 2-1.

Most of the major process tanks and equipment other than those in the solids handling system currently have adequate capacity. However, a number of equipment, especially in the headworks, may require replacement in the near future due to wear and tear of the equipment as they approach the end of their operating life. Based on information given in the 1995 plant upgrade design drawings, the hydraulic capacity of the headworks and all piping was designed for a peak hour flow (PHF) of 2.0 mgd, while all other unit processes were designed for a PHF of 1 mgd. The projected 2033 peak hour flow is 1.19 mgd, as shown in Table 1-3. Therefore, the liquid stream processes, including the SBRs and UV system, are expected to require upgrade or expansion before 2033 to accommodate the projected plant flows.

In terms of loading capacity, the main constraints are the SBR aeration system and the solids handling system. The solids handling system will be upgraded as part of this project and the design criteria are discussed below in Section 5. The nominal capacity of the existing GBT is a throughput of 40 gallons per minute (gpm). Assuming an effective operating time of 32 hours per week and average WAS solids concentration of 5,000 mg/L, this corresponds to an average production capacity of approximately 460 pounds per day (lb/d). As shown in Table 1-4, the projected mass loading rate in 2014 is 490 lb/d. These estimates indicate that the GBT unit is at or nearing its capacity, corroborating the plant staff's observations in the field.

The SBR aeration system consists of three aeration blowers and jet aerators in the SBR basins. The jet aerators operate in conjunction with the recirculation pumps to provide a two-phase flow into each basin during the aerated fill-and-react phases of each SBR cycle. Each SBR basin has a dedicated blower, with the third blower serving as a common standby blower. The 1995 plant upgrade design documents indicate a rated capacity of 264 standard cubic feet per minute (scfm) for each blower and a standard oxygen requirement (SOR) of 2,166 lb/d. The latter was assumed to represent the maximum month oxygen delivery capacity of the aeration system and was used to estimate the corresponding maximum month BOD loading limit. Because oxygen is consumed in the SBRs for nitrification as well as carbonaceous BOD oxidation, oxygen requirements associated with the former are also included in the calculations assuming partial nitrification as shown in the historical data. The analysis shows a maximum month BOD loading capacity of approximately 590 lb/d.

2.3 Recommended Improvement Plan

Figure 2-2 shows the recommended plant improvements both to remove a capacity bottleneck and to replace equipment that will reach the end of its operating life. The plant improvements are marked on a curve indicating the projected maximum month plant flow expressed as a function of year and equivalent residential units (ERUs). Current sewer billing records show a total of 892 sewer accounts in the Suquamish service area. For this analysis, a sewer account is assumed to correspond to 1 ERU. The plant average dry weather flow was assumed to increase by 2 percent per year due to population growth, as discussed in Section 2. Except for the first year (in 2014, when I/I reduction is assumed to be implemented, thus reducing the maximum month flow), the maximum month flow increases proportionally with time and ERUs. If the actual growth rate differs from 2 percent, the actual year of the capacity-driven improvements will change from what is shown. The timing of capacity-driven improvements relative to the number of ERUs would remain the same, regardless of the year in which they occur.

The first set of improvements shown on Figure 2-2 to be implemented in 2014 is grouped together and referred to as the Phase 1 plant upgrade project. The Phase 1 project will include the following:

- Replacement of GBT with new rotary drum thickener
- Replacement of existing thickener feed pump with new pump
- Replacement of existing thickened sludge pump with new pump
- New TWAS tank
- Plant PLC upgrade

The SBRs, including the decanters, were designed for a PHF of 1 mgd. Therefore, it was assumed that when the projected peak hour flow reaches 1 mgd in 2023, new or retrofitted decanters would be required to accommodate the future peak flows. The existing UV channel includes space for a third UV bank; therefore, the UV system capacity constraint shown to occur in 2023 can be removed by adding the third bank in the channel.

Table 2-1. Unit Process Design Criteria and Condition Assessment

Equipment	# units	Type	Capacity[a]	Existing condition[b]	Estimated remaining life[b]	Comments
Headworks			Nominal PHF: 2 mgd			
Raw sewage screen	1	1/4" rotary screen with screw conveyor and screenings dewatering compactor	2 mgd	Fair	5 years	Need rock trap for influent line Plugging problems with compactor
Grit removal tank	1	-	2 mgd	Good	-	-
Grit removal pump	2	Recessed impeller	150 gpm at 25' TDH, 100 gpm at 20' TDH	Fair	5 years	-
Grit classifier	1	Inclined screw	200 gpm, 400 lb/d	Poor - Fair	10 years	Needs new auger
Sequencing batch reactors			Nominal PHF: 1 mgd			
SBR tanks	2	-	0.39 Mgal (volume)	Good	-	Need sump pump isolation valve and new coating
Decanters	2	Floating	50,000 gal/cycle at peak flow of 1,833 gpm	Fair	5 – 10 years	
Aeration blowers	3	Rotary lobe	264 scfm	-	-	-
Aerators	2	Jet aerators	2,166 lb/d (SOR)[c]	-	-	Estimated to correspond to max month BOD loading capacity of 590 lb/d (blowers + aerators)
Recirculation pumps	3	Horizontal centrifugal	1,465 gpm at 20–25' TDH	-	-	Includes one common spare; used for mixing and jet aeration
Equalization basins	1	-	69,000 gal (volume)	-	-	Designed to equalize 1 mgd peak hour flow
UV disinfection			Nominal PHF: 1 mgd			
UV channel	1	Open channel	-	Good	-	Need flow control valve update and better automation
UV lamps	72	Low pressure horizontal		-	-	Two banks (space for third bank)
W3 pumps	2	Centrifugal	40 gpm	-	-	Problem feeding from UV channel
Outfall and diffuser		12” diameter outfall and diffuser, including two 6-inch and one 4-inch ports	2.6 mgd (outfall)[d] 3.1 mgd (diffuser)[d]	Good	-	Outfall inspection conducted in February 2010 indicated diffuser and ports were in good condition.

Table 2-1. Unit Process Design Criteria and Condition Assessment

Equipment	# units	Type	Capacity[a]	Existing condition[b]	Estimated remaining life[b]	Comments
Solids handling						
Sludge storage tank	1	-	32,000 gal	-	-	-
Blowers	2	Rotary lobe	200 acfm	-	-	-
Thickener feed pump	1	Progressing cavity	60 gpm at 30 psi	-	-	Needs new augur and stator
Gravity belt thickener	1	-	40 gpm at 0.4%–1% TS	-	-	Capacity marginally sufficient for current flows.
Thickened sludge pump	1	Progressing cavity	40 gpm at 30 psi	-	-	Actual operating capacity marginally sufficient for current flows. Built into GBT.
Truck loading pump	1	Centrifugal	-	-	-	Marginally sufficient for current flows and % solids. Cannot pump 4-5% thickened sludge into truck.

a. Capacity and design values given in the plant design drawings for Kitsap County Wastewater Treatment Plant at Suquamish, Washington by Parametrix, Inc., dated December 1995, or as shown on existing equipment nameplates (thickener feed pump, thickened sludge pump, and truck loading pump).
b. Existing condition and estimated remaining life based on operator input.
c. *Standard oxygen requirement (SOR) of 2,166 lb/d given in the technical memorandum prepared by Parametrix dated 6/30/1995 establishing the process design criteria. In the design drawings (dated December 1995), an oxygen requirement of 988 lb/d was given. These values are assumed to correspond to maximum month conditions.*
d. *Hydraulic capacity of outfall and diffuser given in Suquamish Wastewater Facilities Plan and Engineering Report dated September 1995. Outfall capacity was estimated to avoid surcharging an upstream manhole (Manhole 19A) when tidal elevations are at the mean higher higher water level (approximately 4.6 feet above MSL). Diffuser capacity was estimated assuming a maximum exit velocity of 10 ft/s through the ports.*

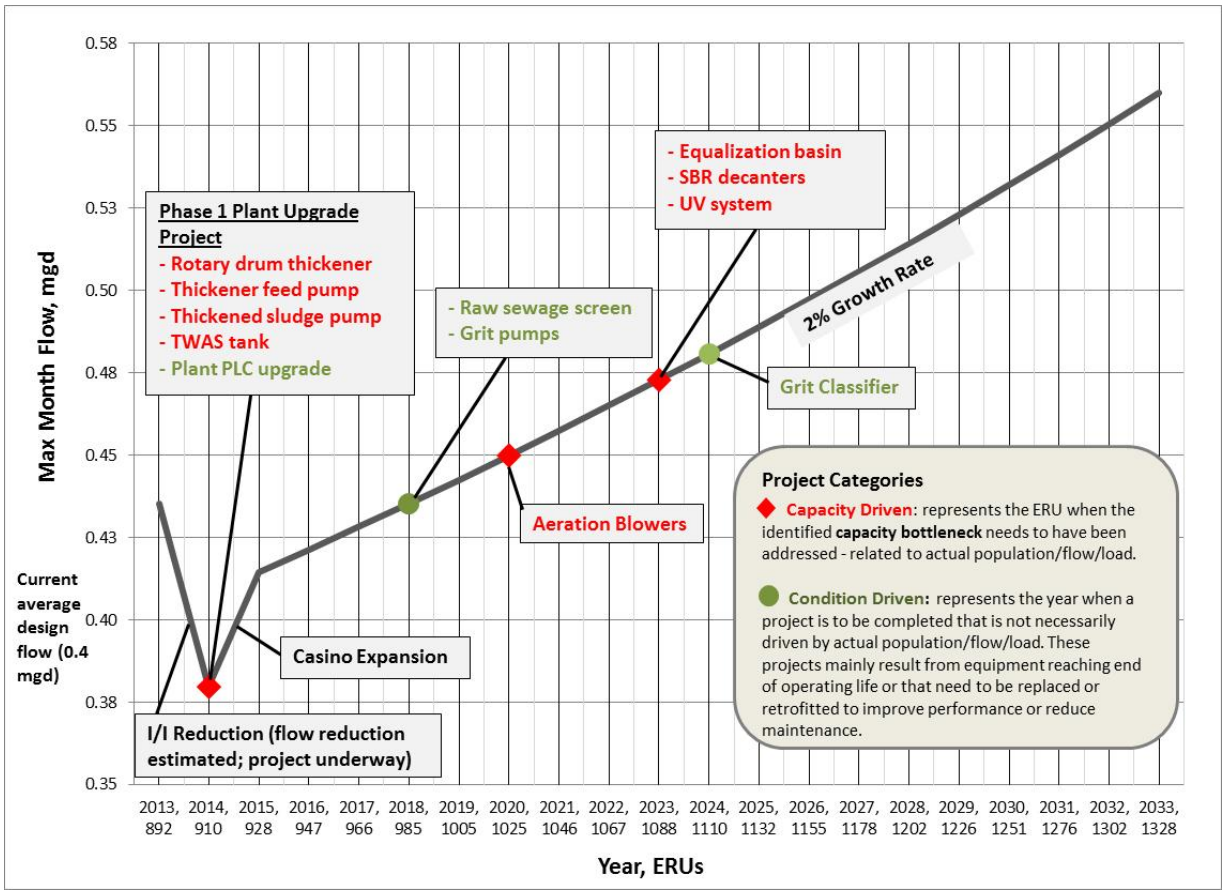

Figure 2-2. Schedule of recommended plant improvements

Section 3

Solids Thickening Evaluation

As the capacity assessment indicates, the capacity of the existing solids handling system is limited to processing only existing flows. The poor physical condition of most of the equipment leads to increased maintenance activities and costs.

Also, the WWTP does not have a dedicated thickened sludge storage tank, but instead employs recuperative thickening using a single tank for WAS and TWAS. A separate thickened sludge storage tank would allow thicker solids to be hauled to the Central Kitsap Treatment Plant (CKTP), thereby reducing the number of truck trips. An initial and conservative life-cycle cost analysis showed a payback period of approximately 10 years to offset the cost of a new thickened sludge storage tank.

This section describes the selection process of the solids equipment and summarizes other miscellaneous improvements that the plant staff requested.

3.1 Thickening Technology and Selection

As part of a comprehensive facility planning process at the CKTP, the County selected RDTs as the process for thickening WAS. This decision was based largely on positive feedback that the County received during tours of other facilities using RDTs for similar applications. Another appealing feature to plant staff is the simplicity of the machine in having relatively few moving parts and slow rotational speeds.

Based on the County's research on thickening devices, comfort level with RDT, and desire to have common processing elements between WWTPs where possible, the decision was made to replace the existing GBT with an RDT.

3.2 Rotary Drum Thickener

Based on the hydraulic loading calculations and operating the RDT 8 hours per day, 5 days per week, the required flow rate to the thickening operation would be 32–48 gpm for the average annual loading in 2013 and 2033 with a winter maximum month flow of 61 gpm in 2033. If reduced hours of operation are required, such as 6 hours per day, 5 days per week, the average annual flow would be 42–64 gpm and the winter max month is 81 gpm. Note that it is assumed that the weekend solids accumulation is processed throughout the week. If an 8-hour shift on Mondays is required to process the solids from the weekend (Friday 4 p.m. until Monday 4 p.m.) at winter max month in 2033, the required thickener sizing would be 130 gpm (high processing rate). As an additional consideration, the existing WAS storage tank holds approximately 27,000 gallons. In order to process this capacity in a single day, a thickening capacity of approximately 100 gpm would be required.

FKC has provided the following two quotes for all stainless-steel units, excluding control panels (see Appendix B):

RST S630x2000L (125 gpm): $57,000

RST S480x2000L (80 gpm): $49,000

Space allocation is similar for both units, with the S630 being approximately 2 feet longer and a few inches taller and wider. Both units will fit into the current space of the existing GBT and pump. Based on discussions with the County, the larger unit is preferred to have the ability to more quickly "catch up" after a weekend and to process a full WAS tank volume in 1 day of operation (see sizing discussion above). The recommended thickening processing capacity is 125 gpm and the preliminary layout is based on the larger RDT S630.

On July 25, 2013, one potential RDT vendor (FKC) visited the Suquamish WWTP to confirm that the S630 unit could be installed in the existing space. The largest access point is the hatch located to the north of the building. Although the RDT would need to be disassembled into a number of pieces, the FKC vendor confirmed that no one piece would be too large to fit through the existing hatch and brought into the room.

FKC estimated that it would take approximately 1 day to get the RDT components into the space and another 1 to 2 days to reassemble them. However, it is estimated that the thickening system would be off-line for at least 2 weeks to account for demolition and reconnection of plumbing, electrical and controls. The design phase will consider the use of a temporary solids thickening device (rental) to avoid hauling liquid sludge to CKTP for an extended period of time.

Because the new thickener will be installed in the headworks (a classified space) a rated control panel will be required. This panel can be either NEMA 7 or NEMA 4X with an air purge system (similar to the existing GBT control panel). The existing air compressor is old and oversized; a new compressor sized specifically for the new panel will be required. It is recommended to implement a new NEMA 4X panel with an air purge system.

3.3 Thickener Feed Pump

The existing thickener feed pump is a Netzsch Type NE60A progressing cavity pump and has a capacity of 60 gpm at 30 pounds per square inch gauge (psig) based on plant documentation. Plant staff report that this pump will likely need a new rotor in the near future. If the existing pump receives a new rotor and is deemed suitable for continued operation, it would have sufficient capacity for feed sludge to the new RDT through 2033. If it is desired to have the capacity to run the RDT at a processing rate that matches the capacity of the RDT (proposed to be 125 gpm), the feed pump would need to be replaced. Seepex has provided a preliminary quote of $21,800 for a 130 gpm pump (see Appendix C).

Because the proposed new thickener feed pump and motor are larger than the current motor, the VFD controlling the pump speed will also be replaced. The VFD for the thickener feed pump will have controls on the VFD enclosure in the electrical room and controls at the RDT control panel located in the headworks room.

3.4 Thickened Sludge Pump

The existing thickened sludge pump is partially built into the GBT and has limited capacity to keep up with existing flows. This pump will need to be replaced with a new open-throated progressing cavity pump that has a higher capacity to match the RDT output. Seepex has provided a preliminary quote of $41,600 for a 12 gpm pump (see Appendix D). During design, other pump manufacturers and alternate pump configuration will be considered (such as piggy-back motor and side-by-side auger and pump) to optimize the use of limited available space.

The thickened sludge pump discharge will be cross-connected to the existing 3-inch thickened solids (3"TS) line to preserve the option of routing thickened sludge to the WAS tank for recuperative thickening.

Because the thickened sludge pump and motor assembly are replaced, the VFD controlling the pump speed will also be replaced. The VFD for the thickened sludge feed pump will have controls on the VFD enclosure in the electrical room and controls at the RDT control panel located in the headworks room.

3.5 Thickened Sludge Storage Tank

The amount of TWAS produced per week during the winter max month in 2033 is approximately 13,200 gallons. With a truck volume of 4,500 gallons, three trucks would be required per week to transfer TWAS to CKTP.

Assuming that solids will be processed on Monday after a long weekend, the maximum storage volume of TWAS would be equivalent to 4 days (Thursday 4 p.m. until Monday 4 p.m.) of solids production. Using the winter MMF projections for 2033, the maximum required storage volume would be approximately 7,500 gallons. A 17-foot-tall and 12-foot-diameter storage tank would provide an effective storage volume of 9,300 gallons, which is at least the same volume as two full tank trucks (each truck with 4,500-gallon capacity).

Three potential locations were identified for the thickened sludge storage tank (these are included on the site plan in Appendix H). Descriptions of the pros and cons associated with each option are presented below. Option 2 is recommended because it preserves the plant's future expansion capability.

Option 1: Locate the thickened sludge storage tank east of the building and in the future SBR 4 location.

Truck loadout: The loadout/recirculation pump would be located on grade next to the tank and the discharge pipe connected to the existing 6-inch-diameter loadout pipe.

Overflow: Assuming grade at approximately 84-foot elevation, the top of the tank would be at an approximate elevation of 101 feet and overflow invert elevation of 99 feet. The headworks influent channel invert is approximately 93 feet and the influent 12-inch raw sewage (RS) pipe terminates at elevation 90.5 feet in an influent sump or box; an overflow pipe from the tank could possibly be routed to this channel or sump/box. Alternatively, the overflow could be routed back to the WAS tank (submerged termination recommended so the foul air system is not connected to the new thickened sludge storage tank).

Electrical/control: Because the loadout/recirculation pump would be located next to the tank, a short run of conduit/cable would be required from the existing electrical and control room. A similar concept applies to level measurement for the tank.

Tank access: Access to the top of the tank could potentially be connected to the existing access stairs and platform at the headworks/thickening building.

Advantage: The advantage of this option is that a new open-cut trench across the site is not required. Additionally, power feed is close by, which would minimize the cable/conduit runs.

Disadvantage: The disadvantage of this option is the limitation of the future plant expansion because a portion of SBR 4 footprint would be unavailable in the future. However, space for SBR 3 is still available for a 50 percent expansion of the plant liquid stream treatment capacity.

Option 2 (recommended): Locate the thickened sludge storage tank by the existing truck loadout.

Truck loadout: The loadout/recirculation pump would be located on grade next to the tank.

Overflow: Overflow to the influent channel would require a pipe support structure over the paved areas and is therefore not considered further. Another option would be to connect to the existing, below-grade, 8-inch-diameter TS drain in the truck loadout area by either hard pipe connection or by letting the overflow discharge to the containment area. Because the overflow rate would be low (same as the TWAS feed to the tank), it should be acceptable to discharge the overflow to the containment area and eliminate some excavation and concrete repair work in this area. The overflow and truck drainage

discharges into the existing decant sump, which pumps back to the grit chamber. Overflow directly to the containment area is acceptable to the County.

Electrical/control: This location will require a new underground electrical power feed and signal wiring across the paved areas. This can be concrete encased to reduce excavation.

Sludge transfer: Because the paved area will be disturbed for electrical work, a new 4-inch-diameter sludge transfer line should be added to this trench. Alternatively, the sludge transfer could be connected to the existing 3-inch-diameter sludge transfer pipe.

Tank access: New access stairs/platforms are required for access to the top of the tank.

Advantage: The advantage of this location is that is preserves the future expansion of both SBRs 3 and 4 as originally planned.

Disadvantage: The disadvantage of this option is that a new open-cut trench across the site is required and some site disturbance will result. New concrete curb containment and relocation of the fence line is required at this location.

Option 3: Locate the thickened sludge storage tank south-east of the building.

During the site visit, an alternate location outside the SBR 4 boundary to the south and east of the building was discussed. This alternate would allow the County to keep the SBR 4 space allocated for future plant expansion. However, this location would have to be coordinated with the existing electrical ductbank and primary effluent line located south of the building and future SBR locations. This constraint moves the tank outside the current fence line and on a sloped section, where groundwater may be exiting the hillside during wet weather. Although a potential consideration, due to the site constraints and groundwater concerns in this area and potential issues with overflow routing back to the headworks, this alternate location does not provide significant advantages over the two options discussed in this section.

3.6 Truck Loadout Pump

A new truck loadout pump will be needed to transfer TWAS to a truck for hauling to CKTP. Plant staff indicated a preference to have the ability to load the truck in 15–20 minutes, which would require a pump capacity of 225–300 gpm. Seepex has provided quotes for both a 225 gpm and 300 gpm pump (see Appendix E). The smaller pump selection (BN70-12) costs about $20,000 less than the larger pump selection (BN130-12). Since the smaller pump is sufficient (with a truck loading time of 20 min), it is recommended to select the smaller pump to reduce power use and requirements. Because a 5 – 6 percent sludge can exhibit thixotropic behavior and require additional headloss at pumping startup, these pumping applications are typically designed for a 100 psig discharge pressure (similar to CKTP sludge pump). During detailed design, this criterion could potentially be refined to reduce the motor hp.

The minimum recommended turnover time for mixing the tank contents is 1 hour, which would require a pump capacity of approximately 150 gpm. Although an air diffuser system can be used to mix solids, the solids of the contents of the TWAS tank would be too concentrated to result in effective air mixing. Tank mixing could be achieved by one of the following options:

1) using the truck loadout pump with a VFD to reduce the pumping rate and power draw;
2) a dedicated, smaller pump sized for 150 gpm.

To minimize the amount of equipment and reduce overall cost, it is recommended to incorporate a VFD on the truck loadout pump and use the pump for mixing as well. Reducing the speed of a 225 gpm pump to provide mixing at 150 gpm is within the pump turndown capability and reduces the power draw proportional to the reduced flow (approximately).

Power for the new truck loadout pump will be provided by the existing MCC. If the MCC electrical capacity for the additional electrical load is not sufficient, power for the new truck loadout pump can be obtained from the switchboard in the original Suquamish WWTP building. Pending results from MCC load measurement, the VFD for a 40 hp pump (large pump selection) will require 45 inches of space in the MCC. In the existing MCC, there is one spare bucket and three empty buckets. These can be used to relocate an existing size 1 motor starter bucket and thereby make room for a new 40 hp VFD. The control and motor power wiring will need to be reworked to support relocation within the MCC. If this space is made available, then the new VFD will fit into the existing MCC. If space cannot be made available, there is space for a circuit breaker to feed a remote VFD. The mounting location for the remote VFD will need to be determined during design.

3.7 Polymer System

The existing system is by Stranco and based on visual inspection and plant staff input, the unit is in good working condition. Using a worst-case condition (125 gpm of 1 percent WAS; 10 lb of polymer per dry-ton solids, 30 percent active polymer), maximum emulsion polymer demand is 1.25 gallons per hour (gph). The emulsion polymer feed pump (Milton Roy C731-25HV) is rated for 8 gph at 60 psig and would therefore be sufficient for the new RDT.

The polymer system will be relocated as shown in Appendix H. The existing control wiring connected to the GBT control panel to interlock the polymer operations will be disconnected and reconnected to the new RDT control panel.

3.8 Wash Water

The existing 3W wash water pumps for the GBT are designed for 40 gpm at 250 feet total dynamic head (TDH) (108 psig) with 7.5 hp motors (see Appendix F for pump curve) and feed a hydro-pneumatic tank. This tank has variable pressure and the current operating pressure is approximately 80-100 psig (estimated from watching on/off operation during site visit). Plant staff expressed concern about the current capacity of these pumps and that they cannot meet the current demand. Even though the new RDT from FKC only needs 10–15 gpm of wash water at 40 psig, these pumps are 28 years old and at the end of their service life. Therefore, it is recommended that these pumps be replaced as part of this project.

An additional concern for the operators is the connection of the 3W water pumps to the effluent UV channel. On Thursdays, plant staff empty the EQ basin, which causes the UV channels to be empty. Plant staff need to either fill the UV channel with potable water to keep GBT wash water available through the 3W pumps or switch to directly using the 2W connection at the existing polymer system. Like the 3W system, the 2W system consists of a pump and a hydro-pneumatic, but its supply is from an air gap tank. The hydro-pneumatic tank is operated at 50–65 psig (estimated from watching on/off operation during site visit). Similar to the 2W system, plant staff expressed concern about the current capacity of this pump and that it cannot keep up with the current demand when providing GBT wash water. The reduced wash water demand to the RDT could address this issue as well. The 2W water pump was installed in 1997 (16 years old) and could have some life remaining. However, the capacity of this pump is limited and, at times, cannot keep up with current demand; replacement is recommended.

Similar to the current configuration of providing both 2W and 3W to the wash water and polymer system, the RDT wash water and polymer system will be cross-connected between the 2W and 3W water systems to ensure that wash water is available. The RDT design will include separating these two systems with a check valve in each supply pipe.

Plant staff also noted a potential 1W supply line issue. At times when 2W demand is high, the air gap tank cannot fill fast enough to keep up with the 2W pump. The main line to the water system is a 1-inch line, but it reduces to ¾" before the backflow preventer. It was speculated that this is the source of the flow restriction to the air gap tank. It is recommended to upsize the air gap supply line to match the incoming potable water line. BC will also determine where the main header is to see if the line can be upsized further. A new backflow preventer would be needed, but existing pressure gauges can likely be reused.

Both 2W and 3W hydro-pneumatic tanks are dated 1997 and should have some life remaining.

Based on the available information at this stage, the following modifications will be made to the water systems:

- 1W supply line and backflow preventer will be upsized to address the air gap tank supply issue.
- 2W pump will be replaced.
- 3W pumps will be replaced with pumps of similar size
- Typically, the RDT manufacturer provides a booster pump and this is shown in the PID in Appendix H pending evaluation of the plant water system.
- Maintaining the 3W pumps in operation during times when the EQ basin is offline will be evaluated during design.

If larger pump motors are required for the 3W pumps, the additional electrical load will be evaluated with the MCC electrical capacity. If the motor is greater than 10 hp, a remote motor starter will be required along with a mounting location.

3.9 Air Handling

The existing air exhaust blower is sized for 5,000 cubic feet per minute (cfm) and withdraws 4,400 cfm from the headworks. This flow rate provides approximately 20 air changes per hour (ACH).

To reduce power consumption, this constant speed blower could be placed on a VFD to reduce the air changes per hour to 12. This could also require a change in the heating system and supply fan because they are sized for the constant-speed blower. Note that a reduced air change rate could create a more humid atmosphere with more hydrogen sulfide, which could cause additional corrosion. Because corrosion appears to be an issue in this room at 20 ACH, it is recommended to keep the system as-is.

3.10 Miscellaneous

During the site visit, various issues were discussed to be considered for final design:

- The hose at the truck loadout needs replacement due to leaks and heat tracing for freeze protection. The design will consider the use of a freeze-protected utility station (self-draining type).
- The only working site hose bib connection is the one at the truck loadout station. Another hose bib is located at the EQ basin/WAS tank, but it is not connected to the water supply. The final design will incorporate reconnecting this hose bib.
- The effluent control valve (FCV 01) is intended to be automated, but it is currently not functioning correctly. Plant operators report that the valve is likely closing more than it should according to the control system signal. This restricts flow to the UV channel and the effluent backs up and fills the EQ basin. Plant operators report that the control program is protected. Plant operators are now manually controlling this valve, which increases operator time. Based on the County's comments, the control system should be replaced and an automatic valve operation should be implemented.

- The air compressor serving the GBT panel purge, GBT belt guide system, and hoist operation was installed in the 1997 plant upgrade. The compressor is currently out of service and inoperable, and will be replaced as part of this design.
- Operators currently estimate the WAS flow rate to thickening and adjust polymer dosage based on this estimate. Adding a flow meter for the waste solids line with help optimize polymer dosage and thickening operating.

3.11 Equipment Design Criteria

The design criteria for new expected solids handling equipment and thickened sludge storage tank are summarized in Table 3-1 and described in the sections below.

3.12 Preliminary Drawings

Preliminary drawings of the solids thickening upgrades are included in Appendix H and are based on the following:

1. Rotary drum thickener: FKC S630x2000L
2. Thickened sludge pump: Seepex BTHE 10-12
3. Thickener feed pump: Seepex BN 35-12
4. Thickened sludge truck loadout pump: Seepex BN 130-12
5. Thickened sludge storage tank: 12-foot diameter

Table 3-1. Suquamish WWTP Thickening Project Design Criteria		
Process element	Unit	Value
Thickener		
Average processing rate required at 2014 annual avg w/o casino	gpm	32
Average processing rate required at 2033 peak month w/ casino	gpm	61
Number of units	-	1
Capacity	gpm	125
Solids concentration		
WAS feed	%	0.45
Thickened WAS	%	5
Thickened WAS tank		
Diameter	ft	12
Total height	ft	17
Freeboard	ft	2
Volume	gal	9,300
Number of units	-	1
Thickener feed pump		
Capacity	gpm	130
Number of units	-	1
Thickened sludge pump		
Capacity	gpm	12
Number of units	-	1
Truck loadout pump		
Capacity	gpm	225
Number of units	-	1
Wash water booster pump (if required by FKC)		
Capacity	gpm	15
Pressure	psi	40
Number of units	-	1
2W pumps		
Capacity	gpm	40
Pressure	psi	~70
Number of units	-	1
3W pumps		
Capacity	gpm	40
Pressure	psi	100
Number of units	-	2
Air compressor		
Capacity	gpm	TBD
Pressure	psi	TBD
Number of units	-	1
Polymer system (no modifications or upgrades)	-	-
Air handling system (no modifications or upgrades)	-	-

Section 4

Design Codes and Standards

This section discusses the key design standards applicable to the design and construction of thickening facility expansion proposed for the Suquamish Thickening project. The design standards are described on an engineering-discipline basis.

4.1 Civil

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. 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:

Process pipes and electrical conduits to the selected thickened sludge tank location. Differential settlement between conduits and structures will be addressed through the use of flexible couplings, special pipe bedding, and pipe materials.

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.

Corrosion of buried metallic pipes is estimated / assumed to be average at this site. Few corrosion protection design measures are expected in the project, pending the geotechnical reports.

A site specific geotechnical analysis and report are required during the design phase (see Section 3.3)

Applicable design standards and references include:

- International Fire Code (IFC) (2012 Edition)
- Washington State Department of Transportation Standard Specifications and Plans for Road, Bridge, and Municipal Construction M41-10 (January 2012)
- Washington State Department of Ecology Criteria for Sewage Works Design (August 2008)
- Kitsap County Stormwater Design Manual (February 2010)
- Kitsap County Fire Code Requirements for Development, Form 6215D
- Low Impact Development (LID) Guidance Manual: Kitsap County, Version 1.21 (July 2009)

4.2 Architectural

Not applicable

4.3 Geotechnical Considerations

A geotechnical report was not produced as part of this effort. As part of detailed design, the design team will review past geotechnical evaluations to determine if sufficient information is available for designing the new thickened sludge storage tank.

4.4 Structural

This effort was based on the assumption that the extent of work was confined to modifications within existing structures. As part of the detailed design phase, structural design criteria will be developed for guiding the design of the thickened sludge storage tank and RDT support system.

4.5 Mechanical and HVAC

This section provides mechanical and heating, ventilation, and air conditioning (HVAC) design standards and codes relevant to the thickening facility expansion.

4.5.1 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
- 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

4.5.2 Code and Hazard Analysis

The RDT will be installed in the existing headworks building and room classification will be according to Table 5.2(a) of NFPA 820 for liquid stream processes. The thickened sludge storage tank and areas will be according to Table 6.2(a) of NFPA 820 for solids stream processes. A summary of the code and hazard analysis is shown in Table 4-1.

As Table 4-1 indicates, the headworks building is a classified space per NFPA 820. During a site visit to review as-built conditions relative to installation of a new thickening device, it was observed that not all of the components within the space appeared to be rated for a Class 1, Div 2 space. Note that an exhaustive analysis of the entire space was not completed. Based on these initial observations, at least the following components would need to be addressed to be suitable for this classified space:

- Hanging light fixtures: These are not labeled/rated and need to be replaced with rated fixtures.
- Existing control panels:
  - Cover bolts need to be reinstalled and tightened to maintain integrity of the panel.
  - The purge systems need to be operational/activated to maintain integrity of the panel.
- Other components: The County should consider conducting a more detailed assessment of all switches, motors, firestops, etc. to verify other components are compatible with the rating of this space. This assessment could be conducted as part of the detailed design phase.

Table 4-1. Suquamish WWTP Thickening Project Code and Hazard Analysis

Area/name	Classification and extent	Reference	Hazardous	Corrosive	Motor type(s)	Notes
Headworks [a]	Class 1, Div 2, Group D with 12 ACH: entire space	NFPA 820 Table 5.2 Row 1a	No	Yes	Type 2	Approximately 20 ACH
Electrical room	Unclassified	-	No	No	-	-
Thickened sludge storage tank [b]	Class 1, Div 1, Group D: entire space	NFPA 820 Table 6.2(a) Row 11a	Yes	Yes	(None)	-
Thickened sludge storage tank and truck loadout area	Class 1, Div 2, Group D for areas within 10' from thickened sludge storage tank walls and 18" above liquid level (use 18" above roof of tank)	NFPA 820 Table 6.2(a) Row 11c	Yes	Yes	(None)	Because the top of the tank is open through the carbon filter, Row 11c applies to the envelope. Outdoors. No motors in this area expected. Truck loadout pump motor to be installed outside 10' boundary of the tank.
Truck loadout area	Unclassified for areas greater than 10' from thickened sludge storage tank walls	NFPA 820 Table 6.2(a) Row 11c	No	Yes	Type 2	Outdoors. Type 1 motor OK, but use Type 2.

a. The WAS thickening is installed in the headworks building and classification of the room is for headworks.

b. Assumes that thickened sludge storage tank will be same configuration as thickened sludge blending tank at the CKTP.

4.6 Electrical and Instrumentation

This section describes applicable electrical and instrumentation system design standards and criteria for the project. It also addresses the electrical and instrumentation work for installation of a TWAS storage tank and truck loadout pump. The plan is to disconnect electrical and instrumentation from equipment to be removed and to connect electrical and instrumentation to new equipment. The existing motor control center (MCC) will need to be surveyed for additional load capabilities as described below.

4.6.1 Electrical General

1. References: The following references will be applied to the design and construction:
    a. Design of all electrical equipment to conform to the current enforced electrical code by the state of Washington. At the time of preparing this report Washington State has adopted the 2008 National Electrical Code (NEC).
    b. Design additional lighting to comply with Washington State Energy Code.
2. General: The following general items will be applied to the design and construction:
    a. Measure and record the existing MCC electrical load during periods of plant high flow rates; a minimum of 30 days of continuous meter reading method as described in NEC 220.87 is required. Determine if additional electrical loads can be added to the MCC load without exceeding the circuit protection rating of the MCC feeder.

b. Any electrical/control devices, enclosures, and motors located within a hazardous boundary will need to be approved and rated for the hazardous location.

c. Plant staff requested that any outdoor control panels and disconnect switches have provisions for padlocks such that non-authorized personnel (after normal working hours) cannot gain access to the controls or power. For power disconnect switches, these will have provisions for padlocks in the Open (Off) as well as the Closed (On) position.

4.6.1.1 Conduit

Exposed conduit in process areas will in general be 1 inch minimum, rigid aluminum. Underground conduits will in general be 1 inch minimum and polyvinyl chloride (PVC). Conduit below grade will be encased in reinforced concrete ductbanks except for lighting circuits, which shall be direct-buried. There will be separate conduit and handholes or pullboxes for low voltage, and signal level distribution. Connections to all equipment will be 1/2-inch minimum liquid-tight flexible conduit, length not to exceed the lesser of 25 times the diameter or 3 feet.

4.6.1.2 Boxes, Fittings, and Seals

Boxes, fittings, and seals shall be approved for the hazardous (classified) location. Minimum size box shall be not less than Ferrous Deep (FD) size. Conduit bodies for pulling only will be mogul type. In corrosive areas, boxes for pulling only will be National Electrical Manufacturer's Association (NEMA) 4X fiberglass or 316 stainless steel. Large pullboxes, where FD boxes are not adequate, will be Joint Industry Council (JIC) except 14-gauge minimum sheet stainless steel with hinged covers. NEMA 4X rating shall be installed outdoors, in wet areas, and indoors. NEMA 4X boxes used in hazardous locations (see Table 4-1) will have an approved purge and pressurizing system to prevent ignition of flammable atmosphere. 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 inches 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.

4.6.1.3 Conductors

New conductors for power distribution or motor control will approved for application and insulated rated for 600 volts (V). New conductors for inside control cables will be approved for application and insulated rated for 600V minimum. Minimum size conductor for power conductors will be No. 12 American wire gauge (AWG). Minimum size conductor for 120V or greater control system conductors 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 with insulator barrier strips. 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.

4.6.1.4 Wiring Devices

Receptacles and switches will be premium specification grade. Devices and covers exposed to weather will be marine grade. Devices and covers located in hazardous locations (see Table 4-1) will be approved for use in that location.

4.6.1.5 Motor Control Center

The existing MCC is located indoors in the electrical room. Motor starters will be size 1 minimum magnetic line voltage type with individual control power transformers, 120V secondary fuses with blown fuse indicators, and three-phase, solid state overload protection with communications (hardwired) to the control system. Primary side fuse overcurrent protection will be provided on all control power transformers. Fractional, single-phase equipment (less than 1/2 horsepower [hp], 115V) will have a manual switch or where auto control is required, a 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 600V, heavy-duty type with quick-make, quick-break mechanism. Disconnect switches for 120/240V circuits will be rated and approved for motor control use. Disconnect switches for instruments will be two position S switch type. Control stations will be heavy-duty corrosion-resistant units with hermetically sealed contact blocks suitable for low energy level control circuits. Control stations and enclosures will be NEMA 4X stainless steel and shall have purge and pressurization approved where located in hazardous environments (see Table 4-1). 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

Indicator lamps located in hazardous locations (see Table 4-1) will be rated and approved for area classification.

Motor control for motors requiring variable speed control will be accomplished via variable-frequency drives (VFD). It is anticipated that the thickener feed pump and associated motor will be replaced. The existing VFD in the electrical room supporting this thickener feed pump will be removed and replaced in kind. The VFD will have manual controls on the front face of the VFD enclosure and there will be remote controls at the RDT control panel. The controls at the RDT control panel will be approved and rated for location installed (see Table 4-1).

4.6.1.6 Circuit Breakers

Replacement circuit breakers will be of the same type and will be sized for the electrical load. The circuit breaker will be rated for short circuit interrupting capacity of the panelboard or MCC.

Panel schedules (directories) and identification labels on MCCs will be replaced where the function/ status of the circuit breaker has changed.

4.6.1.7 Lighting Fixtures

Outdoor lighting for new equipment or new equipment control area will be per Washington State Energy Code and integrated with exterior lighting controls. Outdoor lighting is preferred to be building-mounted but optional pole-mounted or rack-mounted if required.

4.6.1.8 Receptacles

A 120V receptacle will be provided for the use of portable lighting or tools.

4.6.1.9 Freeze Protection

New exposed outdoor piping will be provided with an electric freeze protection system, where required.

4.6.1.10 Grounding System

New equipment will be grounded per NEC. New equipment grounding will be bonded to the building's existing ground electrode system.

4.6.1.11 Arc Flash

It is not anticipated that the design work for this project will include preparing an arc flash study. The CKTP had an arc flash study performed and equipment was placarded with warning labels listing potential energy release parameters, safe boundaries, and safety practice for working on energized equipment. This is an item that Kitsap County may want to be performed at the Suquamish WWTP in the future.

Washington State has adopted the 2008 NEC, which includes the following:

> Article 110.16 Flash Protection. Switchboards, panel boards, industrial control panels, and motor control centers in other than dwelling occupancies, that are likely to require examination, adjustment, servicing, or maintenance while energized, shall be field marked to warn qualified persons of potential arc flash hazards.

The 2008 NEC does not require a flash study to be performed for power distribution equipment including MCCs, only a warning label.

The governing codes and how they are enforced are as follows:

1. Occupational Safety and Health Administration (OSHA) Code of Federal Regulations (CFR) Title 29 is federal law and when an injury accident occurs, OSHA will investigate. Severe fines and citations can be issued to the employer if the following codes are not met:
    a. OSHA 29 CFR 1910 subpart K: Requires safety related work practices to be applied to safeguard employees from injury due to electrical hazards.
    b. OSHA CFR 1926 subpart K: Same as above except for construction sites.
    c. OSHA 1910.335: *Employees working in areas where there are potential electrical hazards shall be provided with, and shall use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed.*
    d. The employer is required to conduct hazard assessment in accordance with 29 CFR 1910.132(d)(1). Employers who conduct the hazard/risk assessment, and select and require their employees to use personal protective equipment (PPE), as stated in the NFPA 70E standard, are deemed in compliance with the Hazard Assessment and Equipment Selection OSHA Standard.
    e. OSHA 1910.335 Clearly defines that proper PPE shall be used. NFPA 70E then establishes what PPE is required for the category of risk. An Arc Flash Hazardous Analysis indicates what the incident energy levels are at each location and correlates directly to the proper PPE to use when exposed to the risk.

Arch Flash Hazardous Analysis is currently the industry standard for producing the Arch Flash warning labels. The Arc Flash warning label provides information to the person who is exposed to the risk, including what PPE is required when electrical equipment doors/covers are opened.

4.6.2 Instrumentation and Controls

This section provides instrumentation and controls design standards and codes relevant to the thickening facility expansion.

4.6.2.1 Control Systems

There are four control systems being used at the WWTP. This section describes the existing systems and recommendations for control system upgrades.

- **Plant Control System:** The plant's control system is a Modicon (820 series) PLC communicating using RS232 with Wonderware SCADA workstation operating on Windows 1995. This control system is primarily used for monitoring and alarming key parameters with control logic for a flow control modulating valve (FCV01) which is described in Section 3; and repeating parameters for the SBR control system.

  The plant control system is an obsolete control system. The Modicon 820 PLC is no longer in production and the County has been migrating to Allen-Bradley as controls systems need replacement.

  The plant's PLC will be replaced with an Allen-Bradley, CompactLogix (as is being used for the CKTP upgrade). The existing inputs and outputs will be transitioned to the new PLC with the exception of the discrete outputs used for the dialer. The new PLC will be located in the existing control panel if at all possible to account for limited space in the electrical/control room and reduce electrical work. The GUI will be updated to Windows 2007 (or as directed by the County's IT group) Wonderware Intouch SCADA.

- **SBR Control System:** A US Filter/Jet Tech graphical user interface (GUI) control system is networked to a vendor programmable logic controller (PLC) with expanded input/output (I/O) (Koyo, DirectLogic 405), a Black Box PC integrated circuit board, and a workstation with SCADA software operating on Windows 1995. This control system interfaces to several processes associated with the SBR system. The SBR Koyo DirectLogic 405 PLC is still in production.

  The SBR control system GUI controls will be transferred to the plant control system GUI station operating on Wondwerware Intouch SCADA. The SBR PLC will require communication upgrade to Ethernet TCP/IP (via adding H2-ECOM or H$-ECOM) and will require DirectLogic software, which is commercially available as well as backwards compatible. The existing PLC application program from US Filter will be required and is available based on communication with US Filter. (US Filter has copies of the application program and it is not password protected.) The Koyo DirectLogic will communicate with Wonderware over a TCP/IP driver.

- **Solids Thickening Control System:** The existing GBT control system is a MicroLogic 1000. This control system does not have a GUI and appears to be independent of the SBR control system.

  The replacement of the GBT equipment with the equipment described in Section 4 will remain independent of the existing SBR control system and have alarm and monitoring ties to the plant control system for key parameters. The rotary drum thickener will be provided with an independent package control system providing both manual and automatic control. The package control system with PLC and GUI will be equipment vendor's standard PLC and GUI, which may not be the same manufacturer and/or model of the new plant control system (Allen-Bradley CompactLogix and Wonderware InTouch). The external network with vendor equipment will be specified with Ethernet IP or Modbus/TCP to allow data exchange remotely for future use. Losses of external network communication will not prohibit vendor equipment to operate in manual or

automatic. Loss of the external network will mean there is no data exchange remotely. See Section 5 for preliminary control.

- Lift Station 54 Control System: The LS54 control system is a level control system operating two variable frequency drives which are no longer working. Currently, floats activate across-the-line starters for draw and fill operation. There are two alarm contacts (high and low level) that are monitored by the plant control system.

  LS54 will have the control panel replaced with new automated control system to allow for a more continuous flow rather than a draw and fill. Asmall Allen-Bradley, CompactLogix PLC will be used. The advantage of the Allen-Bradley, CompactLogix PLC is that unanticipated logic can be programmed (e.g., short term speed increase for unclogging debris), whereas a Multitrode system control is limited to what the manufacturer has developed.

  The level measurement devices will be replaced with devices that do not contain mercury, are durable for highly corrosive, damp and humid environments, and suitable for Class I, Division 1 installations. Because of the proximity of the lift station to the plant control system, a new remote monitoring option of wireless communication will be added.

4.6.2.2 Equipment Controls Offsite Plant Communication

Kaye DiaLog Ultra, automatic dialing alarm system is used for offsite monitoring. During the workday, the alarm system is set to bypass the dial-out of alarms and is placed in Run during the evenings and non-workdays to dial out alarms. Kaye DiaLog Ultra, automatic dialing alarm system is no longer manufactured. Kaye Instruments (owned by General Electric) is no longer producing the Kaye Dialers. Antx, Inc. carries the DiaLog line of products (which was produced by Kaye Instruments) but not DiaLog Ultra. The closest model to DiaLog Ultra is the DiaLog Elite, which is a modular base unit. Based on field observation, the dialer may be more than 10 years old with no physical damage showing power On with a Phone Fault alarm present; however, this alarm may be present because the unit is set in Bypass. Unless the Owner has existing manuals and wiring diagrams, modifications to the dialer will be difficult and not recommended to add new alarm inputs. The potential age and the obsolescence of the product lead to providing an alternative offsite monitoring for the equipment described in Section 4 and Section 5, which can be a software based system such as WIN911 (currently being used by the County).

4.6.2.3 Quality Assurance

Instrumentation and controls will be specified as industrial grade (not commercial grade), high percent accuracy and repeatability, listed (UL or FM) for the required installation and service, and suitable for the installation environment.

Section 5

Preliminary Control Narrative

Control of the RDT will be similar to the design recently completed for the CKTP and includes the following main elements:

- The RDT will be a complete system with RDT, flocculation tank, booster pump for spray water (if required), mixing valve, and control panel (preliminary process and instrumentation diagrams for this system and associated equipment are included in Appendix H).
  - Startup: The RDT and flocculation tank mixer speeds and sludge feed flow rate are manually set by the operator at the RDT local control panel. The control panel will control/modulate pump speed based on the flow meter. At startup, a wash water valve will open to begin the spray water operation (and, if required, a vendor-provided booster pump will operate). The spray header will be automatically cleaned with motor operated brushes internal to spray header. Cleaning interval is based on an RDT run-timer. Polymer operation can remain as currently operated (manual on/off and set point), but the design phase can consider integrating polymer operation with the RDT panel (polymer dosing or flow rate input at the panel and automatic start/stop/modulation).
  - Shutdown: The operators will shut down the system at the RDT local control panel or shutdown can be interlocked with WAS tank low level. Shutdown procedure will automatically stop the feed pump and operate the RDT and spray water for some time to clear out solids and wash the screens.
- The sludge feed pump will operate based on a speed/flow set point from the RDT control panel.
- The thickened sludge pump will modulate and operate based on a level measurement in the inlet hopper.
- Truck loadout pump:
  - Pump will operate continuously in recirculation mode to keep the thickened WAS tank mixed to minimize septic conditions, fermentation, and digestion. In recirculation mode, it will operate at the speed/flow set point input in the RDT control system. The pump will be interlocked with low tank level to stop.
  - In truck loadout mode, the operator will place the valves in the correct configuration to allow for truck loading and operate the pump in HAND at full speed.
- All progressing-cavity pumps will be interlocked to a high outlet pressure, high motor temp, high stator temp (run-dry protection), and seal water flow.
- Thickening operation will be interlocked to a high thickened sludge storage tank level.

Section 6

Influent Lift Stations

Lift stations (LS) 53 and 54 convey raw wastewater to the Suquamish WWTP. LS 53 is located to the southeast of the WWTP on the shores of Port Madison and LS 54 is located northeast of the WWTP at the entrance of the lane that leads to the WWTP. Plant staff indicated that the two influent lift stations have clogging issues and there is concern about the ability of the lift stations to deliver a constant flow to the SBR treatment process since they operate in on/off mode.

This section provides a preliminary assessment of pump parameters to determine what upgrades can be made to improve performance. The existing pump operation is based on the pump information shown in Appendix I. Current design practices locate the pumps' typical operating point(s) in the Preferred Operation Region (POR), which is typically 70–120 percent of the flow at the Best Efficiency Point (BEP). The farther below this flow the pump goes, and especially near the lowest end of the published curves, the potential result is more internal recirculation occurs with ragging, vibration, and high amperage and power consumption.

6.1 Lift Station 53

LS 53 was installed in 1977. The pumps are Smith & Loveless (8L18A with 25 hp motors and 10.5-inch impellers) and operate at constant speed. The datasheet and lift station inventory report two different impeller values; the inventory report shows 10.5 inches and the datasheet shows 11.0 inches. The 10.5-inch impeller appears to match the shutoff head test shown on the inventory report and is assumed to be the correct impeller.

The inventory report indicates only one operating condition: 360 gpm at 116 feet TDH. The estimated BEP for this impeller size (10.5 inches) is 800 gpm. The reported test operating point of 108 feet of TDH for the 10.5-inch impeller indicates a flow rate of 360 gpm, according to the pump curves. The design and test operating point flow rates are therefore only 45 percent and 43 percent of BEP, respectively.

However, the actual current operating flow rate is likely less due to worn impellers and increased head loss in the force main. As a result, it is likely that the pumps are operating farther back on the curves and at less than 43 percent of the BEP.

These pumps are likely clogging because the estimated current operating point is well below the recommended POR. For this reason, adding VFDs to this pumping system is not recommended because it would move the operating point even farther away from the lower limit of the POR at reduced pump speed operation.

Although new impellers would likely improve the clogging issue, they would not move the operating point into the POR. Therefore, replacing these older pumps with new ones designed with VFDs should eventually be considered for addressing the clogging issue and providing continuous and more even flow to the WWTP.

6.2 Lift Station 54

LS 54 was added as part of the treatment plant expansion and modification in 1995 (design) and appears to have been installed in 1998. The pumps are ABS submersible pumps (AFP 1042 with a 9.4 hp motor and 7.5-inch impeller) and operate on a VFD.

The pump curves report the following two operating conditions:

Design point: 350 gpm at 40 feet TDH. The pump operates at approximately 57 hertz (Hz). The estimated BEP at this operating speed is 650 gpm. The design point flow rate is therefore only 54 percent of BEP.

Reduced speed: ~175 gpm at 31 feet TDH. The pump operates at approximately 47 Hz. The estimated BEP at this operating speed is 530 gpm. The reduced speed point flow rate is therefore only 33 percent of BEP.

Similar to LS 53, the design point and the reduced speed operating point are well below the recommended POR, which is likely a major cause for the clogging issues. Plant staff indicated that the VFDs have been replaced several times because the pumps got clogged at slower speeds and drew excessive current. This mode of failure is consistent with increased internal recirculation at slower speeds causing ragging and high amperage. Based on both plant staff comments and operating points being well outside the recommended POR, these pumps do not benefit from operating in variable frequency mode and modifying pumps or replacing VFDs are unlike to solve the operational issues. Plant staff now operate the station in fill-and-draw mode.

The force mains of LS53 and LS54 combined just outside the headworks building. Because both LS53 and LS54 can operate simultaneously, this common header will convey a higher flow rate than one of the station alone and a higher head loss is seen in this pipe segment (the magnitude of this increase was not evaluated at this time). At higher heads, both sets of pumps will operate even farther from the recommended POR, compounding the operational issues already experienced.

Although new impellers may improve the clogging issue, they would not move the operating point into the POR and clogging could persist. Therefore, replacing these older pumps with new ones designed with VFDs should be considered for addressing the clogging issue and providing continuous and more even flow to the WWTP.

Based on discussions with the County, addressing these issues at LS 54 is a high priority and it is recommended to plan on the replacement of the pumps, VFDs, level instruments, and control system (see also discussion of control system and level instruments in Section 4.6.2.1) in the near future.

Section 7

Preliminary Cost Estimate

Preliminary cost estimates for the thickening project, LS 54 project, and PLC project are included in Appendix G. A summary of these costs is included in Table 7-1 below. Note that these costs do not include allowances for additional scope items; they only include contingency costs for known scope.

Table 7-1. Opinion of Probable Construction and Project Costs

	Opinion of Probable Construction Cost [a, b] Class 4 Estimate (-30% to +50%) 2013$	Project Cost [e] 2013$
Thickening Project [c]	822,000 to **$1,233,000**	1,110,000 to **$1,665,000**
LS 54 Project [d]	213,000 to **$320,000**	288,000 to **$432,000**
PLC Project [d]	66,000 to **$99,000**	89,000 to **$134,000**

a. See Appendix G for detailed cost estimates
b. No owner's reserve (allowances) are included
c. Includes 25 percent estimator's contingency
d. Includes 20 percent estimator's contingency
e. Includes 35 percent for engineering, administration, legal, etc.

Section 8

Limitations

This document was prepared solely for Kitsap County in accordance with professional standards at the time the services were performed and in accordance with the contract between Kitsap County and Brown and Caldwell dated May 20, 2013. This document is governed by the specific scope of work authorized by Kitsap County; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Kitsap County and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

This document sets forth the results of certain services performed by Brown and Caldwell with respect to the property or facilities described therein (the Property). Kitsap County recognizes and acknowledges that these services were designed and performed within various limitations, including budget and time constraints. These services were not designed or intended to determine the existence and nature of all possible environmental risks (which term shall include the presence or suspected or potential presence of any hazardous waste or hazardous substance, as defined under any applicable law or regulation, or any other actual or potential environmental problems or liabilities) affecting the Property. The nature of environmental risks is such that no amount of additional inspection and testing could determine as a matter of certainty that all environmental risks affecting the Property had been identified. Accordingly, THIS DOCUMENT DOES NOT PURPORT TO DESCRIBE ALL ENVIRONMENTAL RISKS AFFECTING THE PROPERTY, NOR WILL ANY ADDITIONAL TESTING OR INSPECTION RECOMMENDED OR OTHERWISE REFERRED TO IN THIS DOCUMENT NECESSARILY IDENTIFY ALL ENVIRONMENTAL RISKS AFFECTING THE PROPERTY.

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Appendix A: Casino Wastewater

Suquamish Casino Lift Station Sampling January 2013

Date	Day	FLOW Meter reading	FLOW gallons	FLOW mgd	TSS mg/L	BOD mg/L	TSS lbs/day	BOD lbs/day
1/24/2013	THU	51318890.7	28045	0.0280	228	628	53.4	147
1/25/2013	FRI	51346935.4						
1/27/2013	SUN		42073	0.0421	160	400	56.2	140
1/28/2013	MON	51473154.2	36763	0.0368	215	396	66.0	121
1/29/2013	TUE	51509917.6	34730	0.0347	187	314	54.1	91.0
1/30/2013	WED	51544648.0	34834	0.0348	149	277	43.3	80.5
1/31/2013	THU	51579481.5	37041	0.0370	152	343	47.0	106
2/1/2013	FRI	51616522.3						
2/2/2013	SAT	51698833.9	41156	0.0412	239	405	82.1	139
2/4/2013	MON	51739989.7	41156	0.0412	147	344	50.5	118
2/5/2013	TUE	51781145.5						
AVERAGE			36975	0.0370	185	388	56.6	118

NOTE: Cells with RED mark have comments.

Suquamish Clearwater Casino
Hotel, Expansion Wastewater Flow Estimate, Hotel @ 100% Occupancy & New Convention JULY 2013

Source	No.	Unit Rate (gpd)	Flow	GPD
Employees	657	15	9,855	(75% working on a given day) 876 * .75 =657
Meals	5118	13	66,534	See below
Casino/Bar/Lounge Patrons	350	5	1,750	Based on 100% occupancy /seat, 280 seats + 70 bar
Hotel Rooms, 85 rooms@ 100% occupancy	85	120	10,200	Based on 100% occupancy
Convention/Meeting in Hotel	120	5	600	Based on 100% occupancy /seat
Hotel Expansion 100 rooms @100 % occupancy	100	120	12,000	Based on 100% occupancy
Spa	10	80	800	
Event Lawn (1day/week)	1200	5	6,000	
New 3,000 Seat Convention (3 day/month, remainder of month 40% occupancy)	3000	5	15,000	Based on 25,000 SF convention
Laundry (3,522 gpd 6 days a week)	1	3522	3,522	
Phase 5 Total			**126,261**	**GPD Maximum Daily Flow**

Restaurants	Seats	Meals/day	Meals		
Deli	58	4	232		62505.45
Cedar Steak House	140	1	140		
Buffet	270	2	540		
Asian Resturant	150	4	600		
Hotel Convention	120	1	120		
New 3,000 Seat Convention	3000	1	3000		
Hotel Expansion (resturant & room service)	100	2	200		
Coffee House	50	3	150		
Breakfast Room in Hotel (2 people/room & 80%)	136	1	136		
			5118	**Meals per Day**	

Historic water use records for the casino have demonstrated a relationship between average daily and maximum daily flow.
Maximum daily flow has averaged 2.02 times greater than average daily flow. Maximum daily flow typically occurs on weekends and on event days.

Average Daily Flow, Q ave. **62,505 GPD**
Maximum Daily Flow, Q max. **126,261 GPD This value can be considered Q design**

WEEKLY AVERAGE DAILY FLOW (3/7 Qmax + 4/7 Qave. less Laundry, Convention & Event Lawn) = 65,307 GPD
WEEKLY AVERAGE DAILY FLOW (6/7 Qmax + 1/7 Q ave. Laundry) = 3,019 GPD
WEEKLY AVERAGE DAILY FLOW (1/7 Qmax + 6/7 Qave. Event Lawn) = 6,000 GPD
MONTHLY AVERAGE DAILY TOTAL FLOW (3/30 Qmax + 27/30 Qmax 40% occcupancy) = 6,900 GPD
MONTHLY AVERAGE DAILY FLOW TOTAL = 81,226 GPD

Conclude 81,226 GPD < 100,000 GPD KITCO Allotment per MOU

Peak Flow Calculation

126,261 GPD + 1000 GPD Inflow and Infiltration Allowance x Peak Factor of 5.0 (assumed) = 636,305 gpd or 442 Gallons Per Minute

Conclude 442 GPM > 430 GPM Existing Single Pump Capacity, but duplex station is designed to have both pumps run in a lead /lag set up.

The pump station is a duplex station, normal operation is one pump running and one pump off. They alternate each time one is called into service.
They will both operate if one pump can not keep up with the influent to the station. Each pump is rated at 430 gpm.
The likely hood off all venues operating simutaneously at peak flow are unlikely. But that is what the 442 gpm is based on.
As we get closer to the completion of the 5 year expansion we will need to monitor peak inflow closely.
If flows are getting near capacity we have options to address it including changing the impeller to a larger one or add eqaulization or upsize the pump station.

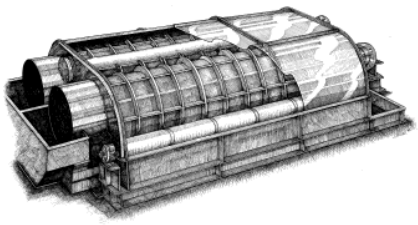
Appendix B: FKC Rotary Drum Thickener

FKC CO., LTD.

2708 West 18th Street
Port Angeles, WA 98363

(360) 452-9472
FAX (360) 452-6880

June 25, 2013



Bo Vestergaard-Hansen
Brown and Caldwell

Re: FKC Co., Ltd. Proposal – Suquamish

Bo:

Attached is a proposal for an FKC rotary screen thickener and flocculation tank.

In summary the scope of supply includes:

Option #1

(1) One FKC Model RST-S630x2000L Rotary Screen Thickeners (RST)
(1) One FKC Model 285GL Flocculation Tank

Option #2

(1) One FKC Model RST-S480x2000L Rotary Screen Thickeners (RST)
(1) One FKC Model 150GL Flocculation Tank

Please note that the pricing found in this scope of supply does not include taxes or bonding requirements.

We hope this information is helpful. Please contact this office if you have questions, or if you need anything further to issue the purchase order.

Sincerely,
FKC Co., Ltd.

Wesley Bond

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A. Proposed Equipment

1. FKC Model RST-S630x2000L Rotary Screen Thickener with Flocculation Tank…… 1
2. FKC Model RST-S480x2000L Rotary Screen Thickener with Flocculation Tank…… 2

B. Miscellaneous

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2. Shipping Arrangements..... 3
3. Equipment Summary..... 3
4. Options Offered…… 3
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6. Payment Terms..... 4
7. Installation..... 4
8. Operator Training and Start up..... 4
9. Warranty..... 4
10. Documentation Schedule..... 4
11. Performance Guarantee..... 5
12. Notes and Clarifications to the Specifications & Drawings..... 5
13. Service Rates..... 5

A. Proposed Equipment – Option #1

Qty.	Description	FOB Suquamish, WA
1 unit	FKC Rotary Screen Thickener Model RST-S630x2000L	$ 56,970.00
	Material:	100% WAS Municipal Sludge
	Inlet Consistency:	0.5 to 1.0% Total Solids
	Inlet Hydraulic Capacity:	125 GPM
	Outlet Consistency:	45-6% Total Solids
	Materials of construction:	SS-304 wetted parts Other Painted Carbon Steel
	Speed reducer:	SEW Varimot Gearbox w/ Motor: 2.0HP 460V/3PH/60Hz
	Other:	One (1) 285GL Flocculation Tank w/ SEW Varimot Gearbox w/ Motor: 1.0HP 460V/3PH/60Hz
	Delivery:	Delivery within four (4) months after approval of submittals and notice to proceed with manufacturing.

*Prices do not include taxes or bonding requirements

A. Proposed Equipment – Option #2

Qty.	Description	FOB Suquamish, WA
1 unit	FKC Rotary Screen Thickener Model RST-S480x2000L	$ 48,780.00
	Material:	100% WAS Municipal Sludge
	Inlet Consistency:	0.5 to 1.0% Total Solids
	Inlet Hydraulic Capacity:	80 GPM
	Outlet Consistency:	45-6% Total Solids
	Materials of construction:	SS-304 wetted parts Other Painted Carbon Steel
	Speed reducer:	SEW Varimot Gearbox w/ Motor: 2.0HP 460V/3PH/60Hz
	Other:	One (1) 150GL Flocculation Tank w/ SEW Varimot Gearbox w/ Motor: 1.0HP 460V/3PH/60Hz
	Delivery:	Delivery within four (4) months after approval of submittals and notice to proceed with manufacturing.

*Prices do not include taxes or bonding requirements

B. Miscellaneous

1. Delivery

On-site delivery will be within four (4) months after approval of submittals and notice to proceed with manufacturing.

2. Shipping Arrangements

The FKC thickening equipment will be shipped best way overland from Port Angeles, Washington to Fort Wayne, Indiana.

3. Equipment Summary

The following summarizes the equipment offered:

(1) One FKC Model RST-S630x3000L Rotary Screen Thickeners (RST)
(1) One FKC Model 285GL Flocculation Tank

FOB Washington*

*Scope of Supply does not include taxes or bonding.

The supply does not include power or logic controls, valves, pumps, field instrumentation, or any other ancillary equipment needed for a complete thickening installation.

4. Options Offered

No options are offered at this time

5. Effective Period

This proposal shall remain valid 60 days from the date of the proposal.

6. Payment Terms

30% with approval drawings & submittals
30% notice to proceed with manufacturing
30% with delivery
10% with start-up and performance

Net 30 days

7. Installation

The Rotary Screen Thickener is shipped ready for installation.

The Flocculation Tank is shipped ready for installation. Field assembly of the agitator drive, base and blades are required.

8. Operator Training and Start Up

Three (3) full days (weekend & holidays not included) in three separate trips are provided for any on-site work by a manufacturer's representative for equipment checkout, start-up, demonstration, testing, training, etc.

Other installation and erection assistance are not included in the price of the equipment and generally are not required. However, the service is available for our standard service rates (see the enclosed rate sheet).

9. Warranty

FKC's mechanical warranty covers material and workmanship for a period of twelve (12) months from start-up or eighteen (18) months from delivery whichever occurs first.

10. Documentation Schedule

The drawings provided with this scope of supply are reference drawings only.

A. Approval Drawings - within 3 weeks after receipt of purchase order
B. Certified Drawings - within 2 weeks after return of approval drawings
C. Operation and Maintenance Manuals - 14-16 weeks after receipt of order

11. Performance Guarantee

The performance figures and conditions denoted in section A of this proposal constitute FKC Co., Ltd.'s performance guarantee and the conditions required to meet the guarantee.

In the event that performance is not met, FKC will provide all parts, engineering, and labor associated with the work necessary to bring the equipment into conformance with the performance guarantee.

12. Notes and Clarifications to the Specifications & Drawings

None.

13. Service Rates

The following are rates and terms for professional and technical services furnished by FKC: If required, round-trip airfare (coach class) from Port Angeles, WA to airport nearest work site.

Weekdays

$1000.00 - Per eight (8) hour day on weekdays plus, lodging, and rental car expenses.
$187.50 - Per hour for all hours exceeding eight (8) hour workday on weekdays.
$108.00 - Per hour for office engineering services and telephone consultations.

Saturdays, Sundays and Holidays

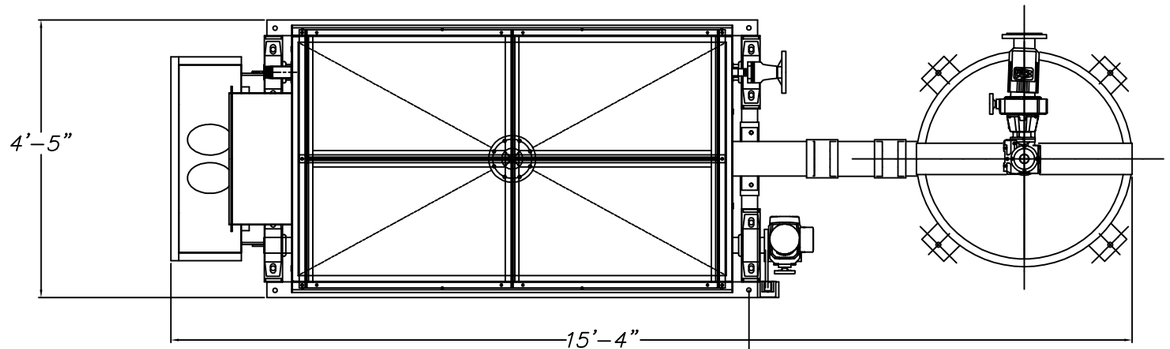
$1,440.00 - Per eight (8) hour day plus lodging and rental car expenses.
$270.00 - Per hour for all hours exceeding eight (8) hour workday.

Travel Time - Weekdays

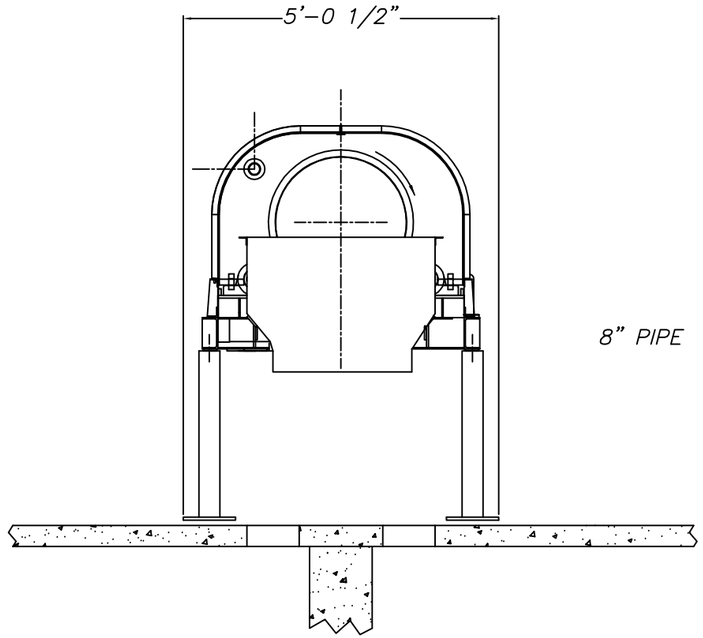
$80.00 - Per hour travel time. (Not to exceed $990/day)

Travel Time – Weekends and US Holidays

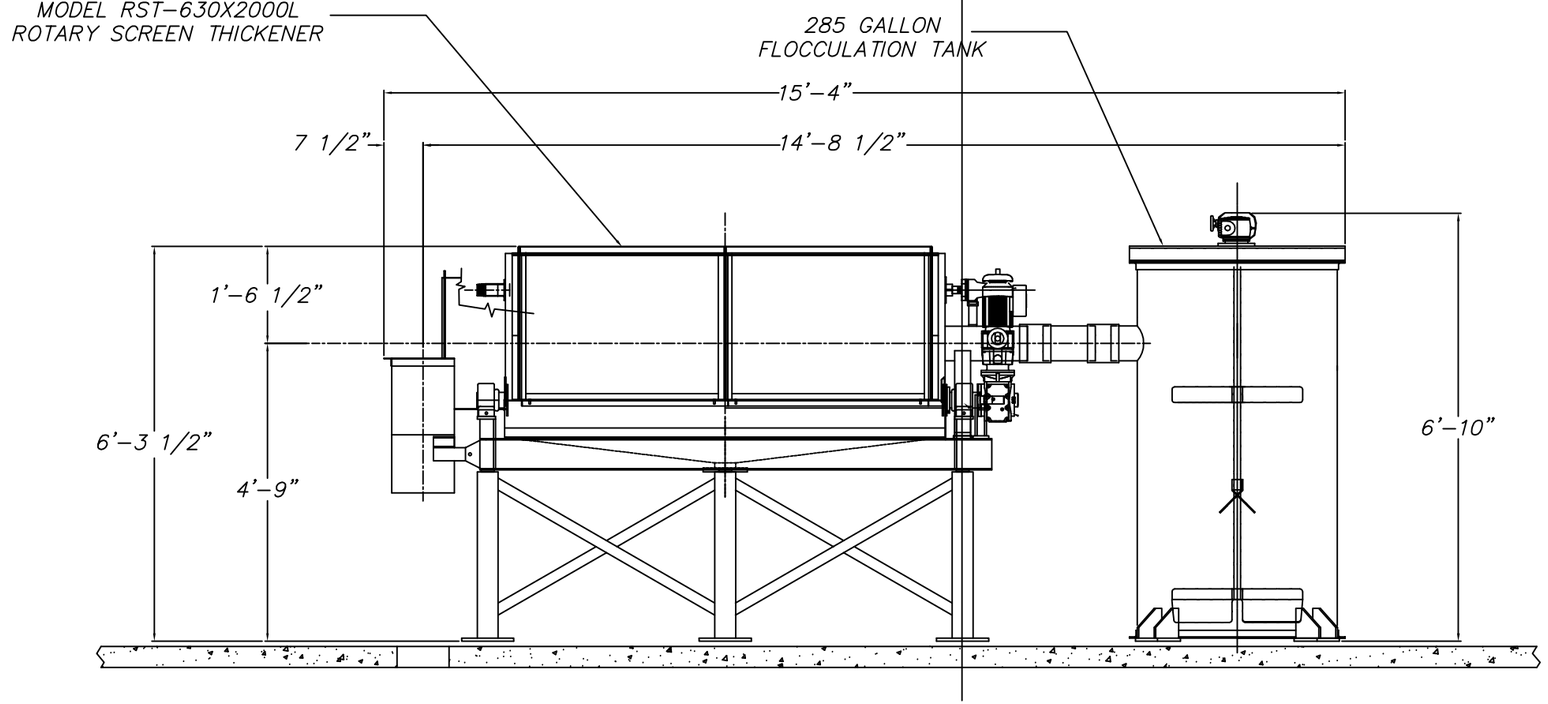
$120.00 - Per hour travel time (Not to exceed $1,440/day)



PLAN VIEW



DISCHARGE END VIEW



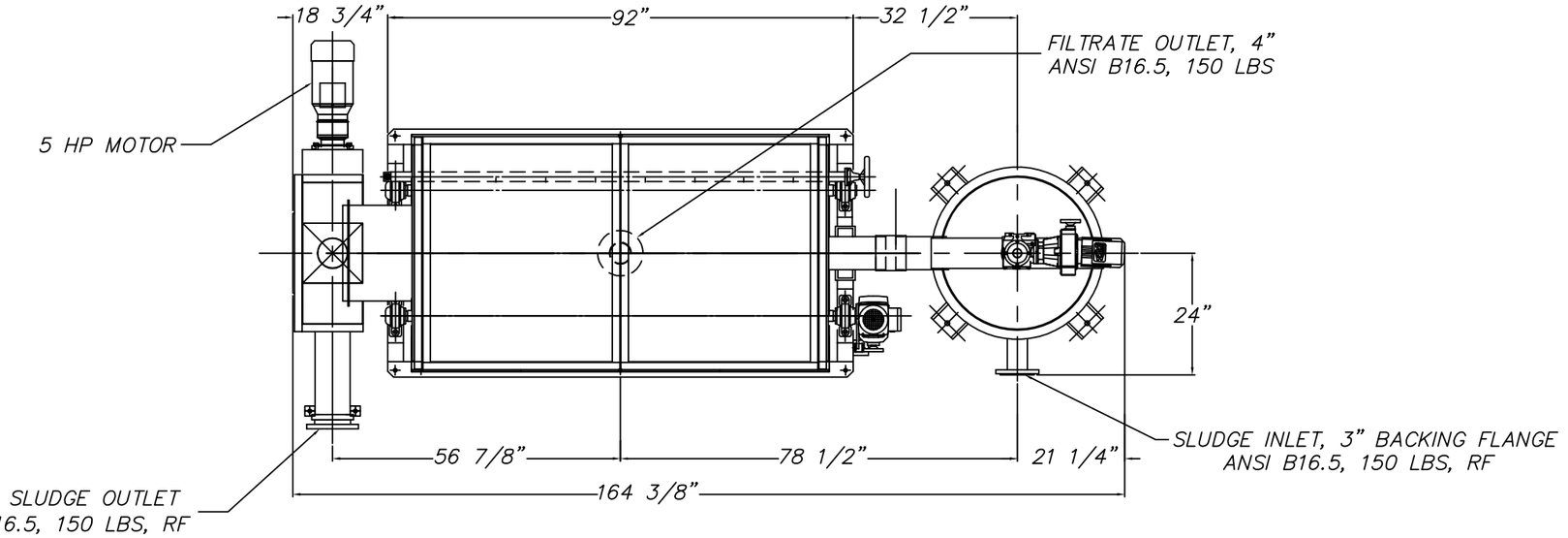
ELEVATION VIEW

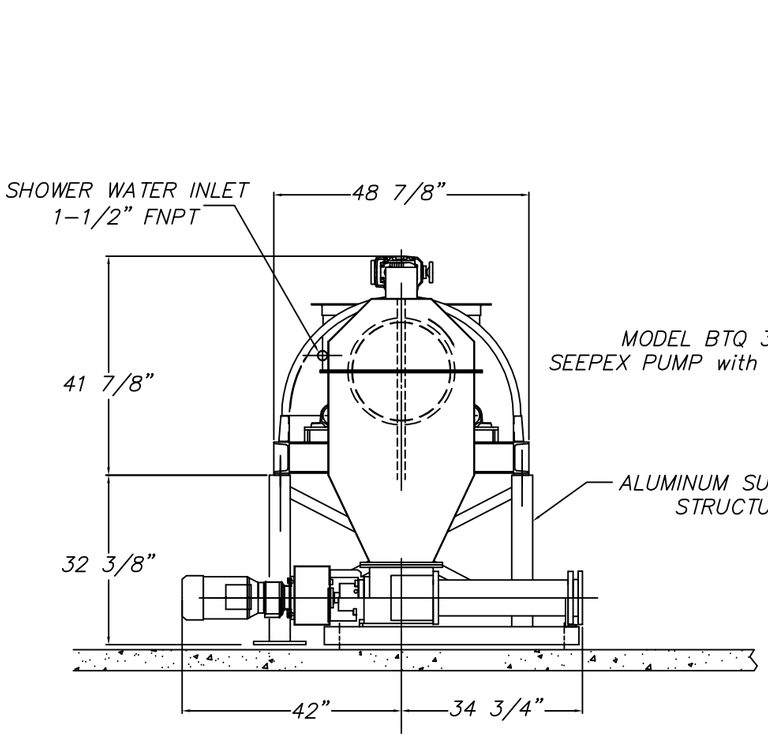
No.	Revision	Date	Sign.
1	Issued for Approval	05/02/07	AH

Mark	Description	pcs.	Weight (kg)	Remarks
JOB No. 191	Messrs. Reference		Quantity 1	Scale
Drawing No. RST LAYOUT.DWG	Title ROTARY SCREEN THICKENER LAYOUT DRAWING		Date 09/05/07	
			Drawn by RJO	Ref. JOB No.

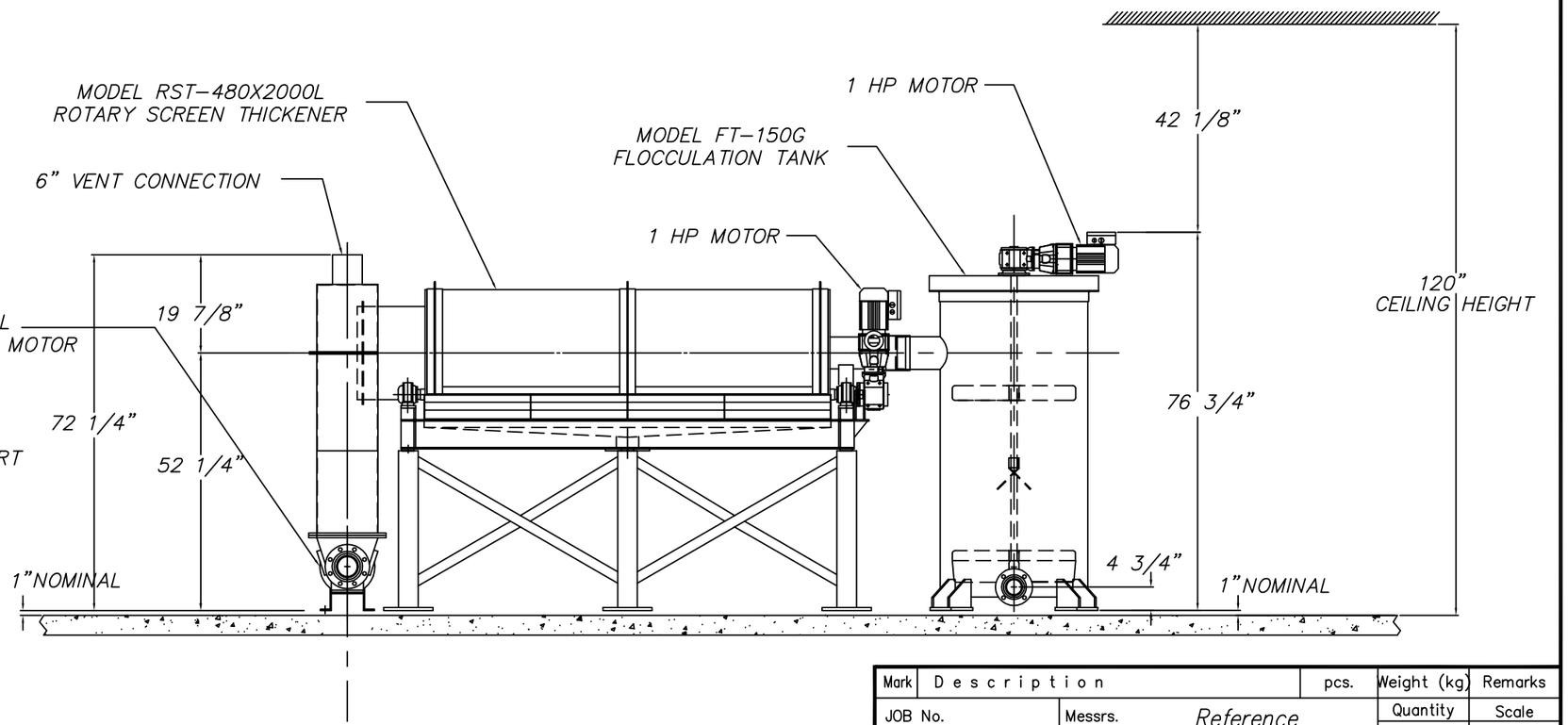
FKC CO., LTD.
2708 W. 18TH ST.
PORT ANGELES, WA 98363
(360) 452-9472 FAX (360) 452-6880

Revision 0 | Sheet 1 of 1





DISCHARGE END VIEW



ELEVATION VIEW

No.	Revision	Date	Sign.
0	Issued for Reference	3/23/07	RJO

Mark	Description	pcs.	Weight (kg)	Remarks
JOB No.	Messrs. Reference		Quantity: 1	Scale:
Drawing No. RST LAYOUT.DWG	Title: REFERENCE ROTARY SCREEN THICKENER SYSTEM LAYOUT DRAWING		Date: 3/20/07	
			Drawn by: RJO	Ref. JOB No.

FKC CO., LTD.
2708 W. 18TH ST.
PORT ANGELES, WA 98363
(360) 452-9472 FAX (360) 452-6880

Revision 0 | Sheet 1 of 1

Appendix C: Seepex BN35-12 Thickener Feed Pump

Granich Engineered Products, Inc
PO Box 80186
5930 1st Ave S.
Seattle, WA 98108
Phone: 866-356-5192
Fax: 206-315-2939
Website: www.granich.com

Quote

To:	Brown & Caldwell Attn: Bo	**Fax:** **Phone:**	
From:	Ken Hogan	**Date**:	6/24/2013
Re:	Kitsap County WWTP Project-Seepex Sludge pumps	**Pages:**	

We are pleased to offer the following equipment for your consideration.

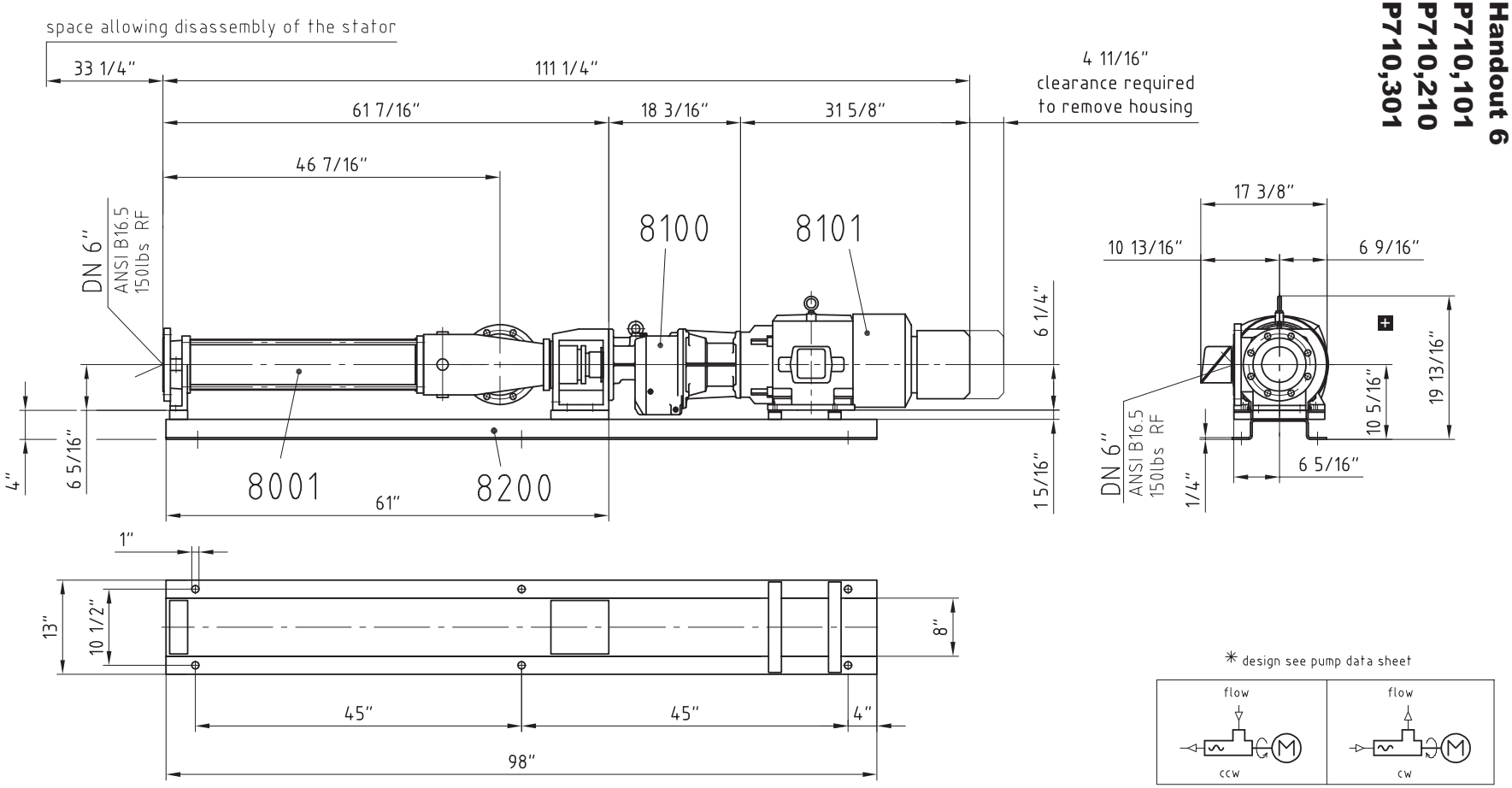
(1)- Seepex model BN 35-12 two stage progressive cavity pumps, cast iron housing, Buna N stator, Duktil coated D-6 tool steel rotor, packed box, run dry protection TSE module, steel base plate, close coupled block design, 15hp, 1750 rpm, 480 volt, 3-phase, inverter duty, TEFC gearmotor. Pump rated for 100 GPM @ 100 PSI. Sludge up to 3%

Price: $21,800.00 Net Each (Budget Estimate)

Prices are F.O.B. factory. Sales tax is not included. Terms are net 30 days. Subject to credit approval. Please allow approximately 8-10 weeks for delivery after release for production. Please call me if you have any questions or need additional information.

Regards,
Ken Hogan
Granich Engineered Products, Inc

Handout 6
P710,101
P710,210
P710,301



Quant.	Denomination	Item	Material	Note	Weight / kg
1	baseplate:	8200		Var.: 801-200/0350-C-131	65
1	motor: Reliance XEX CQ00035211-1	8101		with brake	182
1	gear: Nord SK42F-250TC	8100			91
1	pump: BN 35-12 / 70-6L / 110-6LT / 55-12T	8001			160

seepex.com

seepex, Inc.
511 Speedway Drive
Enon, OH 45323
www.seepex.com

	2008	Name	Day	Scale	Weight	Denomination
Drawn		sbe	29.04.	◎▷ 1:20	498 kg	dimensional drawing
Checked		goe	29.04.	EDP-No. L:\Lfdzchng.920\92069.dwg		Drawing-no. 262-D65/0350-C-115A4

changes of dimensions reserved

seepex.com

Offer No. 5396/0064

Granich Engineered Products, Inc., Seattle

07/23/2013

Item 1

qty. 1

seepex progressive cavity pump
BN 35-12 / A1-C1-C6-F0-GA-X
X= 0804

Application data

Pumped liquid	primary sludge
Viscosity	well flowable
Solids content	approx. 3%
Size of solids	assumed screened
Spec. gravity	no advice
Temperature	32 to 113F
pH value	assumed neutral
Composition/Concentr.	no advice
Kind of operation	8h/day
Site of installation	indoors

Performance data

	Flow rate	**Pressure**	**Speed**	
	60 USGPM	100 psi	148 rpm	min
	130 USGPM	100 psi	291 rpm	max
Starting torque	369 lb.ft			
Max. power absorbed	12.47 hp			
NPSH required	8.27 ft			
Suction pressure	ass. flooded			
Discharge pressure	100 psi			
Differential pressure	100 psi			
Remarks	Tolerances according to seepex standards.			

Materials and executions

Installation	01 H	horizontal
Rotation	02 L	counter clockwise (left)
Lantern / drive casing	04 N	lantern, standard
Lantern / drive casing material	05 A1	EN-JL-1040 (grey cast iron 25)
Wetted casing parts	06 E	standard
Wetted casing parts material	07 A1	EN-JL-1040 (grey cast iron 25)
Joint execution	09 B	encapsulated (closed) joints with universal joint sleeve
Joints material	10 N6	standard
Universal joint sleeve material	11 F0	NBR - Perbunan
Coupling rod	12 N	standard
Coupling rod material	13 C1	1.4021 / 420 SS
Rotor	14 N	standard
Rotor material	15 C6	1.2436 / tool steel AISI D6
Rotor coating	16 1	without

Offer No. 5396/0064

Granich Engineered Products, Inc., Seattle

Stator	17 N	standard
Stator material	18 F0	NBR - Perbunan
Shaft sealing	19 GA	mechanical seal, single acting elastomer bellows, either sense of rotation, unbalanced
Shaft seal casing material	20 A6	1.4408 / CF8M / 316 SS
Shaft seal material	21 D	rotating seal face: SiC solid stationary seal face: SiC solid elastomers: FPM spring: 1.4571 / 316 TI SS metal parts: 1.4571 / 316 TI SS
Plug-in shaft	22 A	standard
Plug-in shaft material	23 C1	1.4021 / 420 SS
Pump screw fitting	24 A1	standard
Painting	25 1A	standard RAL 5013 (blue)

Connections

Branch / hopper position	03 10	branch / hopper position 1
Casing parts connections	08 04	suction connection flange drilled to ANSI B16,5: DN 6" ANSI B16,5 150lbs discharge connection flange drilled to ANSI B16,5: DN 5" ANSI B16,5 150lbs

Drive

Type	**In-line Helical Gear Reducer**		
Manufacturer	Nord		
Model	SK42F-250TC		
Gear ratio	i = 5.75		
	Nom.	**Min.**	**Max.**
Output speed (rpm)	307	148	291
Motor speed (rpm)	1765	853	1675
Frequency (Hz)	60	29	57

Electr. motor

Type	**Prem Eff, TEFC, C-face, Footed Motor**
Manufacturer	Weg
Model	01518ET3H254TC-W22
Rated output	15 hp
Rated speed	1800 rpm
Starting	Direct on VFD
Voltage	3x208-230/460 VAC
Frequency	60 Hz

Baseplate

Baseplate	60 B	baseplate for block pump Extended Baseplate

Appendix D: Seepex BTHE10-12 Thickened Sludge Pump

seepex.com

Offer No. 5396/0061

Granich Engineered Products, Inc., Seattle

07/18/2013

Item 1

qty. 1

seepex progressive cavity pump
BTHE 10-12 / B2-C1-C6-F0-IE-X
X= 08E4, 09DG_C1, 163, 17T, 20A7, 21XX

Application data

Pumped liquid	thickened sludge
Viscosity	well flowable
Solids content	approx. 4-6%
Size of solids	no advice
Spec. gravity	no advice
Temperature	32 to 113F
pH value	no advice
Composition/Concentr.	no advice
Kind of operation	8h/day
Site of installation	indoors

Performance data

	Flow rate	**Pressure**	**Speed**	
	3 USGPM	100 psi	42 rpm	min
	7 USGPM	100 psi	74 rpm	norm
	12 USGPM	100 psi	114 rpm	max

Starting torque	118 lb.ft
Max. power absorbed	1.3 hp
NPSH required	6.82 ft
Suction pressure	ass. flooded
Discharge pressure	100 psi
Differential pressure	100 psi
Remarks	Tolerances according to seepex standards.

Materials and executions

Installation	01 H	horizontal
Rotation	02 L	counter clockwise (left)
Lantern / drive casing	04 N	lantern, standard
Lantern / drive casing material	05 A1	EN-JL-1040 (grey cast iron 25)
Wetted casing parts	06 TR2S2	inlet hopper with drain plug, cleanout on one side pos. 2, flushing connection pos. 2 and hopper separation
Wetted casing parts material	07 B2	1.0037 (St 37-2) / A 283 C
Joint execution	09 DG_C1	encapsulated (closed) joints with universal joint sleeve incl. universal joint protection on both sides divided, 1.4021 / 420 SS
Joints material	10 N6	standard

Offer No. 5396/0061

Granich Engineered Products, Inc., Seattle

Universal joint sleeve material	11 F0	NBR - Perbunan
Coupling rod	12 HEV	standard, with additional concentrically rotating ribbon auger in reinforced design running directly on the liner
Coupling rod material	13 B2	1.0037 (St 37-2) / A 283 C
Rotor	14 N	standard
Rotor material	15 C6	1.2436 / tool steel AISI D6
Rotor coating	16 3	ductile chromium coating
Stator	17 T	stator in TSE-design sensor sleeve 1.4571 / 316 TI SS
Stator material	18 F0	NBR - Perbunan
Shaft sealing	19 IE	double acting mechanical seal as cartridge unit
Shaft seal casing material	20 A7	1.4571 / 316 TI SS
Shaft seal material	21 XX	CHesterton 255
Plug-in shaft	22 A	standard
Plug-in shaft material	23 C1	1.4021 / 420 SS
Pump screw fitting	24 A1	standard
Painting	25 1A	standard RAL 5013 (blue)

Connections

Branch / hopper position	03 10	branch / hopper position 1
Casing parts connections	08 E4	hopper dimensions: 500x320 mm enlarged discharge connection flange drilled to ANSI B16,5: DN 4" ANSI B16,5 150lbs

Drive

Type	**In-line Helical Gear Reducer**		
Manufacturer	Nord		
Model	SK22F-180TC		
Gear ratio	i = 14.69		
	Nom.	**Min.**	**Max.**
Output speed (rpm)	120	41	114
Motor speed (rpm)	1760	615	1681
Frequency (Hz)	60	21	57

Electr. motor

Type	**Prem Eff, TEFC, C-Face, Footed Motor**
Manufacturer	Weg
Model	00318ET3E182TC-W22
Rated output	3 hp
Rated speed	1760 rpm
Starting	Direct on VFD
Voltage	3x208-230/460 VAC
Frequency	60 Hz

Offer No. 5396/0061

Granich Engineered Products, Inc., Seattle

Baseplate

Baseplate	60 BV	baseplate for block pump with inlet hopper
Baseplate material	61 ST	carbon steel, painted
Baseplate options	62 XX	Drain pan with 1" NPT connection
Baseplate options	62 XX	Side Feet
Baseplate options	62 XX	Grout holes

Dry-running protection device

Dry running protection device	70 115	TSE 115AC consisting of: - sensor sleeve fitted to the stator of the pump with installed NTC temperature sensor in IP55 connection head inst. in pump stator - TSE control device for installation in a control panel - 110-115V / 50-60 Hz

Other

Accessories	93 XX	Anchors Bolts HAS-R 316 SS 1/2" x 6 1/2"
Quality assurance	95 P_B05H	Hydraulic Performance Test Quality Inspection Certificate DIN 55 350-18-4.2.2 per Commission
Quality assurance	95 P_B06N	NPSH-Test Quality Inspection Certificate DIN 55 350-18-4.2.2 per Curve

Price composition	**Unit price (net)**
pump, baseplate, dry running protection device, Accessories	**USD 41600.--**

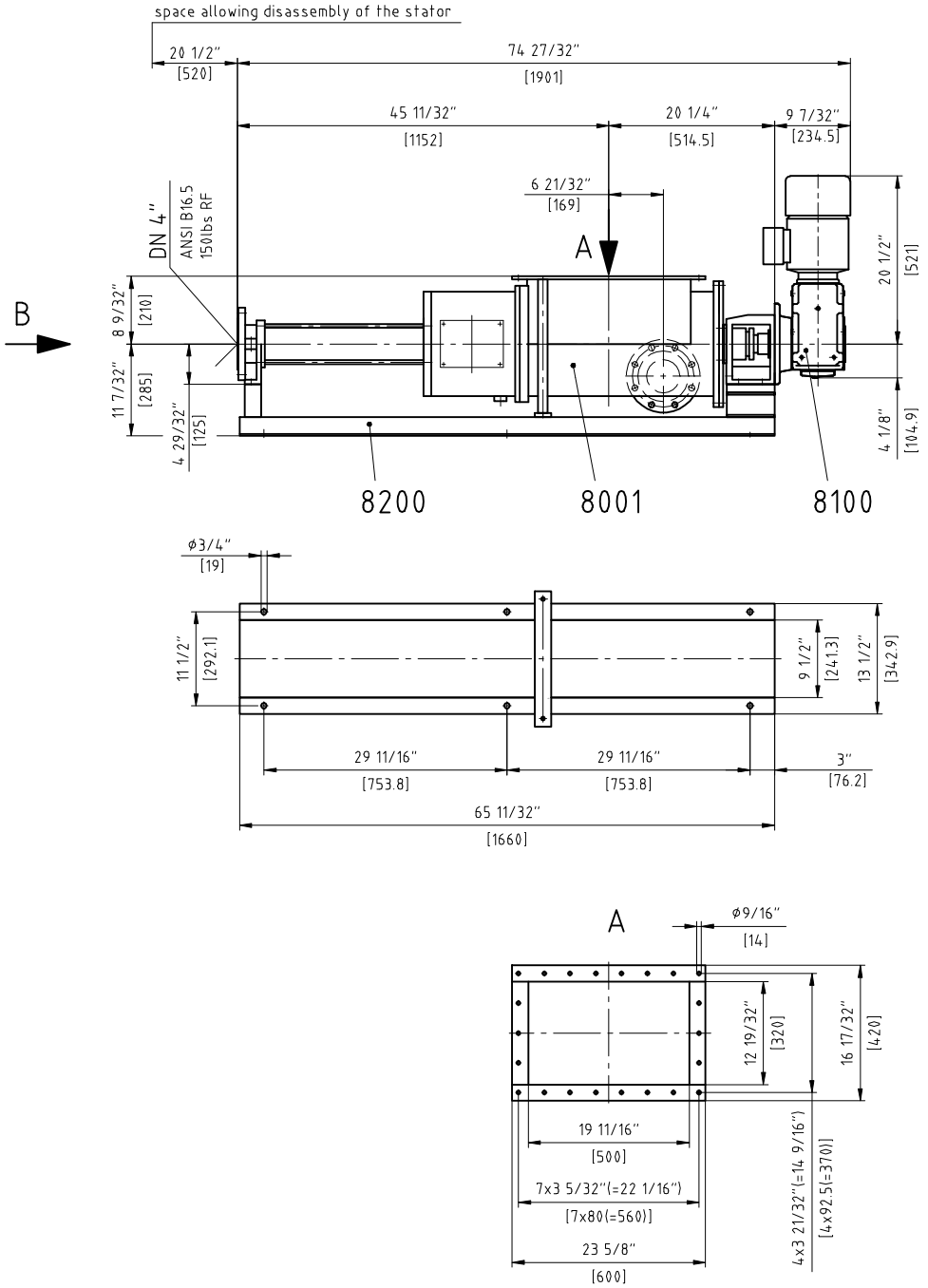
General remarks

Please send your purchase order to incomingorders@seepex.net

All drawings accompanying this offer is for REFERENCE ONLY, final drawings will be created upon receipt of order. If you need this drawing please request on PO.

In order to process your order, we will require either a copy of the quote this order is based on, or the quote number.

In order to process duplicate wet end orders, we will require the commission number of the pump being duplicated.



dimensions in [...] are in millimeter

Unit	Standard	Item	Denomination / Drawing-Number	Material	Remark	Weight kg
1		8200	baseplate 843-200/0100-C-103			51
1		8100	drive SK9022.1-100L			59
1		8001	pump BTHE 10-12 / 17-6L			

seepex.com

seepex, inc.
511 Speedway Drive
Enon, OH 45323
www.seepex.com

	Issue	Modification	Name	Date
General tolerances for dimensions without specified tolerances DIN ISO 2768-average				
Symbol for surface roughness acc. to DIN EN ISO 1302				
	Drawn		aon	11.09.2009
	Checked		her	22.09.2009

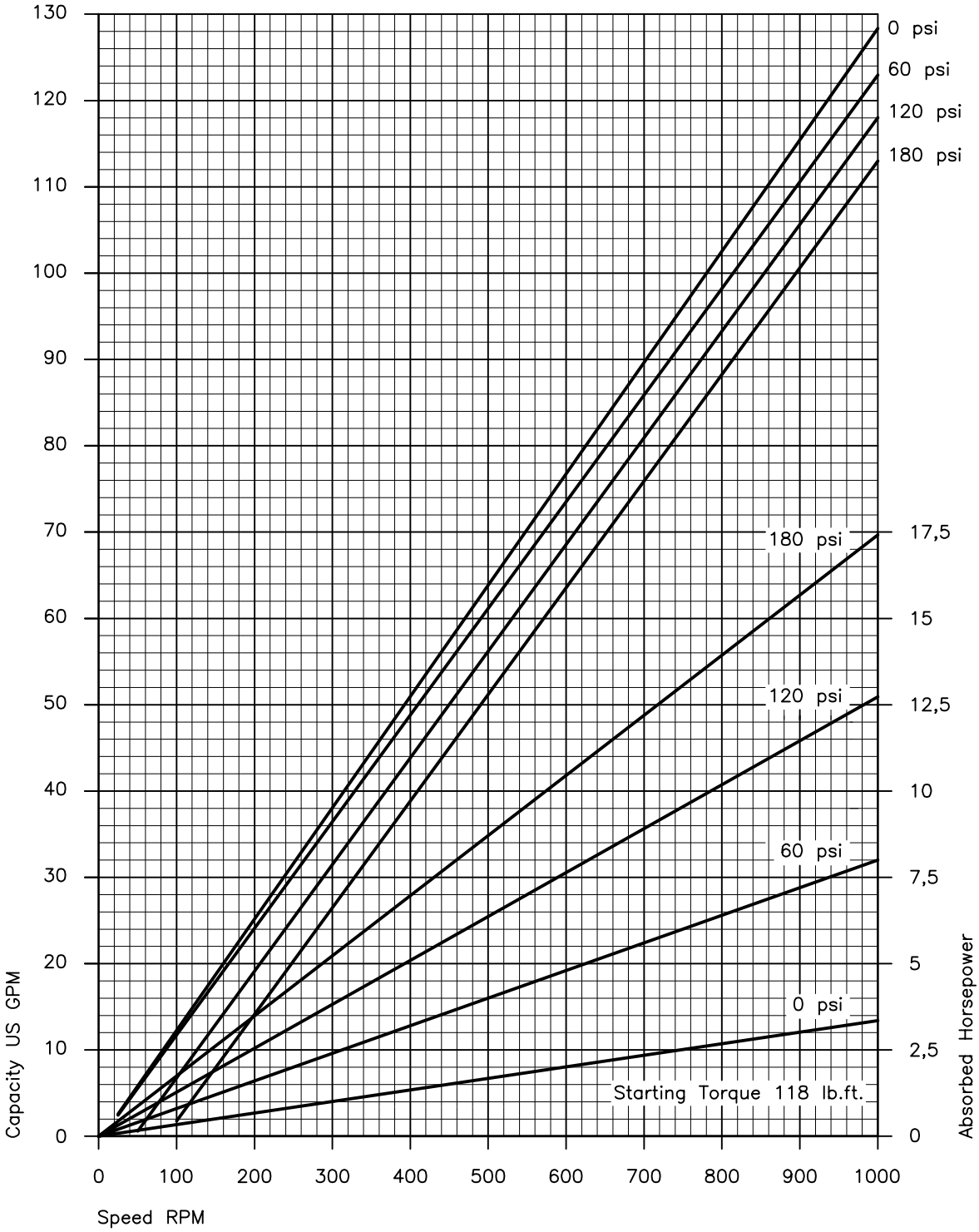
Scale 1:15 ◎▷ | Material | Weight

Denomination: dimensional drawing

Drawing-Number: 147-E18/0100-C-700A3

EDP-No. 102552.dwg | Replacement for:

Characteristic Curves
Size
10–12



Values based upon water 68°F ; For notes on drive selection refer to PER

Appendix E: Seepex Truck Loadout Pumps

seepex.com

Offer No. 5396/0066

Granich Engineered Products, Inc., Seattle

07/24/2013 **Item 1**

qty. 1 **seepex progressive cavity pump**
BN 70-12 / A1-C1-L8-F0-IE-X
X= 0804, 20A7, 21XX

General remarks
Truck Loadout Pump

Application data

Pumped liquid	thickened sludge
Viscosity	well flowable
Solids content	approx. 5%
Size of solids	no advice
Spec. gravity	no advice
Temperature	32 to 113F
pH value	no advice
Composition/Concentr.	no advice
Kind of operation	8h/day
Site of installation	indoors

Performance data

	Flow rate	Pressure	Speed	
	100 USGPM	100 psi	128 rpm	min
	225 USGPM	100 psi	258 rpm	max
Starting torque	664 lb.ft			
Max. power absorbed	23.99 hp			
NPSH required	8.6 ft			
Suction pressure	ass. flooded			
Discharge pressure	100 psi			
Differential pressure	100 psi			
Remarks	Tolerances according to seepex standards.			

Materials and executions

Installation	01	H	horizontal
Rotation	02	L	counter clockwise (left)
Lantern / drive casing	04	N	lantern, standard
Lantern / drive casing material	05	A1	EN-JL-1040 (grey cast iron 25)
Wetted casing parts	06	B1	suction casing with cleanouts on both sides
Wetted casing parts material	07	A1	EN-JL-1040 (grey cast iron 25)
Joint execution	09	B	encapsulated (closed) joints with universal joint sleeve
Joints material	10	N6	standard
Universal joint sleeve material	11	F0	NBR - Perbunan
Coupling rod	12	N	standard
Coupling rod material	13	C1	1.4021 / 420 SS

Offer No. 5396/0066

Granich Engineered Products, Inc., Seattle

Rotor	14 N	standard
Rotor material	15 L8	1.0503 (C45) / 576 - 1045
Rotor coating	16 3	ductile chromium coating
Stator	17 N	standard
Stator material	18 F0	NBR - Perbunan
Shaft sealing	19 IE	double acting mechanical seal as cartridge unit
Shaft seal casing material	20 A7	1.4571 / 316 TI SS
Shaft seal material	21 XX	Chesterton 255 SiC Faces Viton Elastomers 316 SS Metal parts
Plug-in shaft	22 A	standard
Plug-in shaft material	23 C1	1.4021 / 420 SS
Pump screw fitting	24 A1	standard
Painting	25 1A	standard RAL 5013 (blue)

Connections

Branch / hopper position	03 10	branch / hopper position 1
Casing parts connections	08 04	suction connection flange drilled to ANSI B16,5: DN 8" ANSI B16,5 150lbs discharge connection flange drilled to ANSI B16,5: DN 6" ANSI B16,5 150lbs

Drive

Type	**In-line Helical Gear Reducer**		
Manufacturer	Nord		
Model	SK62F-280TC		
Gear ratio	i = 6.35		
	Nom.	**Min.**	**Max.**
Output speed (rpm)	276	127	258
Motor speed (rpm)	1765	812	1639
Frequency (Hz)	60	28	56

Electr. motor

Type	**Prem Eff, TEFC, C-Face, Footed Motor**
Manufacturer	Weg
Model	03018ET3E286TC-W22
Rated output	30 hp
Rated speed	1765 rpm
Starting	Direct on VFD
Voltage	3x208-230/460 VAC
Frequency	60 Hz

Baseplate

Baseplate	60 B	baseplate for block pump

Offer No. 5396/0066

Granich Engineered Products, Inc., Seattle

		Extended Baseplate	
Baseplate material	61 ST	carbon steel, painted	
Price composition			**Unit price (net)**
pump, baseplate			**USD 43755.--**
Optional dry-running protection device			
Dry running protection device	70 115	TSE 115AC consisting of: - sensor sleeve fitted to the stator of the pump with installed NTC temperature sensor in IP55 connection head inst. in pump stator - TSE control device for installation in a control panel - 110-115V / 50-60 Hz	**USD 823.--**
Optional overpressure protection			
Pressure control device	75 XX	6" PSW with Switch & Gauge Assembly -Carbon steel center section (Epoxy coated) with Buna Elastomer -Module seal with internal pulsation dampner -Derlin Acetal end plates -Silicone Oil sensing fluid -½" NPT dual instrument fitting (option A) -4" dial Gauge. Stainless steel case, liquid filled, 2% accuracy -Single set point pressure switch, SPDT, NEMA 4X Enclosure	**USD 1276.--**

General remarks

Please send your purchase order to incomingorders@seepex.net

All drawings accompanying this offer is for REFERENCE ONLY, final drawings will be created upon receipt of order. If you need this drawing please request on PO.

In order to process your order, we will require either a copy of the quote this order is based on, or the quote number.

In order to process duplicate wet end orders, we will require the commission number of the pump being duplicated.

Offer No. 5396/0066

Granich Engineered Products, Inc., Seattle

07/24/2013 **Item 2**

qty. 1 **seepex progressive cavity pump**
BN 130-12 / A1-C1-L8-F0-IE-X
X= 0804, 21XX

General remarks

Truck Loadout Pump

Application data

Pumped liquid	thickened sludge
Viscosity	well flowable
Solids content	approx. 5%
Size of solids	no advice
Spec. gravity	no advice
Temperature	32 to 113F
pH value	no advice
Composition/Concentr.	no advice
Kind of operation	8h/day
Site of installation	indoors

Performance data

	Flow rate	**Pressure**	**Speed**	
	150 USGPM	100 psi	103 rpm	min
	300 USGPM	100 psi	190 rpm	max
Starting torque	1151 lb.ft			
Max. power absorbed	32.31 hp			
NPSH required	8.23 ft			
Suction pressure	ass. flooded			
Discharge pressure	100 psi			
Differential pressure	100 psi			
Remarks	Tolerances according to seepex standards.			

Materials and executions

Installation	01 H	horizontal
Rotation	02 L	counter clockwise (left)
Lantern / drive casing	04 N	lantern, standard
Lantern / drive casing material	05 A1	EN-JL-1040 (grey cast iron 25)
Wetted casing parts	06 B1	suction casing with cleanouts on both sides
Wetted casing parts material	07 A1	EN-JL-1040 (grey cast iron 25)
Joint execution	09 B	encapsulated (closed) joints with universal joint sleeve
Joints material	10 N6	standard
Universal joint sleeve material	11 F0	NBR - Perbunan
Coupling rod	12 N	standard
Coupling rod material	13 C1	1.4021 / 420 SS

Offer No. 5396/0066

Granich Engineered Products, Inc., Seattle

Rotor	14 N	standard
Rotor material	15 L8	1.0503 (C45) / 576 - 1045
Rotor coating	16 3	ductile chromium coating
Stator	17 N	standard
Stator material	18 F0	NBR - Perbunan
Shaft sealing	19 IE	double acting mechanical seal as cartridge unit
Shaft seal casing material	20 A7	1.4571 / 316 TI SS
Shaft seal material	21 XX	Chesterton 255 SiC Faces Viton Elastomers 316 SS Metal parts
Plug-in shaft	22 A	standard
Plug-in shaft material	23 C1	1.4021 / 420 SS
Pump screw fitting	24 A1	standard
Painting	25 1A	standard RAL 5013 (blue)

Connections

Branch / hopper position	03 10	branch / hopper position 1
Casing parts connections	08 04	suction connection flange drilled to ANSI B16,5: DN 8" ANSI B16,5 150lbs discharge connection flange drilled to ANSI B16,5: DN 8" ANSI B16,5 150lbs

Drive

Type	**In-line Helical Gear Reducer**		
Manufacturer	Nord		
Model	SK82F-320TC		
Gear ratio	i = 8.82		
	Nom.	**Min.**	**Max.**
Output speed (rpm)	201	102	189
Motor speed (rpm)	1775	906	1673
Frequency (Hz)	60	31	57

Electr. motor

Type	**Prem Eff, TEFC, C-Face, Footed Motor**
Manufacturer	Weg
Model	04018ET3E324TC-W22
Rated output	40 hp
Rated speed	1775 rpm
Starting	Direct on VFD
Voltage	3x208-230/460 VAC
Frequency	60 Hz

Baseplate

Baseplate	60 B	baseplate for block pump

Offer No. 5396/0066

Granich Engineered Products, Inc., Seattle

		Extended Baseplate	
Baseplate material	61 ST	carbon steel, painted	

Price composition	**Unit price (net)**
pump, baseplate	**USD 63821.--**

Optional dry-running protection device

Dry running protection device	70 115	TSE 115AC consisting of: - sensor sleeve fitted to the stator of the pump with installed NTC temperature sensor in IP55 connection head inst. in pump stator - TSE control device for installation in a control panel - 110-115V / 50-60 Hz	**USD 823.--**

Optional overpressure protection

Pressure control device	75 XX	8" PSW with Switch & Gauge Assembly -Carbon steel center section (Epoxy coated) with Buna Elastomer -Module seal with internal pulsation dampner -Derlin Acetal end plates -Silicone Oil sensing fluid -½" NPT dual instrument fitting (option A) -4" dial Gauge. Stainless steel case, liquid filled, 2% accuracy -Single set point pressure switch, SPDT, NEMA 4X Enclosure	**USD 1453.--**

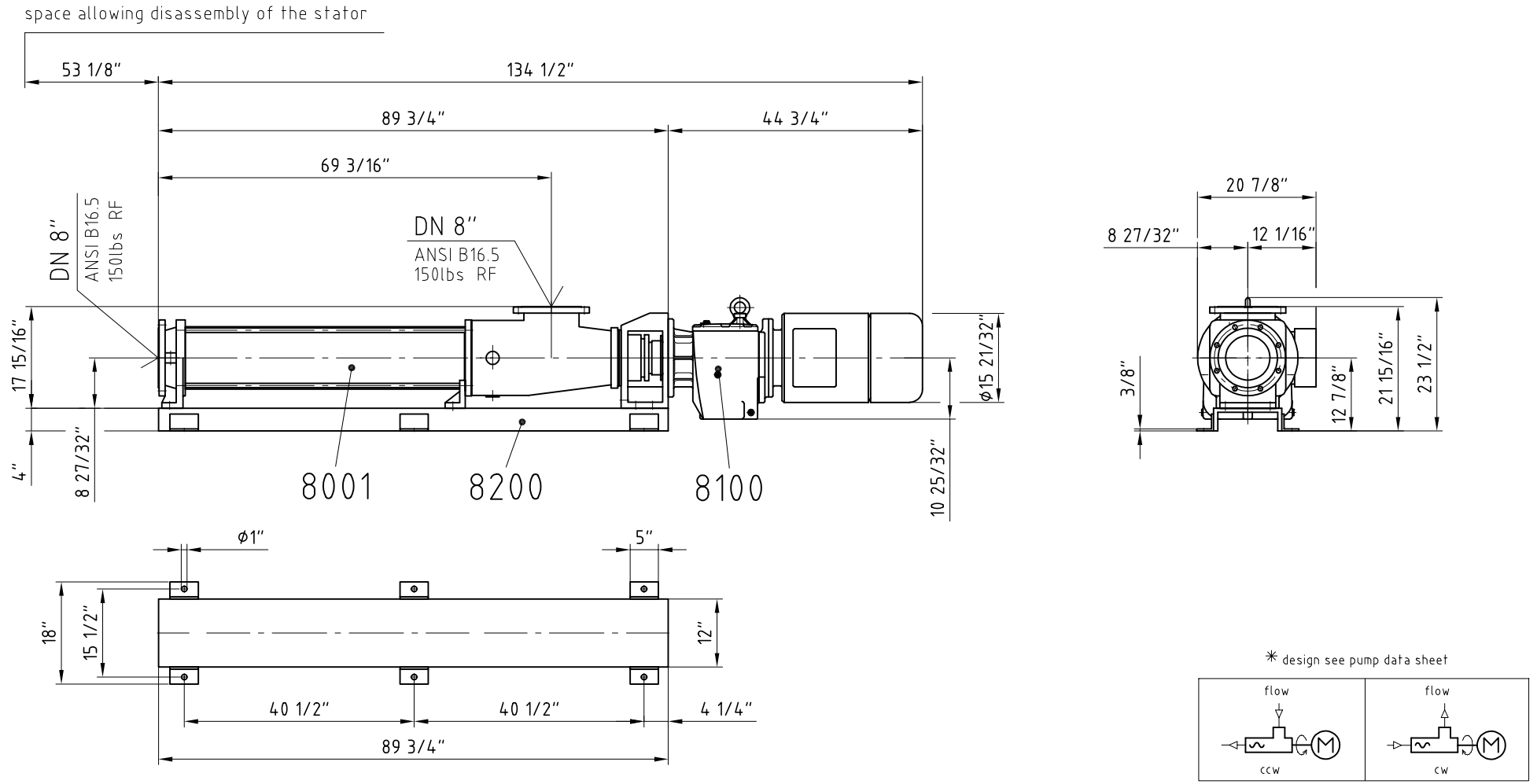
General remarks

Please send your purchase order to incomingorders@seepex.net

All drawings accompanying this offer is for REFERENCE ONLY, final drawings will be created upon receipt of order. If you need this drawing please request on PO.

In order to process your order, we will require either a copy of the quote this order is based on, or the quote number.

In order to process duplicate wet end orders, we will require the commission number of the pump being duplicated.



Quant.	Denomination	Item	Material	Note	Weight / kg
1	baseplate	8200		var.: 801-200/1300-C-102	136
1	drive: SK72F-225M	8100			451
1	pump: BN 130-12 / 300-6L / 200-12T	8001			450

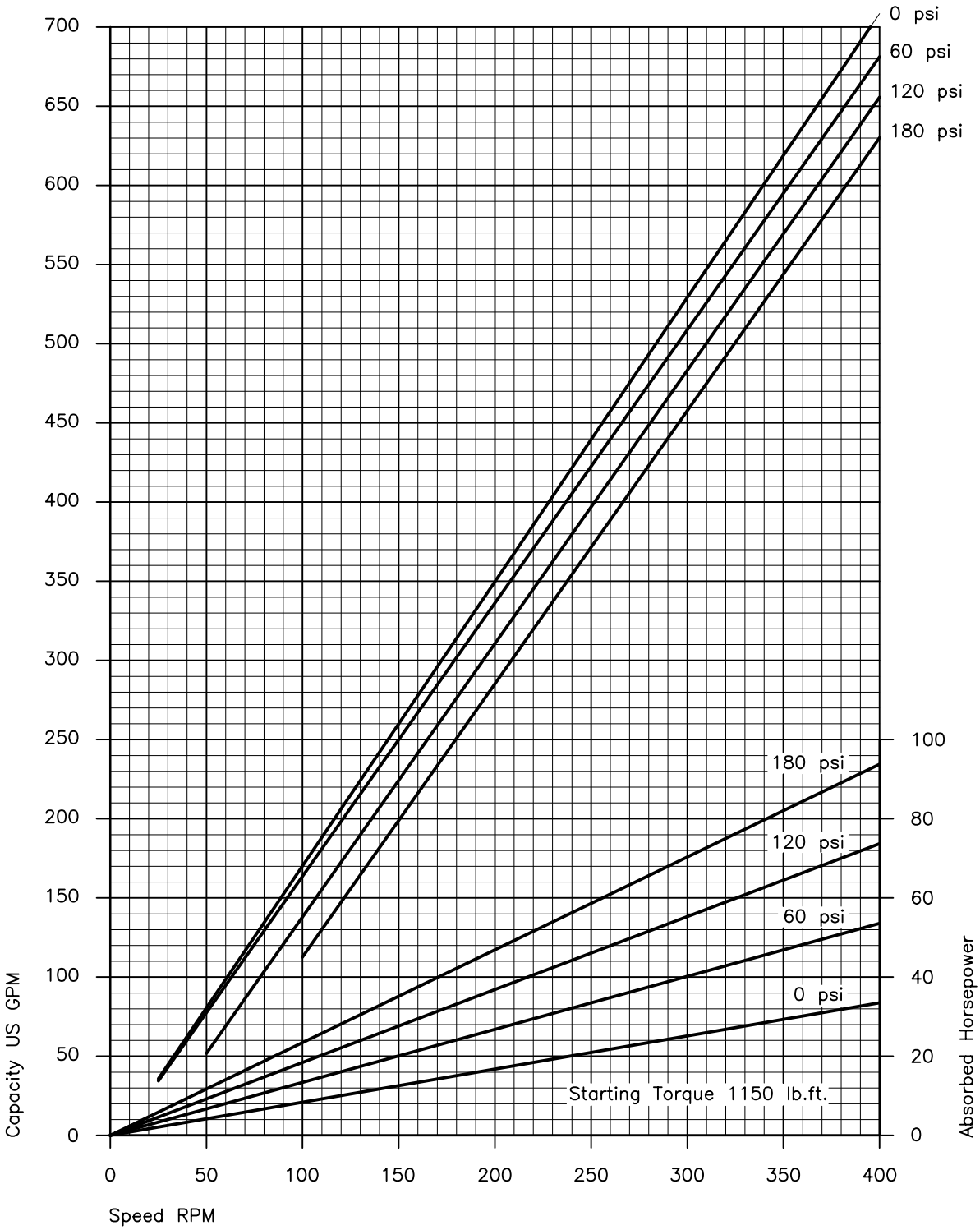
seepex.com

seepex, Inc.
511 Speedway Drive
Enon, OH 45323
www.seepex.com

	2004	Name	Day	Scale	Weight	Denomination
Drawn		her	15.07.	◎▷ 1:25	1037 kg	dimensional drawing
Checked		goe	15.07.	EDP-No. L:\LFDZCHNG.635\63633.DWG		Drawing-no. 262-C18/1300-C-115A4

changes of dimensions reserved

Characteristic Curves
Size
130–12



Values based upon water 68°F ; For notes on drive selection refer to PER

Appendix F: 3W Wash Water Pumps

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

Customer:	CASCADE MACHINERY
Customer Order No:	554752
Model:	1W-F5
Impeller Dia:	7.50"
Serial No:	97590 97591
For:	CORNELL PUMPS
Job:	SUQUAMISH WWTP
Cornell Job No:	MP3872/22160
Manual No:	2127
Date:	3/10/97 (8)

PLEASE READ CAREFULLY

YOUR WARRANTY MAY BE VOID IF INSTRUCTIONS ARE NOT FOLLOWED

Note: when ordering parts give pump model and serial number

Cornell Pump Co.
2323 SE Harvester Drive Portland, Or 97222 USA
Phone: 503-653-0330 Fax: 503-653-0338

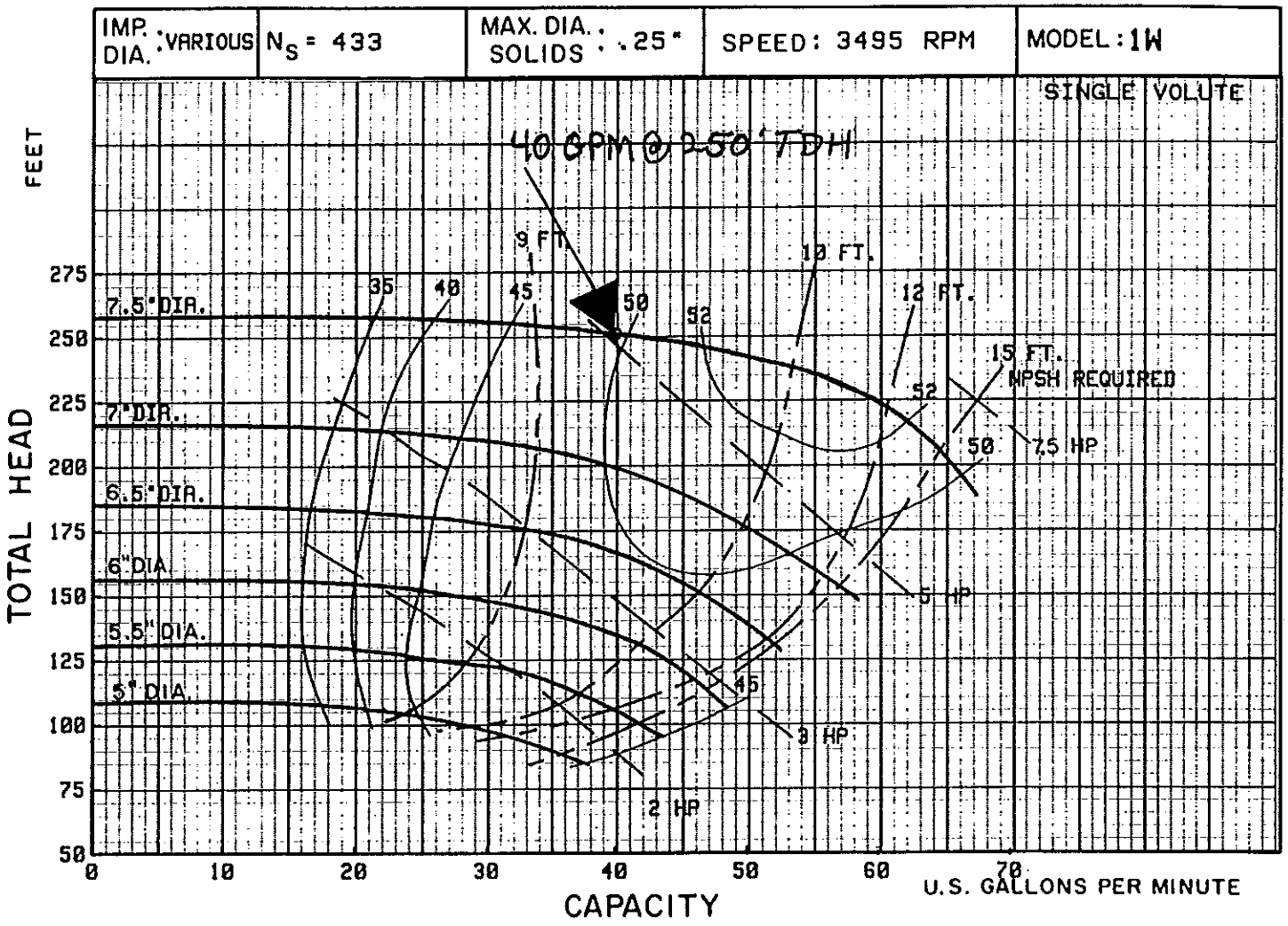
APRIL 1985

MODEL 1W PUMP

SPEED - 3600 RPM

CLOSED IMPELLER

60 HERTZ



HP	MAXIMUM IMPELLER DIAMETER	
	FOR FULL MOTOR LOAD	FOR FULL MOTOR LOAD + 15% S.F.
7.5	A(7.5")	
5	B(7.19")	B+(7.38")
3	C(6.12")	C+(6.44")
2	D(5.25")	D+(5.50")

FT. x (.305) = METERS

GPM x (.227) = CUBIC METERS PER HOUR

Performances shown are for close-coupled electric configuration with packing.
Other mounting styles may require horsepower and/or performance adjustments.

Appendix G: Preliminary Cost Estimates

- Thickening Project
- LS 54 Project
- PLC Project

Brown AND Caldwell

6962 Deframe Ct
Arvada, Colorado 80004

Tel: 303-284-3058
Fax: 303-284-3354

Memorandum

Date: August 21, 2013

To: Tadd Giesbrecht, Seattle

From: Bob Ferguson, Arvada

Reviewed by: Butch Matthews, Jacksonville

Copy to: Bo Vestergaard-Hansen, Seattle

Project No.: 144449.130

Subject: Suquamish Thickening Project
15-Percent Design Completion
Basis of Estimate of Probable Construction Cost

The Basis of Estimate Report and supporting estimate reports for the subject project are attached. Please call me if you have questions or need additional information.

RAF:bf

Enclosures (3):

1. Basis of Estimate Report
2. Summary Estimate
3. Detailed Estimate

Basis of Estimate Report

Suquamish Thickening Project

Introduction

Brown and Caldwell (BC) is pleased to present this opinion of probable construction cost (estimate) prepared for the Suquamish Thickening 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

The work covered by this estimate is improvements to the solids thickening process at the Suquamish WWTP. These improvements include:

- Construction of a reinforced concrete TWAS tank.
- Replacement of the existing gravity belt thickener with a new rotary drum thickener
- Replacement of the thickened sludge pump.
- Replacement of the thickener feed pump.
- Installation of a new thickened sludge truck loadout pump.
- Electrical and instrumentation
- Miscellaneous appurtenances.

Background of this Estimate

The attached estimate of probable construction cost is based on documents dated August 2013, received by the ESG. These documents are described as 15 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 4 estimate. A Class 4 estimate is defined as a Planning Level or Design Technical Feasibility Estimate. Typically, engineering is from 1 to 15 percent complete. Class 4 estimates are used to prepare planning level cost scopes or to evaluate alternatives in design conditions and form the base work for the Class 3 Project Budget or Funding Estimate.

Expected accuracy for Class 4 estimates typically range from -30 to +50 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 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.

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 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.

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. The TWAS tank invert is located 4 feet below existing ground surface.
10. The TWAS tank is overexcavated and backfilled with 3 feet of compacted granular fill to support the structure on the existing soils.
11. Fabricated steel stairs are included to the elevated top of the TWAS tank which has a perimeter handrail.
12. Exposed piping is insulated and heat traced.

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.

Allowances for Known but Undefined Work

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

1. Electrical/Instrumentation
2. Small Bore Piping

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 (%)
Net Cost Markups	
Labor (employer payroll burden)	10
Materials and process equipment	8
Equipment (construction-related)	8
Subcontractor	5
Sales Tax (Excise-Gross Receipts-Contract Value)	8.6
Material Shipping and Handling	2
Gross Cost Markups	
Start-up, Training and O&M	2
Construction Contingency	25
Builders Risk, Liability and Auto Insurance	2
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 include base rate paid to the laborer plus fringes. A labor burden factor is applied to these such that the final rates include all employer paid taxes. These taxes are FICA (which covers social security plus Medicare), Workers Comp (which varies based on state, employer experience and history) and unemployment insurance. The result is fully loaded labor rates. In addition to the fully loaded labor rate, an overhead and profit markup is applied at the back end of the estimate. This covers payroll and accounting, estimator's wages, home office rent, advertising and owner profit.

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 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.

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 to 50 percent.

Performance and Payment Bonds

Based on historical and industry data, this can range from 0.75 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.

SUMMARY ESTIMATE REPORT
WITH MARK-UPS ALLOCATED

SUQUAMISH THINKENING PROJECT
15% DESIGN STAGE ESTIMATE

Project Number:	144449-130
BC Project Manager:	TADD GIESBRECHT
BC Office:	SEATTLE
Estimate Issue Number:	01
Estimate Original Issue Date:	AUGUST 14, 2013
Estimate Revision Number:	01
Estimate Revision Date:	AUGUST 21, 2013
Lead Estimator:	BOB FERGUSON
Estimate QA/QC Reviewer:	BUTCH MATTHEWS / DESIGN TEAM
Estimate QA/QC Date:	AUGUST 14, 2013 / AUGUST 20, 2013

PROCESS LOCATION/AREA INDEX

01 - TWAS TANK
02 - ROTARY DRUM THICKENER
03 - THICKENER FEED PUMP
04 - OTHER WORK
05 - ELECTRICAL WORK

SUQUAMISH THINKENING PROJECT
15% DESIGN STAGE ESTIMATE

Description		Total w/ Markups Allocated
--- Base Estimate ---		787,035
01 - TWAS TANK		
01 - General Requirements		111
02 - Site Construction		31,778
03 - Concrete		79,109
05 - Metals		13,906
08 - Doors & Windows		11,098
09 - Finishes		467
11 - Equipment		125,588
15 - Mechanical		65,090
	01 - TWAS TANK Total	327,147
02 - ROTARY DRUM THICKENER		
02 - Site Construction		21,092
03 - Concrete		3,527
05 - Metals		10,471
09 - Finishes		718
11 - Equipment		189,430
15 - Mechanical		57,533
	02 - ROTARY DRUM THICKENER Total	282,770
03 - THICKENER FEED PUMP		
02 - Site Construction		5,719
03 - Concrete		884
05 - Metals		1,963
11 - Equipment		41,822
15 - Mechanical		12,372
	03 - THICKENER FEED PUMP Total	62,760
04 - OTHER WORK		
11 - Equipment		22,157
	04 - OTHER WORK Total	22,157
05 - ELECTRICAL WORK		
16 - Electrical		92,201
	05 - ELECTRICAL WORK Total	92,201
	Grand Total	787,035

DETAILED ESTIMATE REPORT

SUQUAMISH THINKENING PROJECT
15% DESIGN STAGE ESTIMATE

Project Number:	144449-130
BC Project Manager:	TADD GIESBRECHT
BC Office:	SEATTLE
Estimate Issue Number:	01
Estimate Original Issue Date:	AUGUST 14, 2013
Estimate Revision Number:	01
Estimate Revision Date:	AUGUST 21, 2013
Lead Estimator:	BOB FERGUSON
Estimate QA/QC Reviewer:	BUTCH MATTHEWS / DESIGN TEAM
Estimate QA/QC Date:	AUGUST 14, 2013 / AUGUST 20, 2013

PROCESS LOCATION/AREA INDEX

01 - TWAS TANK
02 - ROTARY DRUM THICKENER
03 - THICKENER FEED PUMP
04 - OTHER WORK
05 - ELECTRICAL WORK

SUQUAMISH THINKENING PROJECT
15% DESIGN STAGE ESTIMATE

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	--- Base Estimate ---									
	01 - TWAS TANK									**191,626**
	01500 - Temporary Facilities & Controls									
	01540750 - Scaffolding									
6610	Scaffolding, steel tubular, heavy duty shoring for elevated slab forms, floor area, rent/month of materials only, to 14'-8" high	1.5	Csf		43.00				43.00	66
	Temporary Facilities & Controls Total									**66**
	02300 - Earthwork									
	02315120 - Backfill, Structural									
4420	**Backfill, structural, common earth, 200 H.P. dozer, 300' haul, from existing stockpile, excludes compaction**	**196.3**	**L.C.Y.**	**1.01**			**1.90**		**2.91**	**572**
	02315310 - Compaction, General									
7000	**Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate**	**241.7**	**E.C.Y.**	**2.14**			**0.18**		**2.32**	**561**
	02315424 - Excavating, Bulk Bank Measure									
4400	Excavating, bulk bank measure, in sheeting or cofferdam, with all other equipment, minimum	162.3	B.C.Y.	5.65			7.64		13.30	2,157
	02315492 - Hauling									
0009	**Loading Trucks, F.E. Loader, 3 C.Y.**	**134.1**	**cuyd**	**0.76**			**1.26**		**2.02**	**271**
9498	**Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 25 min load/wait/unload, 18 C.Y. 8 wheel truck, cycle 20 miles, 45 MPH, excludes loading equipment**	**179.2**	**L.C.Y.**	**3.08**			**5.06**		**8.13**	**1,457**
	02315610 - Excavating, Trench									
0500	**Excavating, trench or continuous footing, common earth, 3/4 C.Y. excavator, 6' to 10' deep, excludes sheeting or dewatering**	**102.2**	**B.C.Y.**	**4.63**			**3.51**		**8.14**	**832**
	02315640 - Utility Bedding									

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
0100	**Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction**	**76.9**	**L.C.Y.**	**9.21**	**31.50**		**2.51**		**43.22**	**3,326**
	Earthwork Total									**9,176**
	02450 - Foundation & Load Bearing Elements									
	02455450 - Prestressed Concrete Piles									
2300	Prestressed concrete piles, 14" diameter, 2-1/2" wall, priced using 200 piles, 50' long, unless specified otherwise, excludes pile caps or mobilization	240.0	vlft	5.84	32.00		2.86		40.69	9,767
	Foundation & Load Bearing Elements Total									**9,767**
	03100 - Concrete Forms & Accessories									
	03110420 - Forms In Place, Elevated Slabs									
1500	C.I.P. concrete forms, elevated slab, flat plate, plywood, 15' to 20' high ceilings, 4 use, includes shoring, erecting, bracing, stripping and cleaning	153.9	SF	6.69	1.25				7.94	1,222
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	28.0	sfca	17.48	1.70				19.18	537
	03110445 - Forms In Place, Slab On Grade									
3050	C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	36.7	sfca	4.92	0.80				5.72	210
3550	**C.I.P. concrete forms, slab on grade, depressed, edge, wood, 12" to 24" high, 4 use, includes erecting, bracing, stripping and cleaning**	**72.5**	**LF**	**12.26**	**0.80**				**13.06**	**947**
	03110455 - Forms In Place, Walls									
2550	C.I.P. concrete forms, wall, job built, plywood, 8 to 16' high, 4 use, includes erecting, bracing, stripping and cleaning	1,551.9	sfca	8.38	0.66				9.04	14,033
	03150860 - Waterstop									
0600	**Waterstop, PVC, ribbed, with center bulb, 3/8" thick x 9" wide**	**141.4**	**LF**	**4.47**	**4.94**				**9.41**	**1,330**
	Concrete Forms & Accessories Total									**18,280**

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	**Reinforcing Steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories**	**3,550.6**	**lb**	**0.64**	**0.50**				**1.14**	**4,065**
0702	Reinforcing Steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4,514.9	lb	0.46	0.50				0.96	4,326
2000	**Reinforcing steel, unload and sort, add to base**	**5.3**	**ton**	**45.93**			**8.51**		**54.44**	**286**
2210	**Reinforcing steel, crane cost for handling, average, add**	**5.3**	**ton**	**49.27**			**9.21**		**58.48**	**307**
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	27.0	EA	3.11	1.15				4.26	115
2450	**Reinforcing steel, in place, dowels, deformed, A615, grade 60, longer and heavier, add**	**2,893.8**	**lb**	**1.87**	**0.55**				**2.42**	**6,994**
	Concrete Reinforcement Total									**16,093**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	**Structural concrete, ready mix, normal weight, 4000 psi, includes local aggregate, sand, Portland cement (Type I) and water, delivered, excludes all additives and treatments**	**68.9**	**CY**		**102.00**				**102.00**	**7,028**
	03310700 - Placing Concrete									
1550	Structural concrete, placing, elevated slab, with crane and bucket, 6" to 10" thick, includes leveling (strike off) & consolidation, excludes material	4.8	CY	41.33			13.04		54.38	258
4600	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includes leveling (strike off) & consolidation, excludes material	0.9	CY	15.47			0.35		15.82	14
4650	**Structural concrete, placing, slab on grade, pumped, over 6" thick, includes leveling (strike off) & consolidation, excludes material**	**34.5**	**CY**	**21.43**			**5.08**		**26.51**	**915**
5350	Structural concrete, placing, walls, pumped, 15" thick, includes leveling (strike off) & consolidation, excludes material	28.7	CY	33.28			7.81		41.08	1,181

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	03350300 - Finishing Floors									
0150	**Concrete finishing, floors, basic finishing for unspecified flatwork, bull float, manual float & broom finish, includes edging and joints, excludes placing, striking off & consolidating**	**537.5**	**SF**	**0.88**					**0.88**	**473**
	03350350 - Finishing Walls									
0150	**Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids**	**722.3**	**SF**	**3.30**					**3.30**	**2,383**
0750	Concrete finishing, walls, sandblast, heavy penetration	24.0	SF	5.05	1.49		0.68		7.22	173
	Cast-In-Place Concrete Total									**12,425**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	10.0	EA	11.68	0.08				11.76	118
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	10.0	EA	71.27	104.00		7.41		182.68	1,827
	Basic Metal Materials & Methods Total									**1,944**
	05500 - Metal Fabrications									
	05514500 - Ladder									
0300	Ladder, shop fabricated, aluminum, 20" W, bolted to concrete, incl cage	17.0	vlft	48.43	115.00		2.58		166.01	2,822
	05520700 - Railing, Pipe									
0210	Railing, pipe, aluminum, clear finish, 3 rails, 3'-6" high, posts @ 5' O.C., 1-1/2" dia, shop fabricated	37.7	LF	20.22	72.00		1.08		93.30	3,517
	Metal Fabrications Total									**6,340**
	08300 - Specialty Doors									
	08310100 - Access Doors									

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
6350	Doors, specialty, tank sidewall access hatch	1.0	EA	1,444.32	3,800.00				5,244.32	5,244
	08310350 - Floor, Industrial									
3020ds	Doors, specialty, access, floor, industrial, aluminum, Gas/Watertight, H-20, single leaf, 3' x 3'	1.0	Opng	224.99	1,147.00				1,371.99	1,372
	Specialty Doors Total									**6,616**
	09900 - Paints & Coatings									
	09910641 - B & C Coatings									
0020bc	**Coatings & paints, B & C coating system E-2 (Epoxy, metal pipe)**	**130.0**	**sqft**	**1.02**	**1.11**				**2.13**	**277**
	Paints & Coatings Total									**277**
	11000 - Equipment									
	11001000 - Pumps miscellaneous									
0033do	Pumps, Truck Loadout Pump, Seepex BN 130-12, quote	1.0	each	6,428.90	66,100.00				72,528.90	72,529
	Equipment Total									**72,529**
	15050 - Basic Materials & Methods									
	15080600 - Piping Insulation									
6980	Insulation, pipe covering (price copper tube one size less than I.P.S.), fiberglass with all service jacket, 1" wall, 8" iron pipe size	35.0	LF	12.41	4.15				16.56	580
	Basic Materials & Methods Total									**580**
	15100 - Building Services Piping									
	15107690 - Pipe, Grooved-Joint Steel Fittings & Valves									
0610	Pipe, fittings and valves, steel, black, grooved joint, 6" diameter, schedule 10, includes coupling & clevis type hanger 10' O.C.	60.0	LF	46.69	18.80				65.49	3,929
4120	Pipe, fittings and valves, elbow, 45 Deg. or 90 Deg., steel, painted, grooved joint, 6" diameter, add 1 coupling (material only) per joint for installed price, includes joint coupling labor, excludes joint coupling material	5.0	EA	86.46	141.00				227.46	1,137

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
4820	Pipe, fittings and valves, tee, steel, painted, grooved joint, 6" diameter, add 1 coupling (material only) per joint for installed price, includes joint coupling labor, excludes joint coupling material	3.0	EA	127.10	229.00				356.10	1,068
	15110600 - Valves, Semi-Steel									
7040	Valves, semi-steel, lubricated plug valve, flanged, 200 psi, 6"	6.0	EA	825.30	780.00				1,605.30	9,632
	Building Services Piping Total									**15,767**
	15200 - Process Piping									
	15200190 - Pipe, Steel									
2170	Pipe, steel, welding labor per joint, schedule 40, 6" pipe size	12.0	each	177.03			4.88		181.91	2,183
	15200195 - Fittings, Steel									
3010	Pipe, steel ftngs, 6" wall pipe	5.0	each	2,250.12	32.39		29.46		2,311.97	11,560
	15200200 - Flanges, Steel									
0080	Stl ftg, gskt & bolt set, 150#, 6" pipe	6.0	each	142.86	13.55				156.41	938
1000	Stl ftg, weld-on flg, fst, wldg neck, 150 lb flg, 6" pipe	12.0	each	248.58	44.00		4.49		297.07	3,565
	Process Piping Total									**18,246**
	15700 - Heating/Ventilating/Air Conditioning Equipment									
	15760250 - Electric Heating									
4050	Electric heating, heat trace system, 400 degree, 115 V, 10 watts per L.F.	35.0	LF	1.28	7.70				8.98	314
	Heating/Ventilating/Air Conditioning Equipment Total									**314**
	15950 - Testing/Adjusting/Balancing									
	15955700 - Piping, Testing									
0160	**Pipe testing, nondestructive hydraulic pressure test**	**3.0**	**EA**	**1,068.62**					**1,068.62**	**3,206**
	Testing/Adjusting/Balancing Total									**3,206**

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	02 - ROTARY DRUM THICKENER									**164,347**
	02200 - Site Preparation									
	02220330 - Selective Demolition, Dump Charges									
9999	Dump Charge, typical urban city, fees only, bldg constr mat'ls	10.0	ton					33.00	33.00	330
	02220350 - Selective Demolition, Rubbish Handling									
0950	Selective demolition, rubbish handling, dumpster, alternate pricing method, disposal fee per ton, average for all sizes, cost to be added to demolition cost.	3.6	ton		82.00				82.00	296
	02220360 - Selective Demolition, Saw Cutting									
0015	Selective demolition, saw cutting, asphalt, up to 3" deep	66.7	LF	1.06	0.15		0.50		1.71	114
0020	Selective demolition, saw cutting, each additional inch of depth over 3"	66.7	LF	0.61	0.05		0.29		0.95	64
	02220450 - Selective Demolition - Process Equipment									
0120bc	Site demolition, gravity belt thickener, complete	1.0	each	2,509.60			868.99		3,378.59	3,379
0120bc	Site demolition, pump, complete	1.0	each	2,509.60			868.99		3,378.59	3,379
	Site Preparation Total									**7,561**
	02300 - Earthwork									
	02310100 - Finish Grading									
1200	Fine grading, fine grade granular base for sidewalks and bikeways	16.6	SY	1.25			0.16		1.40	23
	02315120 - Backfill, Structural									
4420	Backfill, structural, common earth, 200 H.P. dozer, 300' haul, from existing stockpile, excludes compaction	98.8	L.C.Y.	1.09			2.06		3.15	311
	02315310 - Compaction, General									
7000	**Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate**	**125.2**	**E.C.Y.**	**2.31**			**0.19**		**2.50**	**313**
	02315424 - Excavating, Bulk Bank Measure									

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
1300	Excavating, bulk bank measure, 3 C.Y. capacity = 130 C.Y./hour, front end loader, track mounted, excluding truck loading	1.8	B.C.Y.	0.77			1.29		2.07	4
	02315492 - Hauling									
0009	**Loading Trucks, F.E. Loader, 3 C.Y.**	**62.5**	**cuyd**	**0.83**			**1.38**		**2.21**	**138**
9302	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 20 min load/wait/unload, 18 C.Y. 8 wheel truck, cycle 40 miles, 45 MPH, excludes loading equipment	2.3	L.C.Y.	5.10			8.43		13.53	31
9498	**Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 25 min load/wait/unload, 18 C.Y. 8 wheel truck, cycle 20 miles, 45 MPH, excludes loading equipment**	**60.2**	**L.C.Y.**	**3.41**			**5.60**		**9.01**	**542**
	02315610 - Excavating, Trench									
0500	Excavating, trench or continuous footing, common earth, 3/4 C.Y. excavator, 6' to 10' deep, excludes sheeting or dewatering	119.1	B.C.Y.	4.63			3.51		8.14	970
	02315640 - Utility Bedding									
0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	34.6	L.C.Y.	9.98	31.50		2.72		44.19	1,529
	Earthwork Total									**3,862**
	02700 - Bases, Ballasts, Pavements & Appurtenances									
	02720200 - Aggregrate Base Course									
0100	Base course drainage layers, aggregate base course for roadways and large paved areas, stone base, compacted, 3/4" stone base, to 6" deep	16.6	SY	0.56	6.00		0.92		7.48	124
	02740310 - Asphaltic Concrete Pavement, Highways Hot Mix									
1050	Plant-mix asphalt paving, for highways and large paved areas, pavement replacement over trench, 4" thick, no hauling included	16.6	SY	41.38	14.65		2.60		58.63	973
	Bases, Ballasts, Pavements & Appurtenances Total									**1,097**
	03100 - Concrete Forms & Accessories									

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	17.5	sfca	17.48	1.70				19.18	335
	Concrete Forms & Accessories Total									335
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	Reinforcing Steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	334.9	lb	0.64	0.50				1.14	383
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	51.0	EA	3.11	1.15				4.26	217
	Concrete Reinforcement Total									600
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	Structural concrete, ready mix, normal weight, 4000 psi, includes local aggregate, sand, Portland cement (Type I) and water, delivered, excludes all additives and treatments	1.0	CY		102.00				102.00	100
	03310700 - Placing Concrete									
4600	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includes leveling (strike off) & consolidation, excludes material	1.0	CY	15.47			0.35		15.82	16
	03350300 - Finishing Floors									
0350	Concrete finishing, floor, bush hammer, cured concrete	80.5	SF	4.49			0.39		4.89	393
	03350350 - Finishing Walls									
0150	Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids	17.5	SF	3.30					3.30	58
0750	Concrete finishing, walls, sandblast, heavy penetration	80.5	SF	5.05	1.49		0.68		7.22	581
	Cast-In-Place Concrete Total									1,148

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0400	**Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor**	**32.0**	**EA**	**11.68**	**0.08**				**11.76**	**376**
	05090540 - Machinery Anchors									
0800	**Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut**	**32.0**	**EA**	**71.27**	**104.00**		**7.41**		**182.68**	**5,846**
	Basic Metal Materials & Methods Total									**6,222**
	09900 - Paints & Coatings									
	09910641 - B & C Coatings									
0020bc	Coatings & paints, B & C coating system E-2 (Epoxy, metal pipe)	200.0	sqft	1.02	1.11				2.13	426
	Paints & Coatings Total									**426**
	11000 - Equipment									
	11000100 - Process Equipment									
0130	Rotary Drum Thickener, including floc tank, quote	1.0	each	5,698.48	57,000.00				62,698.48	62,698
	11001000 - Pumps miscellaneous									
0033do	Pumps, Thickener Sludge Pump, Seepex BTHE 10-12, quote	1.0	each	4,714.53	42,000.00				46,714.53	46,715
	Equipment Total									**109,413**
	15001 - Pipe, Water Supply									
	15001002 - Water Supply, Ductile Iron Pipe									
2020	Water supply distribution piping, ductile iron pipe, cement lined, mechanical joint, no fittings, 18' lengths, 4" diameter, class 50, excludes excavation or backfill	300.0	LF	13.83	14.55		2.38		30.76	9,229
8006	Water supply distribution piping, fitting, 90 degree bend or elbow, mechanical joint, ductile iron, cement lined, 4" diameter, class 50 water piping	3.0	EA	140.87	258.00				398.87	1,197

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Pipe, Water Supply Total									**10,426**
	15050 - Basic Materials & Methods									
	15050010 - Miscellaneous Mechanical									
0440	Seal water stations, complete	1.0	each	582.31	588.90				1,171.21	1,171
0450	piping, connect to existing 3" line	2.0	each	482.15	36.02				518.17	1,036
0450	piping, connect to existing 4" line	2.0	each	482.15	36.02				518.17	1,036
	Basic Materials & Methods Total									**3,244**
	15100 - Building Services Piping									
	15108520 - Pipe, Plastic									
1120	Pipe, plastic, PVC, high impact/pressure, 2" diameter, schedule 80, includes couplings 10' OC, and hangers 3 per 10'	20.0	LF	25.73	14.45				40.18	804
	15110500 - Valves, Plastic									
1470	Valves, plastic, PVC, ball, double union, socket or threaded, 1"	4.0	EA	32.39	67.50				99.89	400
	Building Services Piping Total									**1,203**
	15200 - Process Piping									
	15200190 - Pipe, Steel									
0370	Pipe,stl,wldd, sch. 40, bl, 3" dia	20.0	lnft	37.88	7.19		1.04		46.11	922
0390	Pipe,stl,wldd, sch. 40, blk,4" dia	50.0	lnft	44.02	10.42		1.21		55.65	2,783
2140	Pipe, steel, welding labor per joint, schedule 40, 3" pipe size	26.0	each	135.72			3.74		139.47	3,626
2150	Pipe, steel, welding labor per joint, schedule 40, 4" pipe size	2.0	each	162.87			4.49		167.36	335
	15200195 - Fittings, Steel									
0055	Pipe, steel ftngs, CI, standard weight, black, 90< elb, straight, 3"	6.0	each	162.87	42.00				204.87	1,229
	15200200 - Flanges, Steel									
0040	Stl ftg, gskt & bolt set, 150#, 3" pipe	16.0	each	77.92	4.80				82.72	1,324

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
0060	Stl ftg, gskt & bolt set, 150#, 4" pipe	1.0	each	93.17	8.70				101.87	102
0660	Stl ftg, weld-on flg, fst, slip-on, 150 lb flg, wld fr&back, 3" pipe	26.0	each	180.96	16.80		4.99		202.75	5,272
0680	Stl ftg, weld-on flg, fst, slip-on, 150 lb flg, wld fr&back, 4" pipe	1.0	each	236.04	22.00		6.51		264.55	265
	15200330 - Flexible Connectors									
301	Connectors, flex, dismantling Joint, 4"	1.0	each	241.08	573.57				814.65	815
	Process Piping Total									**16,671**
	15950 - Testing/Adjusting/Balancing									
	15955700 - Piping, Testing									
0160	**Pipe testing, nondestructive hydraulic pressure test**	**2.0**	**EA**	**1,068.62**					**1,068.62**	**2,137**
	Testing/Adjusting/Balancing Total									**2,137**

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	03 - THICKENER FEED PUMP									**36,469**
	02200 - Site Preparation									
	02220450 - Selective Demolition - Process Equipment									
0120bc	Site demolition, pump, complete	1.0	each	2,509.60			868.99		3,378.59	3,379
	Site Preparation Total									**3,379**
	03100 - Concrete Forms & Accessories									
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	6.6	sfca	17.48	1.70				19.18	127
	Concrete Forms & Accessories Total									**127**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	Reinforcing Steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	66.6	lb	0.64	0.50				1.14	76
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	19.0	EA	3.11	1.15				4.26	81
	Concrete Reinforcement Total									**157**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	Structural concrete, ready mix, normal weight, 4000 psi, includes local aggregate, sand, Portland cement (Type I) and water, delivered, excludes all additives and treatments	0.2	CY		102.00				102.00	20
	03310700 - Placing Concrete									
4600	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includes leveling (strike off) & consolidation, excludes material	0.2	CY	15.47			0.35		15.82	3
	03350300 - Finishing Floors									
0350	Concrete finishing, floor, bush hammer, cured concrete	16.0	SF	4.49			0.39		4.89	78

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	03350350 - Finishing Walls									
0150	Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids	6.6	SF	3.30					3.30	22
0750	Concrete finishing, walls, sandblast, heavy penetration	16.0	SF	5.05	1.49		0.68		7.22	116
	Cast-In-Place Concrete Total									**239**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	6.0	EA	11.68	0.08				11.76	71
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	6.0	EA	71.27	104.00		7.41		182.68	1,096
	Basic Metal Materials & Methods Total									**1,167**
	11000 - Equipment									
	11001000 - Pumps miscellaneous									
0033do	Pumps, Thickener Feed Pump, Seepex BN 35-12, quote	1.0	each	2,357.26	21,800.00				24,157.26	24,157
	Equipment Total									**24,157**
	15050 - Basic Materials & Methods									
	15050010 - Miscellaneous Mechanical									
0440	Seal water stations, complete	1.0	each	582.31	588.90				1,171.21	1,171
0450	piping, connect to existing 6" line	2.0	each	642.87	36.02				678.89	1,358
	Basic Materials & Methods Total									**2,529**
	15200 - Process Piping									
	15200190 - Pipe, Steel									
0410	Pipe,stl,wldd, sch. 40, blk,6" dia	6.0	lnft	69.05	22.16		1.25		92.46	555
2170	Pipe, steel, welding labor per joint, schedule 40, 6" pipe size	4.0	each	203.58			5.61		209.20	837

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	15200200 - Flanges, Steel									
0080	Stl ftg, gskt & bolt set, 150#, 6" pipe	2.0	each	142.86	13.55				156.41	313
0700	Stl ftg, weld-on flg, fst, slip-on, 150 lb flg, wld fr&back, 6" pipe	2.0	each	414.31	33.50		7.48		455.29	911
	15200330 - Flexible Connectors									
302	Connectors, flex, dismantling Joint, 6"	1.0	each	348.22	683.68				1,031.91	1,032
	Process Piping Total									**3,647**
	15950 - Testing/Adjusting/Balancing									
	15955700 - Piping, Testing									
0160	Pipe testing, nondestructive hydraulic pressure test	1.0	EA	1,068.62					1,068.62	1,069
	Testing/Adjusting/Balancing Total									**1,069**

SUQUAMISH THINKENING PROJECT
15% DESIGN STAGE ESTIMATE

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	04 - OTHER WORK									**12,976**
	11000 - Equipment									
	11000700 - Chemical Equipment									
0060	Hose station, remove existing, complete	2.0	each	428.58					428.58	857
0060	Hose station,complete,hose,valve,stand	2.0	each	428.58	344.84				773.43	1,547
	11000800 - Chemical Metering Pumps									
0340	Polymer system, remove and relocate, complete, allowance	1.0	lsum	8,571.64	2,000.00				10,571.64	10,572
	Equipment Total									**12,976**

SUQUAMISH THINKENING PROJECT
15% DESIGN STAGE ESTIMATE

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	05 - ELECTRICAL WORK									**56,800**
	16000 - Electrical and Instrumentation									
	16000000 - Electrical and Instrumentation									
0001	Electrical and Instrumentation Subcontract	1.0	lsum			53,800.00			53,800.00	53,800
0002	Electrical demand reading by 3rd party	1.0	lsum			3,000.00			3,000.00	3,000
	Electrical and Instrumentation Total									**56,800**

SUQUAMISH THINKENING PROJECT
15% DESIGN STAGE ESTIMATE

Item	Item Description	Takeoff Quantity	Unit	Labor $/ Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Grand Total									**462,218**

SUQUAMISH THINKENING PROJECT
15% DESIGN STAGE ESTIMATE

Category	Percent	Amount	Hours
--- Base Estimate --- Totals			
Labor	**31.26 %**	**144,495**	**1,877.6**
Material	**54.14 %**	**250,259**	
Subcontractor	**12.29 %**	**56,800**	
Equipment	**2.24 %**	**10,334**	**298.4**
Other	**0.07 %**	**330**	
User			
Net Costs		**462,218**	
Labor Mark-up	10.00 %	14,449	
Construction Equipment Mark-up	8.00 %	827	
Material/Process Equipment Mark-up	8.00 %	20,021	
Subcontractor Mark-up	5.00 %	2,840	
Material Shipping & Handling	2.00 %	4,160	
Contractor General Conditions	10.00 %	50,451	
Subtotal		**554,966**	
Start-up, training, O & M	2.00 %	5,034	
Subtotal		**560,000**	
Construction Contingency	25.00 %	140,000	
Subtotal		**700,000**	
Bldg Risk, Liability Auto Ins.	2.00 %	14,000	
Subtotal		**714,000**	
Bonds	1.50 %	10,710	

SUQUAMISH THINKENING PROJECT
15% DESIGN STAGE ESTIMATE

Category	Percent	Amount	Hours
Subtotal		**724,710**	
Sales tax - Excise, Gross Receipts	8.60 %	62,325	
Total --- Base Estimate ---		**787,035**	
Total Estimate		**787,035**	

Brown AND Caldwell

201 North Civic Drive
Walnut Creek, California, 94596

Tel: 925-937-9010
Fax: 925-937-9026

Memorandum

Date: October 31, 2013

To: Tadd Giesbrecht, Seattle

From: Teakia Sabb, Raleigh

Reviewed by: Butch Matthews, Jacksonville

Copy to: Bo Vestergaard-Hansen, Seattle

Project No.: 144449.130.***

Subject: Suquamish Thickening Project – LS54
Preliminary Planning Design Completion
Basis of Estimate of Probable Construction Cost

The Basis of Estimate Report and supporting estimate reports for the subject project are attached. Please call me if you have questions or need additional information.

TSS:dlg

Enclosures (3):

1. Basis of Estimate Report
2. Summary Estimate
3. Detailed Estimate

Basis of Estimate Report

Suquamish Thickening Project – LS54

Introduction

Brown and Caldwell (BC) is pleased to present this opinion of probable construction cost (estimate) prepared for the Suquamish Thickening Project - LS54 in Suquamish, 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's scope consists of the replacement of two (2) submersible pumps and the control panel. The base elbows and guiderail system in the pump station vault are also a part of the pump replacement. Temporary bypass pumping downstream from the valve vault is included as part of construction, allowing the continuous flow to the water treatment plant.

Background of this Estimate

The attached estimate of probable construction cost is based on documents dated October 2013, received by the ESG. These documents are described as predesign (as little as 5%) 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 4 estimate. A Class 4 estimate is defined as a Planning Level or Design Technical Feasibility Estimate. Typically, engineering is from 1 to 15 percent complete. Class 4 estimates are used to prepare planning level cost scopes or to evaluate alternatives in design conditions and form the base work for the Class 3 Project Budget or Funding Estimate.

Expected accuracy for Class 4 estimates typically range from -30 to +50 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 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.

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 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

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 has complete access for lay-down areas and mobile equipment.
2. 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.
3. Contractor markup is based on conventionally accepted values that have been adjusted for project-area economic factors.
4. 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.
5. 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.
6. Bulk material quantities are based on manual quantity take-offs.
7. There is sufficient electrical power to feed the specified equipment. The local power company will supply power and transformers suitable for this facility.
8. Pump vendor quote does not include control panel and level controls; these components are provided by the Electrical subcontractor.

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.

Allowances for Known but Undefined Work

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

1. Dismantling for bypass setup

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 (%)
Net Cost Markups	
Labor (employer payroll burden)	8
Materials and process equipment	5
Equipment (construction-related)	5
Material Shipping and Handling	2
Gross Cost Markups	
General Conditions	8
Construction Contingency	20
Builders Risk, Liability and Auto Insurance	2
Payment Bonds	1.5
Sales Tax (Excise-Gross Receipts-Contract Value)	8.6

Labor Markup

The labor rates used in the estimate were derived chiefly from the latest published State Prevailing Wage Rates. These include base rate paid to the laborer plus fringes. A labor burden factor is applied to these such that the final rates include all employer paid taxes. These taxes are FICA (which covers social security plus Medicare), Workers Comp (which varies based on state, employer experience and history) and unemployment insurance. The result is fully loaded labor rates. In addition to the fully loaded labor rate, an overhead and profit markup is applied at the back end of the estimate. This covers payroll and accounting, estimator's wages, home office rent, advertising and owner profit.

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 (Materials, Process Equipment and Construction Equipment)

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 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

Escalation has not been applied to the estimate due to the short time of the construction period.

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 to 50 percent.

Performance and Payment Bonds

Based on historical and industry data, this can range from 0.75 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.

SUMMARY ESTIMATE REPORT
WITH MARK-UPS ALLOCATED

SUQUAMISH THICKENING PROJECT
LS54
Pre-Design

Project Number:	144449
BC Project Manager:	Tadd Giesbrecht
BC Office:	Seattle
Estimate Issue Number:	1
Estimate Original Issue Date:	October 31, 2013
Lead Estimator:	Teakia Sabb/Dan Goodburn
Estimate QA/QC Reviewer:	Butch Matthews
Estimate QA/QC Date:	October 31, 2013

PROCESS LOCATION/AREA INDEX
1000 - SITEWORK
2000 - MECHANICAL
3000 - ELECTRICAL & INSTRUMENTATION

KITSAP COUNTY

SUQUAMISH THICKENING PROJECT LS54

Description		Gross Total Costs	Total w/ Markups Allocated
--- Base Estimate ---		212,279	212,279
1000 - SITEWORK			
02 - Site Construction		441	441
	1000 - SITEWORK Total	441	441
1500 - BYPASS PUMPING			
01 - General Requirements		24,241	24,241
02 - Site Construction		18,986	18,986
15 - Mechanical		14,475	14,475
	1500 - BYPASS PUMPING Total	57,703	57,703
2000 - MECHANICAL			
02 - Site Construction		55,124	55,124
09 - Finishes		1,162	1,162
15 - Mechanical		3,928	3,928
	2000 - MECHANICAL Total	60,214	60,214
3000 - ELECTRICAL AND INSTRUMENTATION (E&I)			
17 - Instrumentation		93,921	93,921
	3000 - ELECTRICAL AND INSTRUMENTATION (E&I) Total	93,921	93,921
	Grand Total	212,279	212,279

DETAILED ESTIMATE REPORT

SUQUAMISH THICKENING PROJECT
LS54
Pre-Design

Project Number:	144449
BC Project Manager:	Tadd Giesbrecht
BC Office:	Seattle
Estimate Issue Number:	1
Estimate Original Issue Date:	October 31, 2013
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PROCESS LOCATION/AREA INDEX
1000 - SITEWORK
2000 - MECHANICAL
3000 - ELECTRICAL & INSTRUMENTATION

KITSAP COUNTY

SUQUAMISH THICKENING PROJECT
LS54

Item	Item Description	Qty	Unit	Labor Unit Price	Mat Unit Price	Subs Unit Price	Equip Unit Price	Other Unit Price	Total $/Unit	Total Net Cost $
	--- Base Estimate ---									
	1000 - SITEWORK									**284**
	02300 - Earthwork									
	02315120 - Backfill, Structural									
4420	Backfill, structural, common earth, 200 H.P. dozer, 300' haul, from existing stockpile, excludes compaction	15.0	L.C.Y.	0.95			1.79		2.74	41
	02315310 - Compaction, General									
7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	20.0	E.C.Y.	2.01			0.17		2.18	44
	02315424 - Excavating, Bulk Bank Measure									
4400	Excavating, bulk bank measure, in sheeting or cofferdam, with all other equipment, minimum	15.0	B.C.Y.	5.65			7.64		13.30	199
	Earthwork Total									**284**

Item	Item Description	Qty	Unit	Labor Unit Price	Mat Unit Price	Subs Unit Price	Equip Unit Price	Other Unit Price	Total $/Unit	Total Net Cost $
	1500 - BYPASS PUMPING									**36,977**
	01500 - Temporary Facilities & Controls									
	01510500 - Traffic Control									
0001	Traffic Control - Active	15.0	day	401.04			55.92		456.96	6,854
	Temporary Facilities & Controls Total									**6,854**
	01590 - Construction Aids									
	01590400 - General equipment rental without operators									
1950A	Floodlights trailer mounted w/generator 1 - 300 watt light - Hourly operating cost - @ Manhole	168.0	hour				3.35		3.35	563
1950A	Floodlights trailer mounted w/generator 1 - 300 watt light - Hourly operating cost - @ Valve Vault	168.0	hour				3.35		3.35	563
1950C	Floodlights trailer mounted w/generator 1 - 300 watt light - Rent per week - @ Manhole	2.0	week				215.00		215.00	430
1950C	Floodlights trailer mounted w/generator 1 - 300 watt light - Rent per week - @ Valve Vault	2.0	week				215.00		215.00	430
3230A	Rent hose, water, section, 6" diameter, 20' long w/coupling - Hourly operating cost	168.0	hour				0.11		0.11	18
3230C	Rent hose, water, section, 6" diameter, 20' long w/coupling - Rent per week	2.0	week				53.00		53.00	106
3230C	Rent hose, water, section, 6" diameter, 20' long w/coupling - Rent per week (STANDBY)	2.0	week				53.00		53.00	106
5650A	Rent trash pump self-prime 6" diameter, diesel drive - Hourly operating cost	168.0	hour				20.50		20.50	3,444
5650C	Rent trash pump self-prime 6" diameter, diesel drive - Rent per week	2.0	week				420.00		420.00	840
5650C	Rent trash pump self-prime 6" diameter, diesel drive - Rent per week (STANDBY)	2.0	week				420.00		420.00	840
	Bypass pumping, mob/demob	2.0	days				738.88		738.88	1,478
	Construction Aids Total									**8,818**
	02200 - Site Preparation									
	02240900 - Wellpoints									

Item	Item Description	Qty	Unit	Labor Unit Price	Mat Unit Price	Subs Unit Price	Equip Unit Price	Other Unit Price	Total $/Unit	Total Net Cost $
0412	Nightly Check - Pumping Unit, 2 cks @ 2 hour, per 24 hour day	60.0	hour	201.08					201.08	12,065
	Site Preparation Total									**12,065**
	15001 - Pipe, Water Supply									
	15001004 - Water Supply, PVC Pipe									
0200	Water supply distribution piping, piping PVC, butt fusion joints, 40' lengths, 6" diameter	150.0	LF	5.97	10.70		1.79		18.46	2,769
1300	Water supply distribution piping, piping PVC, butt fusion joints, fittings, elbows, 90 degree, 6" diameter	4.0	EA	80.97	104.00		24.10		209.07	836
2300	Water supply distribution piping, piping PVC, butt fusion joints, fittings, tees, 6" diameter	1.0	EA	87.47	123.00		26.25		236.72	237
	Pipe, Water Supply Total									**3,842**
	15050 - Basic Materials & Methods									
	15050010 - Miscellaneous Mechanical									
0009	Allowance - Disconnetions/dismantling, temporary connections, piping and fittings	1.0	lsum	1,250.00	1,250.00				2,500.00	2,500
	Basic Materials & Methods Total									**2,500**
	15100 - Building Services Piping									
	15110200 - Valves, Iron Body									
2300	Valves, iron body, gate, non-rising stem, flanged, 125 lb., 6", install only	2.0	EA	724.54					724.54	1,449
6070	Valves, iron body, swing check, flanged, 125 lb., 6", install only	2.0	EA	724.54					724.54	1,449
	Building Services Piping Total									**2,898**

Item	Item Description	Qty	Unit	Labor Unit Price	Mat Unit Price	Subs Unit Price	Equip Unit Price	Other Unit Price	Total $/Unit	Total Net Cost $
	2000 - MECHANICAL									**39,224**
	02300 - Earthwork									
	02370700 - Synthetic Erosion Control									
1100	Synthetic erosion control, silt fence, polypropylene, adverse conditions, 3' high	120.0	LF	0.74	0.25				0.99	119
	Earthwork Total									**119**
	02500 - Utility Services									
	02520510 - Wells & Accessories									
3100	Duplex Pump Assembly	2.0	EA	1,074.16	16,000.00		848.90		17,923.06	35,846
	Utility Services Total									**35,846**
	09900 - Paints & Coatings									
	09910641 - B & C Coatings									
0020bc	Painting - 6" Ductile Iron Pipe, vertical pipe in pump station	1.0	LSUM	333.75	416.25				750.00	750
	Paints & Coatings Total									**750**
	15001 - Pipe, Water Supply									
	15001002 - Water Supply, Ductile Iron Pipe									
2040	Pipe - 6" water distribution piping, ductile iron pipe, flanged	20.0	LF	11.79	16.55		2.84		31.18	624
8020	Elbow - 90 degree bend, mechanical joint, ductile iron, 6" diameter	1.0	EA	118.52	385.00				503.52	504
	Pipe, Water Supply Total									**1,127**
	15050 - Basic Materials & Methods									
	15060300 - Pipe Hangers And Supports									
2884	Pipe hanger/supports assembly - 6" pipe size, size includes an insulation allowance, includes adjustable clevis, saddle, rod and clamp	2.0	EA	26.46	94.00				120.46	241
	Basic Materials & Methods Total									**241**
	15200 - Process Piping									

Item	Item Description	Qty	Unit	Labor Unit Price	Mat Unit Price	Subs Unit Price	Equip Unit Price	Other Unit Price	Total $/Unit	Total Net Cost $
	15200330 - Flexible Connectors									
0220	Flange Coupling Adaptor - 6" dia.	1.0	EA	64.54	291.79				356.33	356
	Process Piping Total									**356**
	15950 - Testing/Adjusting/Balancing									
	15955700 - Piping, Testing									
0320	Testing - piping and pump assembly	1.0	EA	784.14					784.14	784
	Testing/Adjusting/Balancing Total									**784**

Item	Item Description	Qty	Unit	Labor Unit Price	Mat Unit Price	Subs Unit Price	Equip Unit Price	Other Unit Price	Total $/Unit	Total Net Cost $
	3000 - ELECTRICAL AND INSTRUMENTATION (E&I)									**64,456**
	17150 - Instrumentation/Controls									
	17150000 - Instrumentation/Controls									
0010	Electrical and Instrumentation Subcontract	1.0	lsum			64,456.00			64,456.00	64,456
	Instrumentation/Controls Total									**64,456**

Item	Item Description	Qty	Unit	Labor Unit Price	Mat Unit Price	Subs Unit Price	Equip Unit Price	Other Unit Price	Total $/Unit	Total Net Cost $
	Grand Total									**140,941**

KITSAP COUNTY

SUQUAMISH THICKENING PROJECT LS54

Category	Percent	Amount	Hours
--- Base Estimate --- Totals			
Labor	**19.51 %**	**27,502**	**483.6**
Material	**26.28 %**	**37,036**	
Subcontractor	**45.73 %**	**64,456**	
Equipment	**8.48 %**	**11,947**	**764.6**
Other			
User			
Net Costs		**140,941**	
Labor Mark-up	8.00 %	2,200	
Construction Equipment Mark-up	5.00 %	597	
Material/Process Equipment Mark-up	5.00 %	1,852	
Material Shipping & Handling	2.00 %	92	
Contractor General Conditions	8.00 %	11,655	
Subtotal		**157,337**	
Construction Contingency	20.00 %	31,467	
Subtotal		**188,804**	
Bldg Risk, Liability Auto Ins.	2.00 %	3,776	
Subtotal		**192,580**	
Bonds	1.50 %	2,889	
Subtotal		**195,469**	
Gross Receipts Tax	8.60 %	16,810	

KITSAP COUNTY

SUQUAMISH THICKENING PROJECT LS54

Category	Percent	Amount	Hours
Total --- Base Estimate ---		**212,279**	
Total Estimate		**212,279**	

E & I DETAILED ESTIMATE REPORT

SUQUAMISH THICKENING PROJECT LS54 Pre-Design

Project Number:	144449
BC Project Manager:	Tadd Giesbrecht
BC Office:	Seattle
Estimate Issue Number:	1
Estimate Original Issue Date:	October 31, 2013
Lead Estimator:	Teakia Sabb/Dan Goodburn
Estimate QA/QC Reviewer:	Butch Matthews
Estimate QA/QC Date:	October 31, 2013

PROCESS LOCATION/AREA INDEX

4000 - ELECTRICAL & INSTRUMENTATION

KITSAP COUNTY

SUQUAMISH THICKENING PROJECT
LS54

Item	Item Description	Qty	Unit	Labor Unit Price	Mat Unit Price	Subs Unit Price	Equip Unit Price	Other Unit Price	Total $/Unit	Total Net Cost $
	--- Base Estimate ---									
	4000 - Electrical and Instrumentation									**53,782**
	02050 - Basic Site Materials & Methods									
	02080600 - Utility Accessories									
0500	Utility Line Signs, Markers, and Flags, underground tape, detectable, reinforced, aluminum foil core, 6", excludes excavation and backfill	1.5	Clf	2.51	5.60				8.11	12
	Basic Site Materials & Methods Total									**12**
	02300 - Earthwork									
	02315120 - Backfill, Structural									
4420	Backfill, structural, common earth, 200 H.P. dozer, 300' haul, from existing stockpile, excludes compaction	12.9	L.C.Y.	0.73			1.71		2.45	31
	02315310 - Compaction, General									
7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	2.9	E.C.Y.	1.75			0.16		1.91	6
7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	11.6	E.C.Y.	1.75			0.16		1.91	22
	02315492 - Hauling									
0009	Loading Trucks, F.E. Loader, 3 C.Y.	9.1	cuyd	0.55			1.15		1.70	16
4498	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 25 min load/wait/unload, 20 CY truck, cycle 20 miles, 45 MPH, no loading equipment	9.1	L.C.Y.	1.29			3.71		5.00	46
	02315610 - Excavating, Trench									
0060	Excavating, trench or continuous footing, common earth, 1/2 C.Y. excavator, 1' to 4' deep, excludes sheeting or dewatering	17.6	B.C.Y.	3.57			1.84		5.41	95
	Earthwork Total									**216**
	02500 - Utility Services									
	02580410 - Underground Ducts And Manholes									

Item	Item Description	Qty	Unit	Labor Unit Price	Mat Unit Price	Subs Unit Price	Equip Unit Price	Other Unit Price	Total $/Unit	Total Net Cost $
1060	Electrical Underground Ducts and Manholes, PVC, conduit with coupling, 2.5" diameter, schedule 40, installed by direct burial in slab or duct bank	150.0	LF	3.39	4.59				7.98	1,197
	Utility Services Total									**1,197**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0502	Reinforcing Steel, in place, footings, #4 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	511.5	lb	0.40	0.51				0.91	467
	Concrete Reinforcement Total									**467**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0020	Structural concrete, ready mix, normal weight, 2000 psi, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	6.0	CY		91.50				91.50	551
	03310700 - Placing Concrete									
1950	Structural concrete, placing, continuous footing, shallow, pumped, includes strike off & consolidation, excludes material	6.0	CY	19.22			5.22		24.44	147
	Cast-In-Place Concrete Total									**699**
	16050 - Basic Electrical Materials & Methods									
	16055300 - Electrical Demolition									
	Control panel, misc conduit, boxes, wire, selective demolition	1.0	lsum	813.12					813.12	813
	16060800 - Grounding									
1000	Ground wire, copper wire, bare stranded, 4/0	1.5	Clf	142.95	420.00				562.95	844
	Basic Electrical Materials & Methods Total									**1,658**
	16100 - Wiring Methods									
	16120230 - Cable Terminations									
0100	Terminal lugs, solderless, #8 to #4	2.0	EA	13.56	0.94				14.50	29

Item	Item Description	Qty	Unit	Labor Unit Price	Mat Unit Price	Subs Unit Price	Equip Unit Price	Other Unit Price	Total $/Unit	Total Net Cost $
0150	Terminal lugs, solderless, #2 to #1	6.0	EA	18.48	1.26				19.74	118
	16120900 - Wire									
3060	Wire, copper, stranded, 600 volt, #8, type XHHW, in raceway	1.5	Clf	50.77	60.00				110.77	166
3120	Wire, copper, stranded, 600 volt, #2, type XHHW, in raceway	4.5	Clf	90.20	239.00				329.20	1,481
	16132205 - Conduit									
4550	Rigid galvanized steel plastic coated conduit elbows, 2-1/2" diameter, to 15' high	2.0	EA	67.53	94.50				162.03	324
	Misc conduit and wire	1.0	lsum	250.00	250.00				500.00	500
	16136720 - Pull Boxes & Cabinets									
0740	Cabinets & enclosures, enclosures, ss, small, screw cover, 15-1/2"H x 12"W x 8-3/16"D, NEMA 4X	1.0	EA	67.53	343.50				411.03	411
	Wiring Methods Total									**3,030**
	17070 - Level instruments									
	17070000 - Level instruments									
0010	Float Level Switches	3.0	each	101.64	96.00				197.64	593
0030	Ultrasonic Level Transmitters	1.0	each	203.28	2,798.00				3,001.28	3,001
	Level instruments Total									**3,594**
	17110 - Control Panels									
	17110000 - Control Panels									
0020	Local Panels, pump control panel, 100A MCB, 2-10hp VFD, 2-size 1, PLC, UPS, wireless, antenna	1.0	each	2,134.44	33,000.00				35,134.44	35,134
	Control Panels Total									**35,134**
	17130 - Instrument Stands And Suppots									
	17130000 - Instrument Stands And Suppots									
0020	Double Stand	1.0	each	101.64	176.86				278.50	279

Item	Item Description	Qty	Unit	Labor Unit Price	Mat Unit Price	Subs Unit Price	Equip Unit Price	Other Unit Price	Total $/Unit	Total Net Cost $
	Instrument Stands And Suppots Total									**279**
	17140 - Loop Check And Testing									
	17140000 - Loop Check And Testing									
0010	Loop Checking	2.0	each	203.28					203.28	407
0020	Calibration	1.0	lsum	50.82					50.82	51
0030	Testing	1.0	lsum	2,439.36					2,439.36	2,439
	Loop Check And Testing Total									**2,897**
	17150 - Instrumentation/Controls									
	17150000 - Instrumentation/Controls									
9002	Programming	1.0	lsum	4,600.00					4,600.00	4,600
	Instrumentation/Controls Total									**4,600**

Item	Item Description	Qty	Unit	Labor Unit Price	Mat Unit Price	Subs Unit Price	Equip Unit Price	Other Unit Price	Total $/Unit	Total Net Cost $
	Grand Total									**53,782**

KITSAP COUNTY

SUQUAMISH THICKENING PROJECT LS54

Category	Percent	Amount	Hours
--- Base Estimate --- Totals			
Labor	**24.71 %**	**13,290**	**203.4**
Material	**75.04 %**	**40,359**	
Subcontractor			
Equipment	**0.25 %**	**133**	**3.3**
Other			
User			
Net Costs		**53,782**	
Labor Mark-up	8.00 %	1,063	
Construction Equipment Mark-up	5.00 %	7	
Material/Process Equipment Mark-up	5.00 %	2,018	
Material Shipping & Handling	2.00 %	777	
Contractor General Conditions	8.00 %	4,612	
Subtotal		**62,258**	
Liability Auto Ins.	2.00 %	1,245	
Subtotal		**63,503**	
Bonds	1.50 %	953	
Subtotal		**64,456**	
Total --- Base Estimate ---		**64,456**	
Total Estimate		**64,456**	

Brown AND Caldwell

201 North Civic Drive
Walnut Creek, California, 94596

Tel: 925-937-9010
Fax: 925-937-9026

Memorandum

Date: October 31, 2013

To: Tadd Giesbrecht, Seattle

From: Teakia Sabb, Raleigh

Reviewed by: Butch Matthews, Jacksonville

Copy to: Bo Vestergaard-Hansen, Seattle

Project No.: 144449.130.***

Subject: Suquamish Thickening Project - PLC
Preliminary Planning Percent Design Completion
Basis of Estimate of Probable Construction Cost

The Basis of Estimate Report and supporting estimate reports for the subject project are attached. Please call me if you have questions or need additional information.

TSS:dlg

Enclosures (3):

1. Basis of Estimate Report
2. Summary Estimate
3. Detailed Estimate

Basis of Estimate Report

Suquamish Thickening Project - PLC

Introduction

Brown and Caldwell (BC) is pleased to present this opinion of probable construction cost (estimate) prepared for the Suquamish Thickening Project in Suquamish, 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's scope consists of replacing the existing programmable logic controller (PLC) components inside of the existing cabinet, along with some modifications to the existing vendor PLC.

Background of this Estimate

The attached estimate of probable construction cost is based on documents dated October 2013, received by the ESG. These documents are described as predesign (as little as 5%) 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 4 estimate. A Class 4 estimate is defined as a Planning Level or Design Technical Feasibility Estimate. Typically, engineering is from 1 to 15 percent complete. Class 4 estimates are used to prepare planning level cost scopes or to evaluate alternatives in design conditions and form the base work for the Class 3 Project Budget or Funding Estimate.

Expected accuracy for Class 4 estimates typically range from -30 to +50 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 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.

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 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
   - HVAC systems

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. Owner provided PLC RSLogix and Wonderware software.
11. No new PLC programming will be required. Load will be placed on existing status/alarm programming.

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.

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 (%)
Net Cost Markups	
Subcontractor	5
Gross Cost Markups	
Construction Contingency	20
Builders Risk, Liability and Auto Insurance	2
Performance and Payment Bonds	1.5
Sales Tax (Excise-Gross Receipts-Contract Value)	8.6

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.

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.

Escalation to Midpoint for Labor, Materials and Subcontractors

Escalation has not been applied to the estimate due to the short time of the construction period.

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 to 50 percent.

Performance and Payment Bonds

Based on historical and industry data, this can range from 0.75 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.

SUMMARY ESTIMATE REPORT
WITH MARK-UPS ALLOCATED

SUQUAMISH THICKENING PROJECT
PLC
Pre-Design

Project Number:	144449
BC Project Manager:	Tadd Giesbrecht
BC Office:	Seattle
Estimate Issue Number:	1
Estimate Original Issue Date:	October 31, 2013
Lead Estimator:	Teakia Sabb/Dan Goodburn
Estimate QA/QC Reviewer:	Butch Matthews
Estimate QA/QC Date:	October 31, 2013

PROCESS LOCATION/AREA INDEX

4000 - ELECTRICAL & INSTRUMENTATION

KITSAP COUNTY

SUQUAMISH THICKENING PROJECT PLC

Description	Gross Total Costs	Total w/ Markups Allocated
--- Base Estimate ---	65,733	65,733
4000 - Electrical and Instrumentation		
16 - Electrical	65,733	65,733
4000 - Electrical and Instrumentation Total	65,733	65,733
Grand Total	65,733	65,733

DETAILED ESTIMATE REPORT

SUQUAMISH THICKENING PROJECT PLC Pre-Design

Project Number:	144449
BC Project Manager:	Tadd Giesbrecht
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PROCESS LOCATION/AREA INDEX

4000 - ELECTRICAL & INSTRUMENTATION

KITSAP COUNTY

SUQUAMISH THICKENING PROJECT PLC

Item	Item Description	Qty	Unit	Labor Unit Price	Mat Unit Price	Subs Unit Price	Equip Unit Price	Other Unit Price	Total $/Unit	Total Net Cost $
	--- Base Estimate ---									
	4000 - Electrical and Instrumentation									**42,963**
	16000 - Electrical and Instrumentation									
	16000000 - Electrical and Instrumentation									
	Electrical and Instrumentation Subcontract	1.0	lsum			42,963.00			42,963.00	42,963
	Electrical and Instrumentation Total									**42,963**

Item	Item Description	Qty	Unit	Labor Unit Price	Mat Unit Price	Subs Unit Price	Equip Unit Price	Other Unit Price	Total $/Unit	Total Net Cost $
	Grand Total									**42,963**

KITSAP COUNTY

SUQUAMISH THICKENING PROJECT PLC

Category	Percent	Amount	Hours
--- Base Estimate --- Totals			
Labor			
Material			
Subcontractor	**100.00 %**	**42,963**	
Equipment			
Other			
User			
Net Costs		**42,963**	
Subcontractor Mark-up	5.00 %	2,148	
Contractor General Conditions	8.00 %	3,609	
Subtotal		**48,720**	
Construction Contingency	20.00 %	9,744	
Subtotal		**58,464**	
Bldg Risk, Liability Auto Ins.	2.00 %	1,169	
Subtotal		**59,633**	
Bonds	1.50 %	894	
Subtotal		**60,528**	
Gross Receipts Tax	8.60 %	5,205	
Subtotal		**65,733**	
Total --- Base Estimate ---		**65,733**	

Category	Percent	Amount	Hours
SITEWORK Totals			
Labor			
Material			
Subcontractor			
Equipment			
Other			
User			
Net Costs			
Subcontractor Mark-up	5.00 %		
Contractor General Conditions	8.00 %		
Subtotal			
Construction Contingency	20.00 %		
Subtotal			
Bldg Risk, Liability Auto Ins.	2.00 %		
Subtotal			
Bonds	1.50 %		
Subtotal			
Gross Receipts Tax	8.60 %		
Subtotal			
Total SITEWORK			
STRUCTURAL Totals			

Category	Percent	Amount	Hours
Labor			
Material			
Subcontractor			
Equipment			
Other			
User			
Net Costs			
Subcontractor Mark-up	5.00 %		
Contractor General Conditions	8.00 %		
Subtotal			
Construction Contingency	20.00 %		
Subtotal			
Bldg Risk, Liability Auto Ins.	2.00 %		
Subtotal			
Bonds	1.50 %		
Subtotal			
Gross Receipts Tax	8.60 %		
Subtotal			
Total STRUCTURAL			
MECHANICAL Totals			
Labor			

Category	Percent	Amount	Hours
Material			
Subcontractor			
Equipment			
Other			
User			
Net Costs			
Subcontractor Mark-up	5.00 %		
Contractor General Conditions	8.00 %		
Subtotal			
Construction Contingency	20.00 %		
Subtotal			
Bldg Risk, Liability Auto Ins.	2.00 %		
Subtotal			
Bonds	1.50 %		
Subtotal			
Gross Receipts Tax	8.60 %		
Subtotal			
Total MECHANICAL			
ELECTRICAL & INSTRUMENTATION Totals			
Labor			
Material			

Category	Percent	Amount	Hours
Subcontractor			
Equipment			
Other			
User			
Net Costs			
Subcontractor Mark-up	5.00 %		
Contractor General Conditions	8.00 %		
Subtotal			
Construction Contingency	20.00 %		
Subtotal			
Bldg Risk, Liability Auto Ins.	2.00 %		
Subtotal			
Bonds	1.50 %		
Subtotal			
Gross Receipts Tax	8.60 %		
Subtotal			
Total ELECTRICAL & INSTRUMENTATION			
Total Estimate		**65,733**	

E & I DETAILED ESTIMATE REPORT

SUQUAMISH THICKENING PROJECT PLC Pre-Design

Project Number:	144449
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PROCESS LOCATION/AREA INDEX

4000 - ELECTRICAL & INSTRUMENTATION

KITSAP COUNTY

SUQUAMISH THICKENING PROJECT PLC

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	--- Base Estimate ---									
	4000 - Electrical and Instrumentation									**35,741**
	16050 - Basic Electrical Materials & Methods									
	16055300 - Electrical Demolition									
	Demo existing PLC and components	1.0	lsum	406.56					406.56	407
	Basic Electrical Materials & Methods Total									**407**
	16200 - Electrical Power									
	16260800 - Uninterruptible Power Supply/Conditioner Transformers									
0120	Uninterruptible power supply, charger, inverter, and alarm 1 phase, 120 V, 0.5 kVA, DIN mounted	1.0	EA	35.57	500.00				535.57	536
	Electrical Power Total									**536**
	17140 - Loop Check And Testing									
	17140000 - Loop Check And Testing									
0030	Testing	1.0	lsum	2,439.36					2,439.36	2,439
	Loop Check And Testing Total									**2,439**
	17150 - Instrumentation/Controls									
	17150000 - Instrumentation/Controls									
9002	Programming	1.0	EA	8,600.00					8,600.00	8,600
9004	PLC	1.0	each	609.84	7,000.00				7,609.84	7,610
9006	I/O Cards, DI module, 8 pts	4.0	each	50.82	450.00				500.82	2,003
9006	I/O Cards, DO module, 8 pts	1.0	each	50.82	400.00				450.82	451
9007	I/O cards, Analog Input 4pt	2.0	each	101.64	800.00				901.64	1,803
9007	I/O cards, Analog Output 4pt	1.0	each	101.64	550.00				651.64	652
9008	I/O Rack, back panel	1.0	each	609.84	400.00				1,009.84	1,010
9008	I/O Rack, misc wireway, DIN rail, fuses, terminal strips	1.0	each	406.56	300.00				706.56	707
9010	Power Supply	1.0	each	203.28	200.00				403.28	403
	Temporary install PLC rack on side panel	1.0	ea	813.12					813.12	813
	Modification to existing vendor PLC, add ethernet module and software	1.0	lsum	508.20	2,400.00				2,908.20	2,908
	Auto dialer software	1.0	ea	500.00	2,500.00				3,000.00	3,000

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Panel drawings	1.0	lsum	2,400.00					2,400.00	2,400
	Instrumentation/Controls Total									**32,360**

SUQUAMISH THICKENING PROJECT PLC

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Grand Total									**35,741**

KITSAP COUNTY

SUQUAMISH THICKENING PROJECT PLC

Category	Percent	Amount	Hours
--- Base Estimate ---			
Labor	**50.6174 %**	**18,091**	**234.5**
Material	**49.3826 %**	**17,650**	
Subcontractor			
Equipment			
Other			
Net Costs		**35,741**	
Labor Mark-up	8 %	1,447	
Construction Equipment Mark-up	5 %		
Material/Process Equipment Mark-up	5 %	883	
Material Shipping & Handling	2 %	353	
Subtotal		**38,424**	
Contractor General Conditions	8 %	3,074	
Subtotal		**41,498**	
Liability Auto Ins.	2 %	830	
Subtotal		**42,328**	
Bonds	1.5 %	635	
Subtotal		**42,963**	
Total Estimate --- Base Estimate ---		**42,963**	
Total All Alternates		**42,963**	

Appendix H: Preliminary Solids Thickening Layout Drawings

NOTES:

1. TOP OF CATCH BASIN ELEVATIONS NOT IN PAVEMENT ARE APPROXIMATE AND MAY BE ADJUSTED AS REQUIRED TO ACHIEVE PROPER DRAINAGE.
2. FOR LEGEND AND ADDITIONAL NOTES, SEE SHEET G-2 AND M-1.
3. FOR STORM DRAIN PROFILES, SEE SHEET C-8.
4. EXISTING UTILITIES SHOWN ARE APPROXIMATE. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THESE LINES AND THEIR LOCATIONS.
5. SEE SHEET C-4 FOR COORDINATES.
6. SEE WSDOT STANDARD PLAN B-1 FOR CATCH BASIN DETAIL.
7. PROVIDE TEMPORARY 4" CAM-LOCK CONNECTION ABOVE GRADE FOR DRAINING OF EXSITING TREATMENT UNIT. CONTRACTOR SHALL REMOVE CAM-LOCK AND BLIND FLANGE CONNECTION AFTER USE.

EXISTING ACCESS ROAD
SEE SHEET PS-2 FOR CONTINUATION OF 6" FM
EASEMENT LINE
PROPERTY LINE
P&T POLE W/UG ACCESS
FOR CATCH BASINS RECEIVING SURFACE WATER PRIOR TO PAVING SEE DETAIL 1/C-1
48 LF UNDERDRAIN PIPE 4" DIA – SEE DETAIL 5/C-5
THICKENED SLUDGE STORAGE TANK OPTION 2
80 LF UNDERDRAIN PIPE 4" DIA – SEE DETAIL 5/C-5
100 LF UNDERDRAIN PIPE, 4" DIA SEE PROFILE NO 1, SHT C-8 SEE DETAIL 5/C-5
ADJUST EXISTING CB'S TO GRADE AND CONNECT NEW DRAIN LINES
CB #8 (EX) TOP EL 85.51
12"CCP
6" FM
4"PERF
STORM DRAIN PROFILE NO 4 SEE SHEET C-8
1" HOSE STATION
DIESEL FUEL TANK
TRANSFORMER AND TRANSFORMER VAULT BY PUGET POWER
4" WYE & CLEANOUT IE 83.40
CB #7 (EX) TOP EL 84.87
32 LF ~ 12" DIA SD
15 LF ~ 6" DIA SD
2'x2' ELEC DUCT
8" TS, DRAIN
CAST METAL INLET TOP EL 83.60 SEE DETAIL 2/C-6
1" DIESEL
EXISTING ASPHALT CONC PAVEMENT
BERM
CB #6 TYPE 1 W/INLET TOP TOP EL 83.25
48 LF ~ 12" DIA STD STORM DRAIN PROFILE NO 2 SEE SHEET C-8
55 LF ~ 12" DIA SD
4" CLEAN OUT
10" FM
12" W1
8" FM
2" W3HP
10" FA
3" TS
3" ALP
3" SN
6" WS
12" TE
1" W3HP
CB #4 TYPE 1 W/INLET TOP TOP EL 83.35
SEE ELECTRICAL DRAWINGS
TO ELECTRICAL CONTROL PANEL (SEE ELECTRICAL DRAWINGS)
SERVICE BUILDING
EXISTING SIDEWALK CUT IN 2"x2"x1'9" TEE & INSTALL 1'9" GV
SEE MECHANICAL DRAWINGS FOR LOCATION OF PIPE PENETRATIONS
DOWN
4" ROOF DRAIN PROVIDE TEE AT EACH DOWNSPOUT SEE ARCH DWGS
CB #3 TYPE 2, 48" WITH OIL/WATER SEPARATOR AND SOLID TOP MARKED "DRAIN" TOP EL 84.00 SEE DETAIL 4/C-6
74 LF ~ 12" DIA STD
STORM DRAIN PROFILE NO 3 SEE SHEET C-8
SLUDGE STORAGE
1" HOSE STATION
CONNECT NEW 8" FM TO EXISTING SFM
SEE NOTE 7
4" CLEANOUT IE 73.21 (2 PLACES)
PLANTING STRIP
4" WYE & CLEANOUT IE 72.50
4" WYE & CLEANOUT IE 72.40
4" WYE & CLEANOUT IE 71.88 SEE DETAIL 3/C-6
15' WIDE GAVEL ACCESS ROAD
SBR #1 & #2 BASIN
FUTURE SBR #3 & #4 BASIN
PROCESS BUILDING FINISHED FLOOR EL 84.33
4" FOUNDATION DRAINS SEE DETAIL 4/C-7
THICKENED SLUDGE STORAGE TANK OPTION 1
61 LF ~ 12" DIA SD
EXISTING SANITARY SEWER MANHOLE
12"COP
STORM DRAIN PROFILE NO 5 SEE SHEET C-8
93 LF ~ 12" DIA SD
2'x2' ELEC DUCT
12" PE
12" SOF
4" WYE & CLEANOUT IE 72.77
4" ROOF DRAIN PROVIDE TEE AT EACH DOWNSPOUT SEE ARCH DWGS
CONNECT FLOOR DRAIN TO 4" ROOF DRAIN SYSTEM LANDING EL 76.80
EXISTING CHAIN LINK FENCE
4" WYE & CLEANOUT IE 71.4
THICKENED SLUDGE STORAGE TANK OPTION 3
CB #2 TYPE 2 (48") W/SOLID TOP MARKED "DRAIN" TOP EL 80.50
CB #1 (EX) IE 70.21
CONNECT NEW 12" PE TO EX 12" SOF WYE EL. 71.80
PLANT PROPERTY BOUNDARY
EFFLUENT OUTFALL

Brown AND Caldwell
SEATTLE, WASHINGTON

SUBMITTED: _____ DATE: _____ PROJECT MANAGER
APPROVED: _____ DATE: _____ BROWN AND CALDWELL

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

DESIGNED: B. Vestergaard-Hansen
DRAWN: A. Lambert
CHECKED:
CHECKED:
APPROVED:

EXTERNAL REFERENCE FILES
144449-G-001-TBLK.dwg

REVISIONS					
ZONE	REV.	DESCRIPTION	BY	DATE	APP.

KITSAP COUNTY

SUQUAMISH WASTEWATER TREATMENT PLANT

THICKENING PROJECT

CIVIL

THICKENED SLUDGE SITE PLAN / TANK LOCATION OPTIONS

FILENAME 144449-C001.dwg
BC PROJECT NUMBER 144449
CLIENT PROJECT NUMBER
DRAWING NUMBER C001
SHEET NUMBER OF

Aug 09, 2013 - 12:27pm alambert
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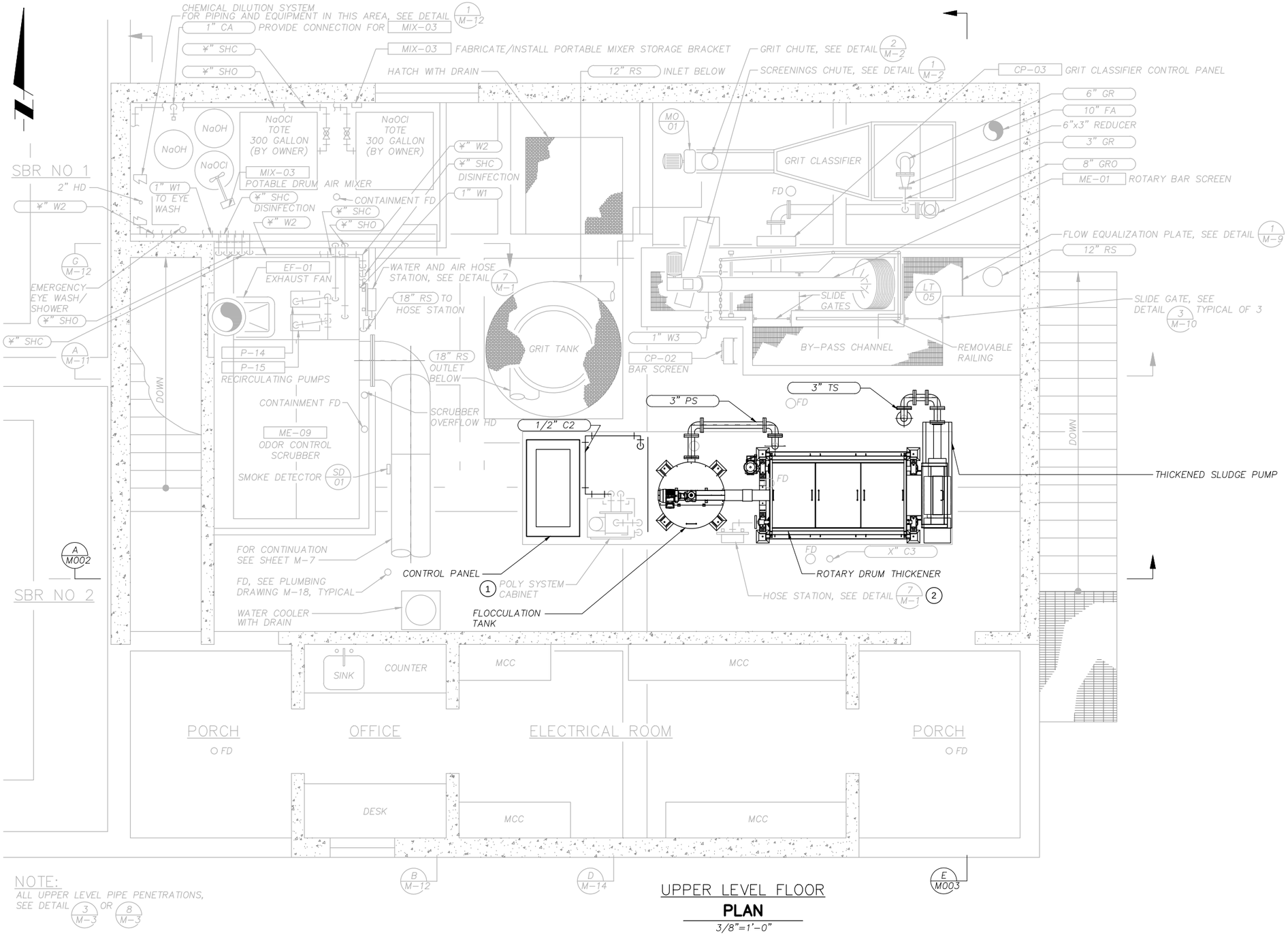

NOTE:
ALL UPPER LEVEL PIPE PENETRATIONS, SEE DETAIL 3/M-3 OR 8/M-3

UPPER LEVEL FLOOR
PLAN
3/8"=1'-0"

GENERAL NOTES:

1. CONTRACTOR TO FIELD VERIFY LOCATIONS AND SIZES OF EXISTING STRUCTURES, EQUIPMENT, PIPES, ETC.

KEY NOTES:

1. RELOCATE POLYMER SYSTEM CABINET.
2. RELOCATE HOSE STATION.

Brown AND Caldwell
SEATTLE, WASHINGTON

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

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

DESIGNED: B. Vestergaard-Hansen
DRAWN: A. Lambert
CHECKED:
CHECKED:
APPROVED:

EXTERNAL REFERENCE FILES
144449-G-001-TBLK.dwg

REVISIONS					
ZONE	REV.	DESCRIPTION	BY	DATE	APP.

KITSAP COUNTY

SUQUAMISH WASTEWATER TREATMENT PLANT

THICKENING PROJECT

MECHANICAL

PROCESS BUILDING
UPPER LEVEL FLOOR PLAN

FILENAME	144449-M001.dwg
BC PROJECT NUMBER	144449
CLIENT PROJECT NUMBER	
DRAWING NUMBER	M001
SHEET NUMBER	OF

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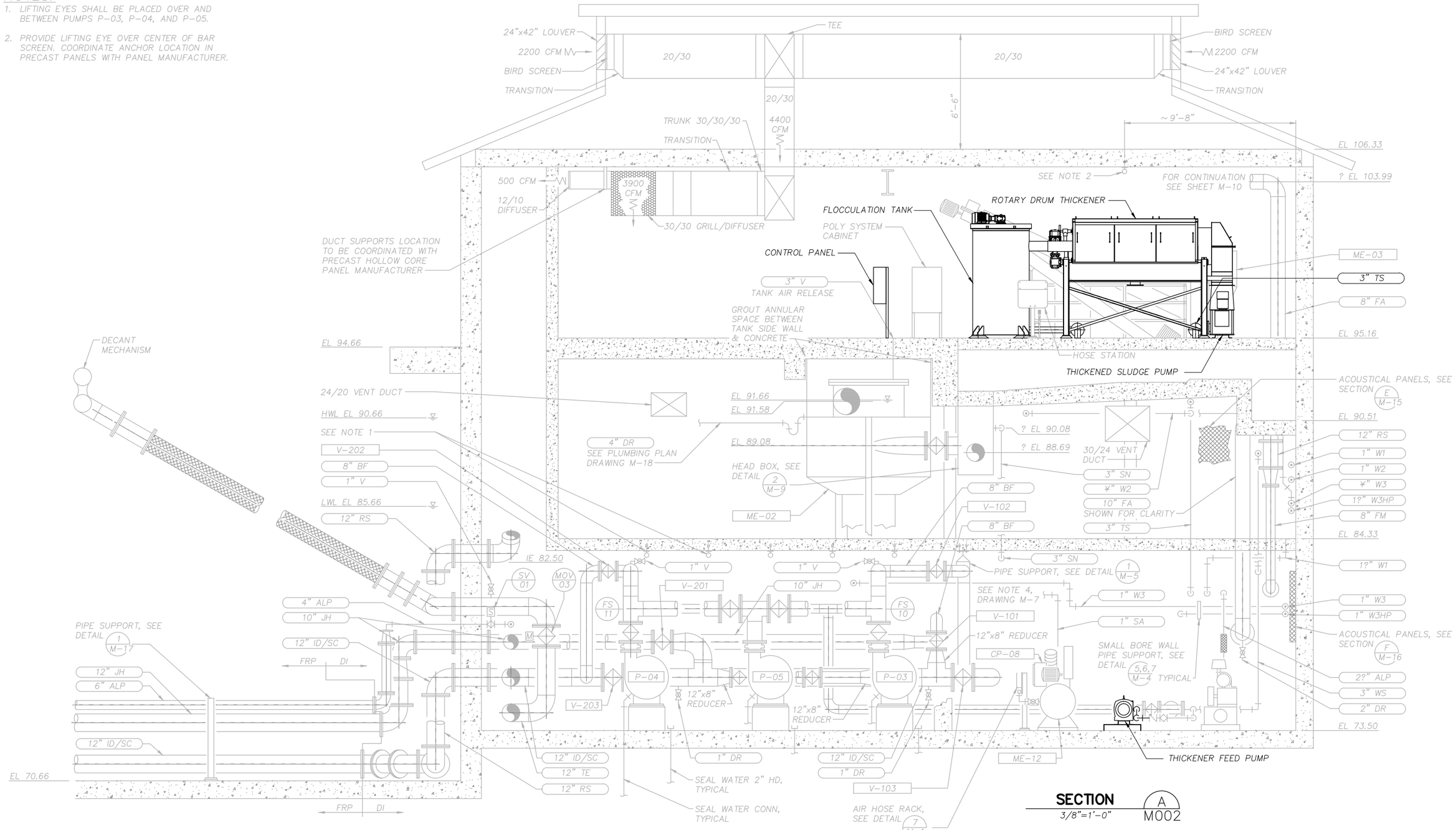
alamber

NOTES:

1. LIFTING EYES SHALL BE PLACED OVER AND BETWEEN PUMPS P-03, P-04, AND P-05.
2. PROVIDE LIFTING EYE OVER CENTER OF BAR SCREEN. COORDINATE ANCHOR LOCATION IN PRECAST PANELS WITH PANEL MANUFACTURER.



SECTION A M002
3/8"=1'-0"

Brown AND Caldwell
SEATTLE, WASHINGTON

SUBMITTED: _____ DATE: _____ PROJECT MANAGER
APPROVED: _____ DATE: _____ BROWN AND CALDWELL

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

DESIGNED: B. Vestergaard-Hansen
DRAWN: A. Lambert
CHECKED:
CHECKED:
APPROVED:

EXTERNAL REFERENCE FILES
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REVISIONS					
ZONE	REV.	DESCRIPTION	BY	DATE	APP.

KITSAP COUNTY

SUQUAMISH WASTEWATER TREATMENT PLANT

THICKENING PROJECT
MECHANICAL
PROCESS BUILDING SECTION 1

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BC PROJECT NUMBER 144449
CLIENT PROJECT NUMBER
DRAWING NUMBER M002
SHEET NUMBER OF

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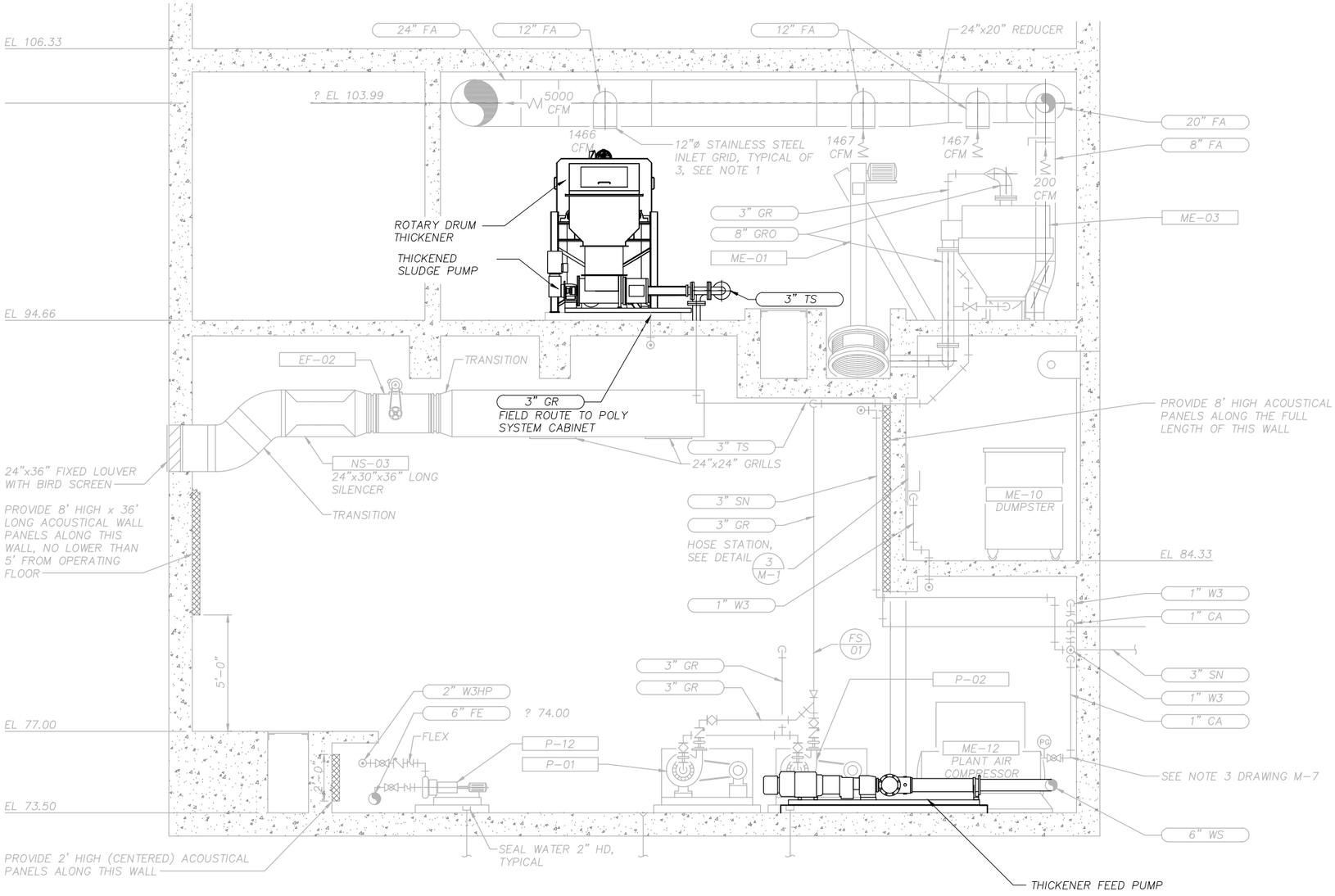

NOTE:
GRIDS TO BE FABRICATED FROM STAINLESS STEEL BIRD SCREEN AND SECURED INTO POSITION WITH STAINLESS STEEL HARDWARE

SECTION E
3/8"=1'-0"
M001

Brown AND Caldwell
SEATTLE, WASHINGTON

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

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

DESIGNED: B. Vestergaard-Hansen
DRAWN: A. Lambert
CHECKED:
CHECKED:
APPROVED:

EXTERNAL REFERENCE FILES
144449-G-001-TBLK.dwg

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

KITSAP COUNTY

SUQUAMISH WASTEWATER TREATMENT PLANT

THICKENING PROJECT

MECHANICAL

PROCESS BUILDING SECTION 2

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BC PROJECT NUMBER 144449
CLIENT PROJECT NUMBER
DRAWING NUMBER M003
SHEET NUMBER OF

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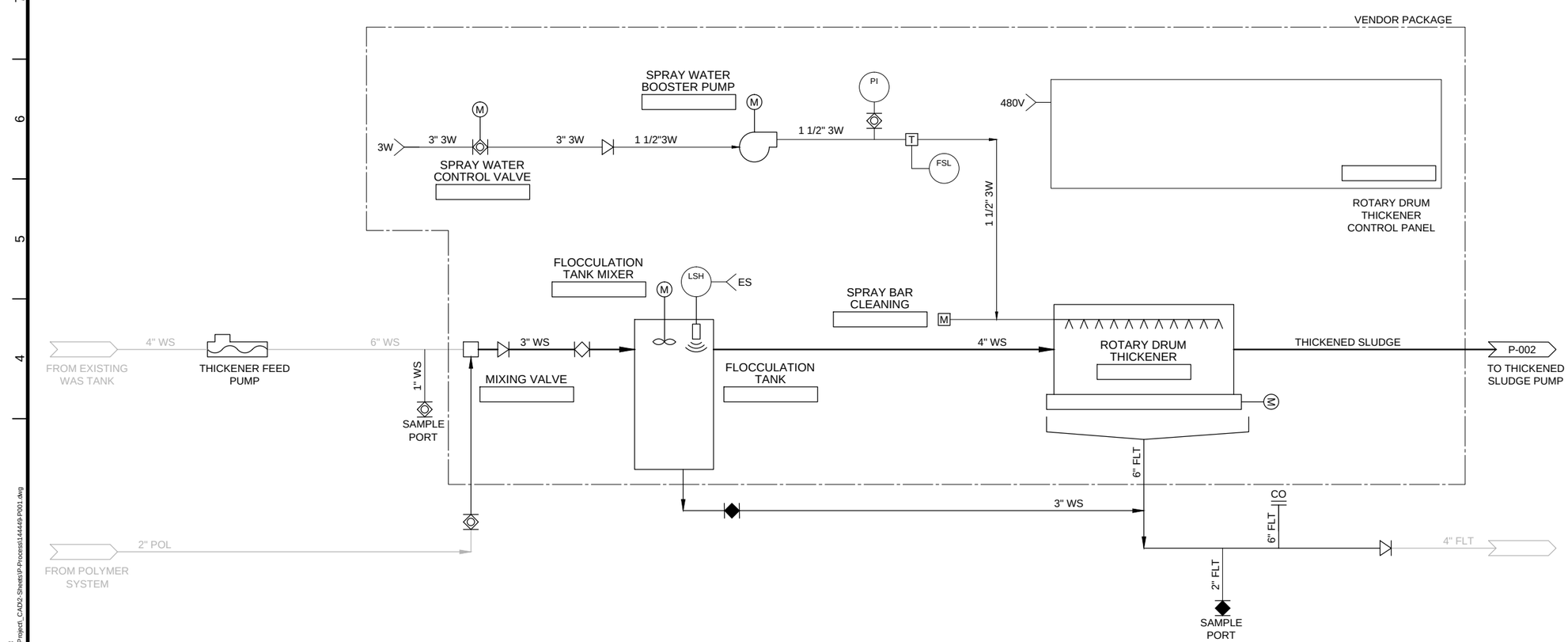

Brown AND Caldwell
SEATTLE, WASHINGTON

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

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

DESIGNED: B. Vestergaard-Hansen
DRAWN: A. Lambert
CHECKED:
CHECKED:
APPROVED:

EXTERNAL REFERENCE FILES
144449-G-001-TBLK.dwg

REVISIONS

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KITSAP COUNTY

SUQUAMISH WASTEWATER TREATMENT PLANT

THICKENING PROJECT

PROCESS AND INSTRUMENTATION DIAGRAM

SLUDGE THICKENING

FILENAME
144449-P001.dwg
BC PROJECT NUMBER
144449
CLIENT PROJECT NUMBER

DRAWING NUMBER
P-001
SHEET NUMBER
OF

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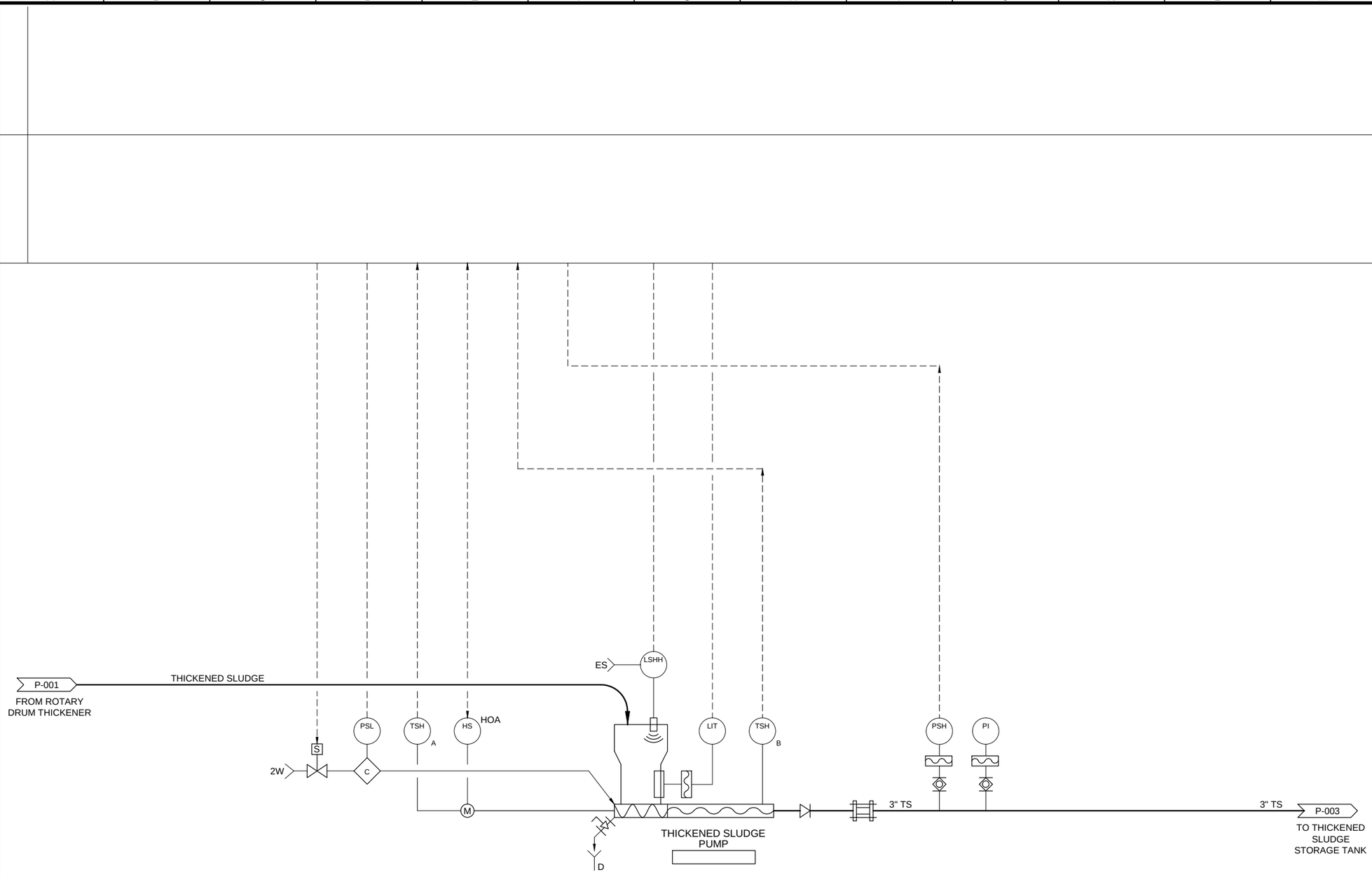

Brown AND Caldwell
SEATTLE, WASHINGTON

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

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

DESIGNED: B. Vestergaard-Hansen
DRAWN: A. Lambert
CHECKED:
CHECKED:
APPROVED:

EXTERNAL REFERENCE FILES
144449-G-001-TBLK.dwg

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

KITSAP COUNTY

SUQUAMISH WASTEWATER TREATMENT PLANT

THICKENING PROJECT

PROCESS AND INSTRUMENTATION DIAGRAM

THICKENED SLUDGE PUMPING

FILENAME
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BC PROJECT NUMBER
144449
CLIENT PROJECT NUMBER

DRAWING NUMBER
P-002
SHEET NUMBER
OF

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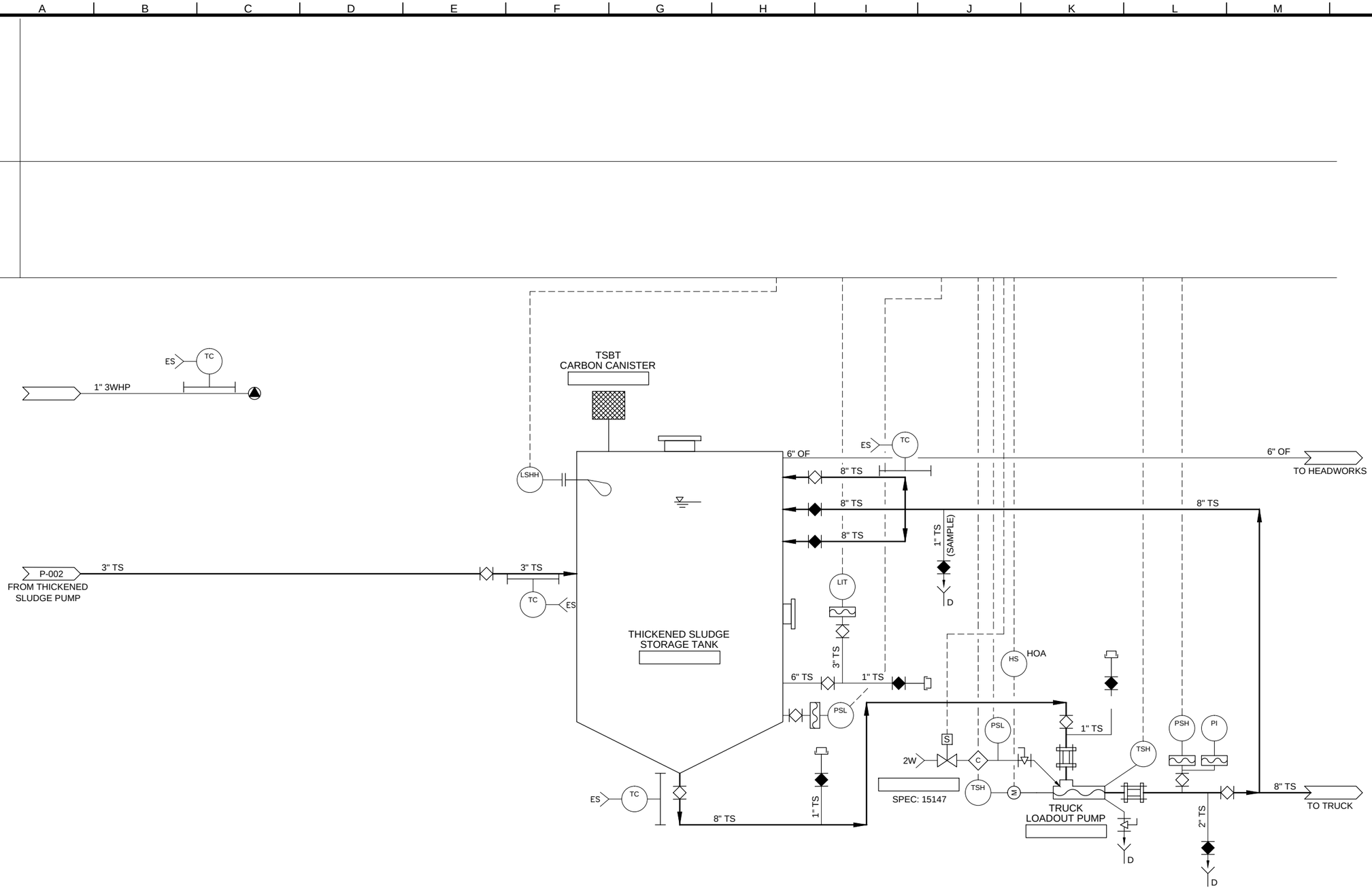

Brown AND Caldwell SEATTLE, WASHINGTON	LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)	EXTERNAL REFERENCE FILES 144449-G-001-TBLK.dwg
SUBMITTED: _____ DATE: _____ PROJECT MANAGER APPROVED: _____ DATE: _____ BROWN AND CALDWELL	DESIGNED: B. Vestergaard-Hansen DRAWN: A. Lambert CHECKED: CHECKED: APPROVED:	

REVISIONS					
ZONE	REV.	DESCRIPTION	BY	DATE	APP.

KITSAP COUNTY

SUQUAMISH WASTEWATER TREATMENT PLANT

THICKENING PROJECT

PROCESS AND INSTRUMENTATION DIAGRAM

THICKENED SLUDGE STORAGE TANK AND TRUCK LOADOUT

FILENAME	144449-P003.dwg
BC PROJECT NUMBER	144449
CLIENT PROJECT NUMBER	
DRAWING NUMBER	P-003
SHEET NUMBER	OF

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Appendix I: Influent Lift Station Pump Curves

Smith & Loveless Engineering Data

A Division of Ecodyne Corporation • Main Plant: Lenexa, Kansas 66215

Pump Performance Curves
Constant Speed
4B3/4C3/4D3
1760 RPM

L553

4B3 4C3 4D3
SEWAGE PUMP
CONSTANT SPEED PERFORMANCE
1760 RPM
S4M32 IMPELLER
MAXIMUM SOLID - 3" SPHERE

BEP: ~800 gpm

Test Point:
108 ft @ ~360 gpm

Design Point:
360 gpm
116 ft

Impeller diameter

TOTAL HEAD IN FEET

U.S. GALLONS PER MINUTE

360 gpm =
45% of BEP

L553

Ecodyne Corporation
Smith & Loveless Division
An Affiliate of Trans Union Corporation

PUMP STATION ENGINEERING ORDER
(Standard Series) (Custom Series)

Form No. 04-6-6 10/72

LOCATION	Sequamish, Washington	STATION SERIAL NO.	08-7276-C
OWNER	Snelson, Inc.	ENGINEER	Hill, Ingman, Chase & Co.

1. Station Size Custom Series (Dia.) 8'0" Height 7'4-1/2" Sump Pump Part No. 8L18A
2. Suction Piping (P.E.) (S.) (C.I.) Pump 1 6" Pump 2 6" Pump 3 _____ Pump 4 _____
3. Suction Gate Valve Pump 1 6" Pump 2 6" Pump 3 _____ Pump 4 _____
4. Pump Discharge Gate Valve Pump 1 6" Pump 2 6" Pump 3 _____ Pump 4 _____
5. Common Discharge Outlet (P.E.) (S.) (C.I.) Size 8"
6. Entrance Tube 44" Dia. x 23'0" Long
7. Main Conduit Size 1-1/2" Aux. Conduit 1/2" (Describe Alarm Blower Part No. 7L7
8. Electrical Service System Data: 3 Phase 60 Cycle 460 Volts 3 Wire
9. 110V Single Phase Current (not) available 3 KVA Trans. Req'd. 460 V to 120 VAC

PUMP & MOTOR DATA

PUMP DATA	PUMP 1	PUMP 2	PUMP 3	PUMP 4
Design Characteristics (GPM@TDH)	360@116'	360@116'		
Pump Model	4C3	4C3		
Impeller Diameter	11"	11"		
Rotation (CW) (CCW)	CW	CCW		
S&L Mech. Seal Filter Ass'y (Size)	2-1/8"	2-1/8"		
Pump Serial Number				
MOTOR DATA (INVENTORY CODE)				
Horsepower	25	25		
R.P.M.	1760	1760		
Phase Cycle/Volts	3/60/460	3/60/460		
Motor Serial No. (Code Ltr.)				
Squirrel Cage (SC) or Wound Rotor (WR)	SC	SC		
Special Modifications				
Across-The Line (AL) or Part Winding (PW) Start	AL	AL		

CONTROL PANEL DATA. TYPE NEMA I WIRING DIAGRAM NO. D08-7276-1, D-2

MOTOR CONTROL EQUIPMENT		PUMP 1	PUMP 2	PUMP 3	PUMP 4
Circuit Breaker – Trip Rating – Amps	70	4L79G	4L79G		
Magnetic Starter – Nema Size	2	4L204C	4L204C		
O.L. Coil No. 1G177H	1046	3-4L54BJ	3-4L54BJ		

AUXILIARY CIRCUIT BREAKERS	LIGHTS	BLOWER DEHUMIDIFIER	SUMP PUMP	AIR COMPRESSORS & CONTROL	TRANSFORMER
Trip Rating–Amps	15	20	15	15	15

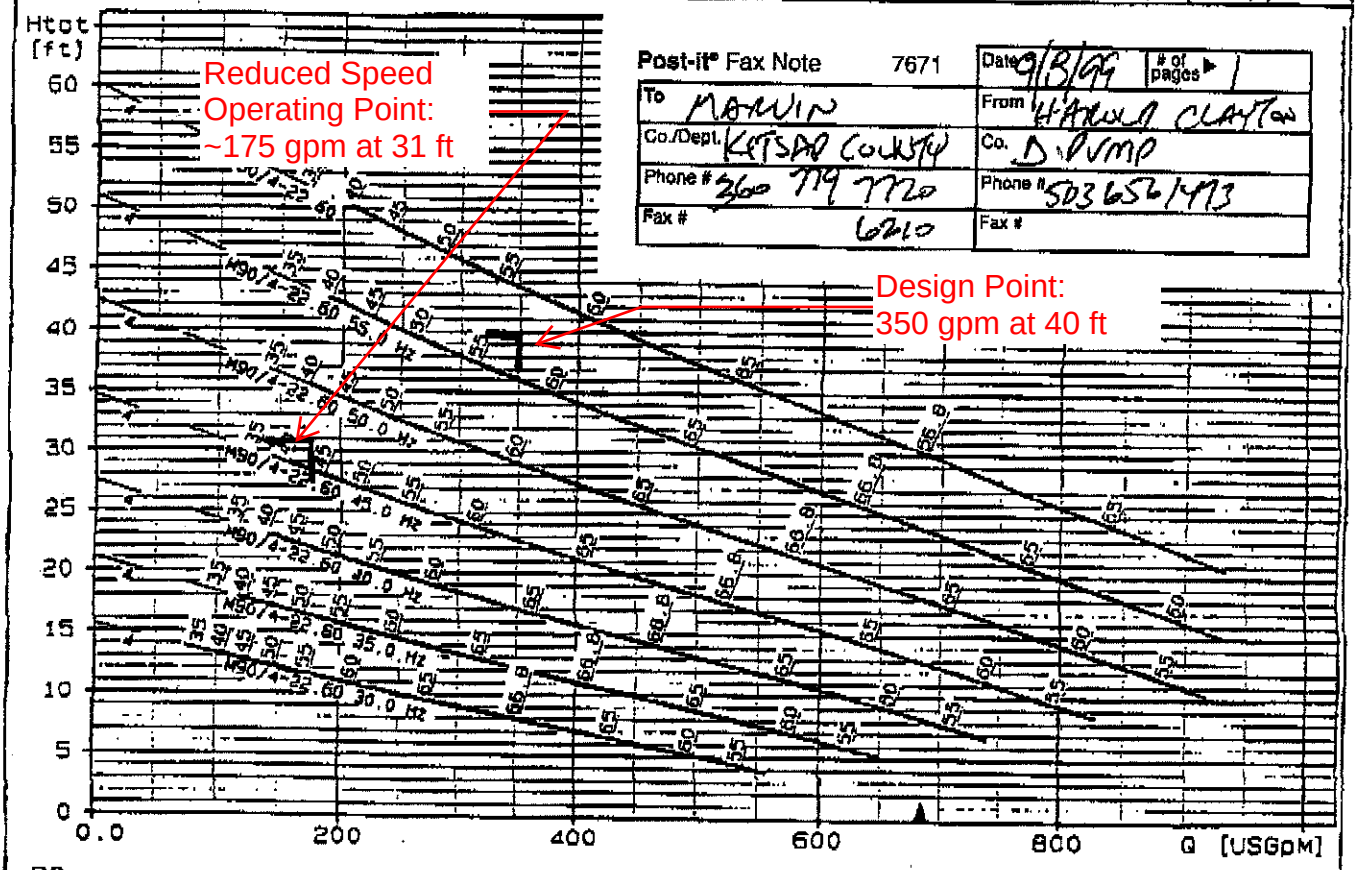
Lift Station Inventory

Lift Station Smith-Loveless Duplex	53		
Location Suquamish Waterfront	Suquamish		
Date Installed	10/31/77	10/31/77	
Type of station (Wet Well/DryWell	Wet Well	Dry Well	
Force Main Size (in) Asbestos class 150	8"		
Discharge Elevation			
Force Main Discharge Length to STP			
Flow Measurement (Yes/No)	No		
Bar Screens (Yes/No)	No		
Comminutor (Yes/No)	No		
Odor Prevention & Type	No		
Standby Power (Diesel or Propane)	PWR From STP Plant		
Generator Capacity (KW)			
Wet Well - Size (ft)	6'		
Wet Well - gal/ft	211.51		
Original Pump Design Capacity (gpm@TDH) (ft)	360@116'	360@116'	
Pump Test Results (gal/min@TDH, Efficiency %)			
Pump Number	1	2	
Manufacturer			
Pump Type	Centrifugal	Centrifugal	
Horizontal/Vertical	Vertical	Vertical	
Model Number	4C3	4C3	
Serial Number	741057100	74055597	
Drive Type	Constant	Constant	
Horsepower	25	25	
Voltage / Phase	480/3	460/3	
Speed Constant	1755	1755	
Amps full load (100% rpm)	31.7	31.7	
Level Control Mercury Tip Switch	Bubbler		
Emerg/Redundant Control	Hi-Alarm Float	Low Alarm Mercury	
Telemetry	Yes		
Visual or Audio Alarm	No		
Redundant Alarm	No		
Suction Diameter (in)	6"	6"	
Discharge Diameter (in)	6"	6"	
Impeller Size (in) 2-ports	10.5"	10.5"	
Shut-off Head	129'	120'	
Dynamic Head	108'	108'	
Static Head	100'	100'	
Distance (FT) CENTERLINE OF PUMP TO GUAGE	1'	1'	
DATE READINGS TAKEN::			
TAKEN BY::			
Condition of pump:			

LS54

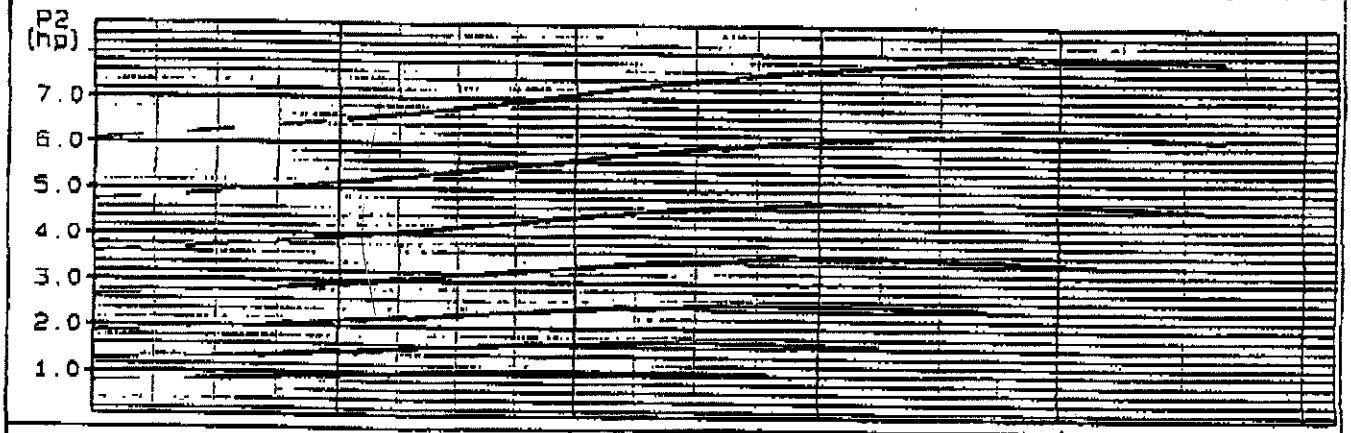
ABS performance field 60 Hz

AFP 1042 M 70 4 p. 9.4 HP



Post-it® Fax Note 7671 | Date 9/8/99 | # of pages ▶

To MARVIN	From HAROLD CLAYTON
Co./Dept. KITSAP COUNTY	Co. D PUMP
Phone # 360 779 7770	Phone # 503 656 1493
Fax # 6210	Fax #



solid size :	100 mm	no.of vane :	1
speed motor:	1780 RPM		
speed hydr.:	1780 RPM		4"
tolerance according to hydraulic institute			
issue :	30.Mar 1994	V2/2-T2.2	

5063/GRA

Lift Station Inventory

Lift Station Submersible Station	54			
Location End of STP Driveway	Division St.			
Date Installed	Apr-98	Apr-98		
Type of station (Wet Well//Submersible)	Wet Well	Submersible		
Force Main Size (in)	6"			
Discharge Elevation				
Discharge Length	741'			
Flow Measurement (Yes/No)	No			
Bar Screens (Yes/No)	No			
Comminutor (Yes/No)	No			
Odor Prevention & Type	No			
Standby Power (Diesel or Propane)	PWR From STP Plant	Overflow to LS 53		
Generator Capacity (KW)				
Wet Well - Size (ft)	7'			
Wet Well - gal/ft	287.88			
Original Pump Design Capacity (gpm@TDH) (ft)	350@40'	350@40'		
Pump Test Results (gal/min@TDH, Efficiency %)				
Pump Number	1	2		
Manufacturer	ABS	ABS		
Pump Type	Submersible	Submersible		
Horizontal/Vertical	Vertical	Vertical		
Model Number	AFP1042EX-M70/4-22	AFP1042EX-M70/4-22		
Serial Number	J67330	J67331	(J6732G?)	
Drive Type Consolidated Elect. Co. Inc.	Variable	Variable		
Horsepower	9.4	9.4		
Voltage / Phase	460/3	460/3		
Speed (Range, if Variable)	1780	1780		
Amps full load (100% rpm)	12	12		
LEVEL Control	Floats/Ultrasonic			
Consolidated Ultrasonic Co Inc / U S Filter				
Emerg/Redundant Control	Hi-Alarm Float			
Telemetry	Yes			
Visual or Audio Alarm	No			
Redundant Alarm	No			
Suction Diameter (in)				
Discharge Diameter (in)	4"	4"		
Impeller Size (in) 1-port	7.5	7.5		
Shut-off Head	35'	40'		
Dynamic Head	26'	25'		
Static Head	18'	18'		
Distance (FT) CENTERLINE OF PUMP TO GUAGE	17'	17'		
DATE READINGS TAKEN::	2/17/2004	2/17/2004		
TAKEN BY::				
Condition of pump:				