Liberty Lake Water Reclamation Facility

Pre-Design Report

November 2013

CENTURY WEST
ENGINEERING CORPORATION
11707 E Montgomery Drive
Spokane Valley, WA 99206
www.centurywest.com

ESVELT ENVIRONMENTAL ENGINEERING, LLC
7605 East Hodin Drive
Spokane, Washington 99212-1816
www.esvelt.com

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INTRODUCTION

The sewer system of Liberty Lake Sewer and Water District (District) collects and treats the sanitary wastewater from a service area that is approximately 5.3 square miles within the corporate limits of the City of Liberty Lake, and to an unincorporated area adjacent to Liberty Lake. It was constructed in 1973 and came online in August of 1982 to improve the water quality of Liberty Lake. Minor modifications to the facility were made in 1998 by replacing the aerobic digester blowers, in 1997 by installing a new headworks screen, and in 2002 by replacing the chlorination system with the ultraviolet disinfection (UV) system. Major upgrades (Phase 1 upgrades) and expansion of the facility started in 2004 and were completed in 2006 to accommodate growth, provide improved biological nitrogen and phosphorus removal and allow provisions for additional treatment (current Phase 2 upgrades). Phase 1 improvements increased the design flow capacity from 1 MGD to 2 MGD.

Phase 2 upgrades are necessary in order to meet the requirements of the District's National Pollutant Discharge Elimination System (NPDES) permit. The current and future permit effluent limitations are shown in the table below

Liberty Lake Sewer and Water District Treatment Plant Effluent Limitations				
	October 2013 - 2020		**2021 and Beyond**	
Parameter	Average Monthly	Average Weekly	Average Monthly	Average Weekly
Flow	2.0 MGD		2.0 MGD	
Biochemical Oxygen Demand	10 mg/L 83 lbs/day	15 mg/L 125.1 lbs/day	5 mg/L Nov 1 - Feb 29	7 mg/L Nov 1 - Feb 29
	Seasonal Average for March 1 to October 31			
Carbonaceous Biochemical Oxygen Demand	-		45 lbs/day	
Total Phosphorus (as P)	0.612 mg/L 7.20 lbs/day		0.050 mg/L 0.45 lbs/day	
Total Ammonia (as NH3-N)	1 mg/L 11.8 lbs/day		2.28 lbs/day June 1 - Sept. 30	8.94 lbs/day March 1 - May 31 Oct. 1 - 31

Purpose of the Pre-Design Report

The purpose of the Pre-Design Report is to develop the basis for the Phase 2 design. The design includes a new filtration building which will house a submerged ultra-fine membrane filtration system, upgrades to the UV disinfection system, and headworks modifications. These upgrades are a necessary step to ensure the District will be in compliance with future DOE NPDES permit requirements. Phase 2 Improvement must be operational by March 1, 2018 to comply with the permit schedule.

Water, Industrial and Domestic Wastewater, Reclaimed Water, Biosolids, Odors and Air Emissions: Treatment Design, Planning, Funding, Studies, Modeling, Operation, Permitting, Management

ESVELT ENVIRONMENTAL ENGINEERING, LLC
7605 EAST HODIN DRIVE, SPOKANE, WA 99212-1816
Phone: 509-926-3049
Fax: 509-922-3073

Project: Liberty Lake Sewer and Water District
Phase 2 Upgrade Design

Tech. Memo: TM-EEE-2 Phase 2 Upgrade Process Design Criteria and Descriptions

Prepared For: Century West Engineering Corporation (CWEC)

Prepared By: Allison Esvelt, MSCE, PE, BCEE
Esvelt Environmental Engineering, LLC

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Date: November 15, 2013

Purpose of Technical Memorandum: The purpose of this technical memorandum is to summarize the process modifications recommended for installing the full phosphorus removal process train required by the District's National Pollutant Elimination Permit System (NPDES) Permit No. WA-0045144 before March 1, 2018. The full phosphorus removal process train includes:

- New chemical feed of coagulant/precipitant (alum or ferric chloride) and alkalinity (sodium hydroxide) and flash mixing ahead of the secondary clarifiers for precipitation and settling of dissolved phosphorus in the clarifiers;
- New chemical feed of coagulant/precipitant (alum or ferric chloride) and alkalinity (sodium hydroxide), rapid mixing, and flocculation ahead of the tertiary filtration system;
- New submerged hollow-fiber ultrafiltration (UF) membrane tertiary filtration system and associated back-pulsing and cleaning systems; and
- New reject pump station to recycle chemical sludge and membrane cleaning water from the filtration system back to the activated sludge treatment system ahead of the secondary clarifiers.

In year 2021, the new seasonal average total phosphorus mass emission rate effluent limitation will come into effect. Depending on the performance of the system, a portion of the treated effluent may be required to be diverted from the Spokane River discharge to reclaimed water applications to meet the new limitation. Therefore, the Phase 2 Upgrade design incorporates provisions for installing additional disinfection for meeting Class A Reclaimed Water Standards for total coliform bacteria.

Effluent Limitations for Discharge to the Spokane River: The effluent limitations for discharge to the Spokane River are summarized in Table TM-EEE-2.1. These effluent limitations are from the District's current NPDES Permit amended October 30, 2013. The upgraded treatment system (Phase 1 and Phase 2) is designed to meet the concentration limitations. The mass (e.g. pounds emitted per day) limitations are dependent on future increases in flow and loadings and may be exceeded at some point in the future, requiring diversion from the Spokane River to reclaimed water applications.

Table TM-EEE-2.1				
	EFFLUENT LIMITATIONS Years 2013 to 2020		**EFFLUENT LIMITATIONS Years 2021 and Beyond**	
Parameter	**Average Monthly**	**Average Weekly**	**Average Monthly**	**Average Weekly**
Flow	2.0 MGD	--	2.0 MGD	--
Biochemical Oxygen Demand (5-day)	10 mg/L; 83 lbs/day	15 mg/L; 125.1 lbs/day	5 mg/L, 83.4 lbs/day as CBOD5 Nov. 1 to Feb. 29	7 mg/L, 116.8 lbs/day as CBOD5 Nov. 1 to Feb. 29
Total Suspended Solids	10 mg/L; 83 lbs/day	15 mg/L; 125.1 lbs/day	5 mg/L, 83.4 lbs/day	7 mg/L, 116.8 lbs/day
Fecal Coliform Bacteria	200 cfu /100 mL	400 cfu /100 mL	200 cfu /100 mL	400 cfu /100 mL
pH	Within or equal to 6.8 to 8.5 S.U.		Within or equal to 7.0 to 8.5 S.U.	
Total PCBs	Future Permit Requirement		Future Permit Requirement	
Parameter	**Average Monthly**	**Maximum Daily**	**Average Monthly**	**Maximum Daily**
Lead (Total Recoverable)	3.7 µg/L	5.4 µg/L	3.7 µg/L	5.4 µg/L
Zinc (Total Recoverable)	80.8 µg/L	117.8 µg/L	80.8 µg/L	117.8 µg/L
Cadmium (Total Recoverable)	76 µg/L	396 µg/L	76 µg/L	396 µg/L
Parameter	**Seasonal Average for March 1 to October 31**		**Seasonal Average for March 1 to October 31**	
Carbonaceous Biochemical Oxygen Demand (5-day) ($CBOD_5$)	-		45.0 lbs/day	
Total Phosphorus (as P)	0.612 mg/L; 7.20 lbs/day		0.050 mg/L; 0.45 lbs/day	
Total Ammonia (as NH_3-N)	1 mg/L; 11.8 lbs/day		2.27 lbs/day June 1 to Sept. 30	8.94 lbs/day March 1 to May 31 and Oct. 1 to 31st

Effluent Limitations for Class A Reclamation Water Applications: The proposed reclaimed water applications (i.e. golf courses or public access wetlands) require the reclaimed water to meet the Water Reclamation and Reuse Standards and the Revised Code of Washington (RCW) 90.46, Reclaimed Water Use, for Class A reclaimed water. The expected reclaimed water quality limitations are summarized in Table TM-EEE-2.2 below.

TM-EEE-2.2 Expected Reclaimed Water Quality Limitations		
Secondary Clarifier Effluent		
Parameter	**Average Monthly**	**Average Weekly**
5-Day Biochemical Oxygen Demand	20 mg/L	30 mg/L
Total Suspended Solids	20 mg/L	30 mg/L
Dissolved Oxygen	Not be less than 0.2 mg/L	
Tertiary Filter Effluent		
Parameter	**Average Monthly**	**Sample Maximum**
Turbidity (Membrane Filtration)	0.2 NTU	0.5 NTU
Disinfected - Reclaimed Water		
Parameter	**Average Monthly**	**Average Weekly**
Total Nitrogen as N	10 mg/L	15 mg/L
	7-day Median	**Sample Maximum**
Total Coliform Bacteria (C.F.U.)	2.2/100 mL	23/100 mL
pH	Within the range of 6.0 – 9.0 S.U.	
Chlorine Residual	Not be less than 0.5 mg/L	
Discharge to Wetlands		
Total Kjeldahl Nitrogen (as N)	3 mg/L	
Total Phosphorus (as P)	1 mg/L	

Influent Design Criteria: Table TM-EEE-2.3 summarizes the projected influent wastewater flows to the District's treatment system for selected years through 2032, the 20-year design projection year. The selected years correspond to specific permit and project related milestones as follows:

- Year 2018: The District must have its new tertiary treatment system installed and operating.
- Year 2021: New seasonal NPDES permit limits are enforced for tertiary treatment system.
- Year 2024: Projected flows are anticipated to reach Phase 2 upgrade tertiary treatment system flow design criteria.
- Year 2028: Projected flows are anticipated to reach existing permitted secondary treatment system flow design criteria.
- Year 2032: This is the twenty-year planning and design projection year from year 2012. The tertiary treatment system is designed to be expanded to treat these design flows with equipment and associated minor piping and electrical additions.

Table TM-EEE-2.3 Projected Influent Wastewater Flows

Year →	**2018**	**2021**	**2024**	**2028**	**2032**
Design Projection Year → (1)	6	9	12	16	20
Annual Average Flow, MGD	1.05	1.24	1.50	1.80	2.29
Maximum Month Flow, MGD	1.16	1.38	1.67	2.00	2.55
Maximum Day Flow, MGD	1.75	2.07	2.50	3.00	3.82
Peak Flow, MGD	2.33	2.76	3.33	4.00	5.09

Notes:
(1) Years projected from the year the Engineering Report Update was approved in 2012.
(2) MGD = Million Gallons Per Day

EPA Reliability and Redundancy Requirements: The treatment system will be designed to meet Class I Reliability Requirements in accordance with Environmental Protection Agency (EPA) Technical Bulletin EPA-430-99-74-001, Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability. Table TM-EEE-2.4 provides a list of the Class I Reliability Requirements and the plan to meet the requirements during each phase of expansion.

Table TM-EEE-2.4 Final Treatment Building Unit Process Reliability Requirements

General Requirements	**Class I Reliability Requirement[1]**	**Plan to Meet Requirement Phase 2 (Year 2024)**	**Plan to Meet Requirement Phase 3 (Year 2032)**
Unit Operation Bypassing			
Membrane Filtration System	The design of the wastewater treatment system shall include provisions for bypassing around each unit operation except for unit operations with two or more open basins. The bypassing system shall provide control of the diverted flow such that only a portion of the flow in excess of the hydraulic capacity of the units in service are bypassed.	The design will include provisions for a gravity overflow from the membrane filtration system tanks to the reject pump station for recycling the flow back to the treatment system in case of system or train shutdown. The design will also include provisions for automatically bypassing the membrane filtration system when the flow to the system exceeds the Phase 2 design peak flow. The minimum capacity of the bypass overflow will be the Phase 2 design peak flow.	Same as for Phase 2, except the design will include provisions for automatically bypassing the membrane filtration system when the flow to the system exceeds the Phase 3 design peak flow. The minimum capacity of the bypass overflow will be the Phase 3 design peak flow.

[1] Environmental Protection Agency, Technical Bulletin EPA-430-99-74-001, "Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability, 1974.

Table TM-EEE-2.4 Final Treatment Building Unit Process Reliability Requirements			
General Requirements	**Class I Reliability Requirement[1]**	**Plan to Meet Requirement Phase 2 (Year 2024)**	**Plan to Meet Requirement Phase 3 (Year 2032)**
Component Backup Requirements			
In-Line Strainers	Unit operations in the main wastewater treatment system shall be designed such that, with the largest flow capacity unit out of service, the hydraulic capacity of the remaining units (and piping between units) shall be sufficient to handle the peak wastewater flow. There shall be system flexibility to enable the wastewater flow to any unit out of service to be distributed to the remaining units in service.	A minimum of 3 strainers will be installed. With one strainer out of service, the minimum hydraulic capacity of the remaining strainers will be the Phase 3 design peak flow.	Same as for Phase 2.
Flash Mixing		A minimum of 3 flash mixers and tanks will be installed. With one mixer/tank out of service, the minimum hydraulic capacity of the remaining mixers/tanks will be the Phase 3 design peak flow.	Same as for Phase 2.
Flocculation		A minimum of 3 flocculators and tanks will be provided. With one flocculator and tank out of service, the minimum hydraulic capacity of the remaining flocculators/tanks will be the Phase 2 design peak flow.	A minimum of 4 flocculators and tanks will be provided. With one flocculator and tank out of service, the minimum hydraulic capacity of the remaining flocculators/tanks will be the Phase 3 design peak flow.
Membrane Filtration System		A minimum of 3 trains will be provided. With one train out of service, the minimum hydraulic capacity of the remaining train(s) will be the Phase 2 design peak flow.	A minimum of 4 trains will be provided. With one train out of service, the minimum hydraulic capacity of the remaining train(s) will be the Phase 3 design peak flow.
UV Disinfection System Channels		Two UV channels will be provided, Both shall be capable of disinfecting the filtered effluent to the Phase 2 design peak flow to the Spokane River discharge limitations. Only one of the channels will have enough modules for disinfection of the Phase 2 design peak flow to Class A reclaimed water standards. If insufficient modules are on-line for disinfection to Class A reclaimed water standards at operating flows, the reclaimed water pump station will be automatically shut down and the disinfected effluent will automatically overflow to the Spokane River discharge.	Same as for Phase 2, except both shall be capable of disinfecting the filtered effluent to the Phase 3 design peak flow to the Spokane River discharge limitations.
UV Disinfection System Modules		The UV system shall be capable of treating the Phase 2 design peak hourly flow with one module out of service in each channel.	The UV system shall be capable of treating the Phase 3 design peak hourly flow with one module out of service in each channel.
Backup Pumps			
Membrane Permeate Pumps	A backup pump shall be provided for each set of pumps that performs the same function. The capacity of the pumps shall be such that with any one pump out of service, the remaining pumps will have the capacity to handle the peak flow.	A minimum of 3 pumps will be provided. With one pump out of service, the minimum hydraulic capacity of the remaining pumps will be the Phase 2 design peak flow.	A minimum of 4 pumps will be provided. With one pump out of service, the minimum hydraulic capacity of the remaining pumps will be the Phase 3 design peak flow.
Reject/Drain Pumps		A minimum of 3 pumps will be provided. With one pump out of service, the minimum hydraulic capacity of the remaining pumps will be the Phase 2 design peak flow.	A minimum of 4 pumps will be provided. With one pump out of service, the minimum hydraulic capacity of the remaining pumps will be the Phase 3 design peak flow.
Backpulse Pumps		A minimum of 2 pumps will be provided, each capable of pumping the required total design flow.	Same as for Phase 2.
CIP Pumps		A minimum of 2 pumps will be provided, each capable of pumping the required total design flow.	Same as for Phase 2.
Chemical Feed Pumps		A minimum of 2 chemical feed pumps will be provided for each chemical feed system, each capable of pumping the required total design flow.	Same as for Phase 2.

Table TM-EEE-2.4 Final Treatment Building Unit Process Reliability Requirements			
General Requirements	**Class I Reliability Requirement[1]**	**Plan to Meet Requirement Phase 2 (Year 2024)**	**Plan to Meet Requirement Phase 3 (Year 2032)**
Utility Water Pumps	A backup pump shall be provided for each set of pumps that performs the same function. The capacity of the pumps shall be such that with any one pump out of service, the remaining pumps will have the capacity to handle the peak flow.	A minimum of 2 pumps will be provided, each capable of pumping the required total design flow.	Same as for Phase 2.
Reclaimed Water Pumps		A redundant pump will be provided, equal in capacity to the largest pump in service.	Same as for Phase 2.
Auxiliary Systems			
Air Compressors for Instrument Air, Pneumatic Chemical Feed Pumps, and Integrity Testing	If a malfunction of the system can result in a controlled diversion or a violation of the effluent limitations, and the required function cannot be done by any other means, then the system shall have backup capability in the number of vital components (i.e., pumps, motors, mechanical stirrers) required to perform the system function.	A minimum of two compressors will be provided, each capable of supplying the maximum required airflow and pressure.	Same as for Phase 2.
Blowers for Membrane Cleaning		A minimum of two blowers will be provided, each capable of supplying the maximum required airflow and pressure.	Same as for Phase 2.

Notes:
(1) Environmental Protection Agency, Technical Bulletin EPA-430-99-74-001, "Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability, 1974.

Water Reclamation and Reuse Standard Reliability Requirements: In addition to the EPA reliability requirements, 1997 Washington State Water Reclamation and Reuse Standards[2] require general design and reliability requirements. Table TM-EEE-2.5 provides a list of these requirements and the plan to meet these requirements.

Table TM-EEE-2.5. Compliance with Reclaimed Water System General Design and Reliability Requirements	
Requirement[2]	**Plan to Meet Requirement**
Article 10. General Requirements of Design	
Section 1. Flexibility of Design	
The design of process piping, equipment arrangement, and unit structures in the reclamation plant must allow for efficiency and convenience in operation and maintenance and provide flexibility of operation to permit the highest possible degree of treatment to be obtained under varying circumstances.	The design of process piping, equipment arrangement, and unit structures in the reclamation plant will allow for efficiency and convenience in operation and maintenance and provide flexibility of operation. EPA Reliability and Redundancy Requirements for Class 1 Publicly Owned Treatment Works (POTW) will be followed.
Section 2. Alarms	
(a) Alarms required for various unit processes as specified in other sections of these regulations shall be installed to provide warning of: (1) Loss of power from the normal power supply; (2) Failure of a biological treatment process; (3) Failure of a disinfection process; (4) Failure of a coagulation process; (5) Failure of a filtration process; and (6) Any other specific process failure for which warning is required by the Washington Departments of Health and Ecology.	Alarms will be provided to the plant Programmable Logic Controllers (PLCs), Supervisory Control and Data Acquisition (SCADA) System, and autodialer for the alarms specified.
(b) All required alarms shall be independent of the normal power supply of the reclamation plant.	The SCADA System and PLCs are provided with Uninterruptible Power Supply (UPS) units and surge suppression. In addition, the standby power system will provide power for all control, communication, and alarm systems.
(c) The person to be warned shall be the plant operator, superintendent, or other responsible person designated by the management of the reclamation plant and capable of taking prompt corrective action.	The existing autodialer is capable of being pre-programmed with multiple phone numbers and automatically dialing the appropriate personnel in a pre-selected order until the required contact is made.

[2] Washington State Department of Health and Department of Ecology, *Water Reclamation and Reuse Standards*, Publication No. 97-23, September 1997.

Table TM-EEE-2.5. Compliance with Reclaimed Water System General Design and Reliability Requirements	
Requirement[2]	**Plan to Meet Requirement**
(d) Individual alarms may be connected to a master alarm to sound at a location where it can be conveniently observed by the attendant. Where the reclamation plant is not attended full time, the alarm(s) shall be connected to sound at a police station, fire station or other full-time service unit with which arrangements have been made to alert the person in charge at times that the reclamation plant is unattended.	The plant control system will be provided with an alarm annunciator connected to an audible device that will be capable of sounding in case of a pre-designated alarm condition. The alarm shall be connected to the autodialer which shall alert designated on-call District personnel when the plant is unattended.
Section 3. Power Supply	
The power supply shall be provided with one of the following reliability features: (1) Alarm and standby power source. (2) Alarm and automatically actuated short-term storage or disposal provisions as specified in Article 12, Section 1. (3) Automatically actuated long-term storage or disposal provisions as specified in Article 12, Section 1.	The power supply shall be provided with an alarm and standby power source. Standby generators shall be provided with a combined minimum capacity to meet the Phase 2 (and beyond) standby power requirements of the plant. At minimum, the standby generators are adequate to provide capacity to all biological treatment, sedimentation, coagulation, filtration, and disinfection unit processes at full loadings, minus standby units where applicable, control and alarms systems, and necessary support systems for protection of public and operator health and safety (heating, lighting, ventilation).
Section 4. Storage, Where No Approved Alternative Disposal System Exists	
(a) Where no alternative disposal system is permitted, system storage or other acceptable means shall be provided to assure the retention of reclaimed water under adverse weather conditions or at other times when reuse is precluded.	The treatment system is permitted to discharge to the Spokane River in the event that the discharge does not meet reclaimed water standards for turbidity, total nitrogen, and total coliform.
(b) When wet weather conditions preclude the use of reclaimed water, the system storage volume shall be established by determining the storage period that would be required for the duration of a 10-year storm, using weather data that is available from, or is representative of, the area involved. A minimum of 20 years of climatic data shall be used in storage volume determinations.	Wet weather conditions would not preclude discharge to the Spokane River.
(c) At a minimum, system storage capacity shall be the volume equal to three times that portion of the average daily flow of reuse capacity for which no alternative reuse or disposal system is permitted.	Discharge to the Spokane River is the permitted alternative disposal system; therefore, this requirement does not apply.
Article 11. Alternative Reliability Requirements	
Section 1. Emergency Storage or Disposal	
(a) Where short-term storage or disposal provisions are used as a reliability feature, these shall consist of facilities reserved for the purpose of storing or disposing of untreated or partially treated wastewater for at least a 24-hour period. The facilities shall include all the necessary diversion works, provisions for odor control, conduits, and pumping and pump back equipment. All of the equipment other than the pump back equipment shall be either independent of the normal power supply or provided with a standby power source.	Short-term storage or disposal provisions are not required to meet reliability requirements.
(b) Where long-term storage or disposal provisions are used as a reliability feature, these shall consist of ponds, reservoirs, percolation areas, downstream sewers leading to other treatment or disposal facilities or any other facilities reserved for the purpose of emergency storage or disposal of untreated or partially treated wastewater. These facilities shall be of sufficient capacity to provide disposal or storage of wastewater for at least 20 days, and shall include all the necessary diversion works, provisions for odor and nuisance control, conduits, and pumping and pump back equipment. All of the equipment other than the pump back equipment shall be either independent of the normal power supply or provided with a standby power source.	Provisions shall be provided for diverting flow to Spokane River outfall in the event that the discharge does not meet reclaimed water standards for turbidity, total nitrogen, and total coliform.
(c) Diversion to a different type of reuse is an acceptable alternative to emergency disposal of partially treated wastewater provided that the quality of the partially treated wastewater is suitable for that type of reuse.	Depending on the final reclaimed water uses, diversion of Class A reclaimed water from constructed wetlands to landscape irrigation may be implemented in the unlikely event the reclaimed water does not meet wetlands standards for total phosphorus and TKN.
(d) Subject to prior approval by the Washington Departments of Health and Ecology, diversion to a discharge point where the wastewater meets all discharge requirements is an acceptable alternative to emergency disposal of partially treated wastewater.	Provisions shall be provided for diverting flow to the Spokane River outfall in the event that the discharge does not meet reclaimed water standards for turbidity, total nitrogen, and total coliform.

Table TM-EEE-2.5. Compliance with Reclaimed Water System General Design and Reliability Requirements	
Requirement[2]	**Plan to Meet Requirement**
(e) Automatically actuated short-term storage or disposal provisions and automatically actuated long-term storage or disposal provisions shall include, in addition to provisions of (a), (b), (c), or (d) of this section, all the necessary sensors, instruments, valves, and other devices to enable fully automatic diversion of untreated or partially treated wastewater to approved emergency storage or disposal in the event of failure of the treatment process, and a manual reset to prevent automatic restart until the failure is corrected.	Automatically actuated long-term disposal will include automatic gravity diversion to the Spokane River outfall in the event flow to the filtration system is prevented, the reclaimed water pump station is shut-down, or the hydraulic capacity of conduits is exceeded. Alarms will be actuated in the event of diversion. Alarm conditions that prevent operations of treatment system components will be manual reset only, preventing the automatic restart of equipment until the failure condition is corrected.
Section 2. Biological Treatment	
All biological treatment unit processes shall be provided with one of the following reliability features: (1) Alarm and multiple biological treatment units capable of producing oxidized wastewater with one unit not in operation; (2) Alarm, short-term storage or disposal provisions, and standby replacement equipment; (3) Alarm and long-term storage or disposal provisions; or (4) Automatically actuated long-term storage or disposal provisions.	The existing biological treatment system is provided with an alarm, multiple biological treatment processes capable of producing oxidized wastewater with one unit not in operation, standby replacement equipment, and standby power. An installed standby blower is provided for the aeration basins.
Section 3. Secondary Sedimentation	
All secondary sedimentation unit processes shall be provided with one of the following reliability features: (1) Multiple sedimentation units capable of treating the entire flow with one unit not in operation; (2) Standby sedimentation unit process; or (3) Long-term storage or disposal provisions.	The existing treatment system is provided with multiple secondary sedimentation units (clarifiers) capable of treating the entire flow with one unit not in operation. Return and waste sludge pump systems are provided with standby pumps.
Section 4. Coagulation	
(a) All coagulation unit processes shall be provided with the following features for uninterrupted chemical feed: (1) Standby feeders; (2) Adequate chemical storage and conveyance facilities; (3) Adequate reserve chemical supply; and (4) Automatic dosage control.	The coagulant feed systems will be provided with standby feeders (multiple feed pumps) capable of treating the design peak flow with one unit not in operation. The chemical feed storage will be adequate for minimum 30 days of supply. The chemical feed pumps will be provided with variable speed drives capable of being automatically adjusted in proportion to flow for automatic dosage control.
(b) All coagulation unit processes shall be provided with one of the following reliability features: (1) Alarm and multiple coagulation units capable of treating the entire flow with one unit not in operation; (2) Alarm, short-term storage or disposal provisions, and standby replacement equipment; (3) Alarm and long-term storage or disposal provisions; (4) Automatically actuated long-term storage or disposal provisions; or (5) Alarm and standby coagulation unit process.	The coagulant feed, flash mixing, and flocculation systems will be provided with an alarm and multiple units capable of treating the entire design peak flow with one unit not in operation. The system will also be provided with alarm and long-term disposal provisions.
Section 5. Filtration	
All filtration unit processes shall be provided with one of the following reliability features: (1) Alarm and multiple filter units capable of treating the entire flow with one unit not in operation; (2) Alarm, short-term storage or disposal provisions and standby replacement equipment; (3) Alarm and long-term storage or disposal provisions; (4) Automatically actuated long-term storage or disposal provisions; or (5) Alarm and standby filtration unit process.	The filtration system will be provided with an alarm and multiple filter units capable of treating the entire design peak flow with one unit not in operation. In addition, it will also be provided with an alarm and automatic diversion to long-term disposal provisions. If the level in one or more of the membrane tanks reaches overflow level, the membrane feed will overflow to the reject pump station and be recycled back to the treatment system ahead of the secondary clarifiers. The reject pump station is capable of pumping the design peak flow with one pump not in operation. In the unlikely event the water level continues to rise above the tank overflow level, secondary effluent will overflow to the UV disinfection system downstream of the clarifiers, bypassing the filtration system.
Section 6. Disinfection	
(a) All disinfection unit processes where chlorine is used as the disinfectant shall be provided with the following features for uninterrupted chlorine feed. (1) Standby chlorinator; (2) Standby chlorine supply; (3) Manifold systems to connect chlorine cylinders (4) Chlorine Scales; (5) Automatic switchover to full chlorine cylinders; and (6) Continuous measuring and recording of chlorine residual.	Ultraviolet (UV) light, not chlorine, will be the primary disinfectant. Liquid sodium hypochlorite will be metered into the reclaimed water pump station discharge to maintain a residual in the reclaimed water distribution system. A standby feed pump will be provided. The feed pumps will be provided with variable speed drives capable of being automatically adjusted in proportion to flow to maintain a target dose.

Table TM-EEE-2.5. Compliance with Reclaimed Water System General Design and Reliability Requirements	
Requirement[2]	**Plan to Meet Requirement**
(b) All disinfection unit processes where chlorine is used as the disinfectant shall be provided with one of the following reliability features. (1) Alarm and standby chlorinator; (2) Alarm, short-term storage or disposal provisions, and standby (4) replacement equipment; (3) Alarm and long-term storage or disposal provisions; (4) Automatically actuated long-term storage or disposal provisions; or (5) Alarm and multiple point chlorination. Each point of chlorination shall have an independent power source, separate chlorinator, and separate chlorine supply.	Primary disinfection process will be UV light. Sodium hypochlorite will be used to maintain a residual in the reclaimed water distribution system. An alarm and automatic shut-down of the reclaimed water pump station will be provided in the event of a feed pump failure. Shut-down of the reclaimed water pumps will cause an automatic diversion to long-term disposal provisions. A standby feed pump will be provided.
(c) All other disinfection unit processes shall be provided with one of the following reliability features: (1) Alarm and standby disinfection unit capable of treating the design flow rate with the largest operating unit out of service; (2) Alarm, short-term storage or disposal provisions, and standby replacement equipment; (3) Alarm and long-term storage or disposal provisions; and (4) Automatically actuated long-term storage or disposal provisions.	The UV disinfection system will be provided with an alarm and standby disinfection unit (a standby redundant UV module) capable of treating the peak design flow with the largest operating unit (one module) out-of-service. The UV transmittance of the reclaimed water (UVT) and membrane permeate flow will be monitored and used to calculate the UV lamp output intensity required to maintain the preset UV dose. All modules will be controlled to maintain the preset dose. The standby modules will be automatically initiated to maintain the required dose. If the total number of lamps available does not meet the dose requirements, an alarm and automatic shut-down of the reclaimed water pump station will be provided. Shut-down of the reclaimed water pumps will cause an automatic diversion to long-term disposal provisions.

Unit Process Design Criteria: The preliminary unit process design criteria for the proposed treatment system upgrades are listed in table TM-EEE-2.6. The proposed process modifications for the Phase 2 Upgrade are designed to meet the projected influent wastewater flows through year 2024 with minor equipment additions to comply with increased influent wastewater flows through year 2032 (Phase 3).

Drawings OP2 and OP3 are the process schematic and hydraulic profile for the proposed system and are attached to this technical memorandum.

The following requirements have been incorporated into the unit process design criteria for the membrane filtration system:

1. The membrane filtration system is to be sized for the peak flux and flow with one train and one permeate pump out of service.
2. The design conditions are met assuming that one train is intermittently out of service for a routine back-pulsing or maintenance clean, and an additional tank is out of service for recovery chemical cleaning.
3. Redundant equipment is to be provided for all major equipment furnished with the system including back-pulse pumps, clean-in-place pumps, chemical feed pumps, blowers, and compressors.
4. All support systems are to be suitable for future expanded peak flow (Phase 3) – back-pulse pumping system, clean-in-place system, air scour system, compressed air system, and electrical and control systems.

Table TM-EEE-2.6 Unit Process Design Criteria		
Parameter	**Phase 2 Upgrade**	**Phase 3 (Future)(1)**
Design Year	2024	2032
Average Design Flow, MGD	1.5	2.3
Maximum Day Design Flow, MGD	2.5	3.8
Peak Design Flow, MGD	3.33	5.09

Table TM-EEE-2.6 Unit Process Design Criteria		
Chemical Mixer ahead of Clarifiers (Q-SB-1)		
Number of Mixers	1	
Type (2)	In-line	
Diameter, Inches	36	
Peak Flow with 150% RAS, MGD (from AB3 and 4 only)	4.5	6.8
Velocity Gradient, s^-1	1000 - 2000	
Detention Time, s	<10	
Power Required, HP	<3	
Automatic Strainers (Q-FB-S1,-S2,-S3)		
Type	In-line, Automatic	
Number of Strainers (1 Standby)	3	
Flow Range Per Strainer (1 Out of Service), MGD	0.8 to 3.5	1.2 to 4.4
Strainer Opening Size, µm	500	
Size, Inches	18	
Pressure Differential, Maximum, PSI	0.1	
Coagulant Feed Pumps (P-FB-CAS-1,-2,-3(Future))		
Type of Chemical	Alum	
Number of Bulk Storage Tanks	1	
Bulk Storage Tank Volume, Gallons	6,000	
Bulk Solution Concentration	48%	
Dose Range, mg/L	80 - 120	
Number of Pumps (1 Standby)	2	3
Type	Peristaltic Hose	
Flow, GPH, Each	2.5 – 25	
Maximum Discharge Pressure, PSIG	100	
Coagulant Flow Meters (M-FB-CAS-1,-2,-3 (Future))		
Type	Magnetic	
Number (1 Standby)	2	3
Calibration Range, 4-20 mA, GPH	0 - 25	
Alkalinity Feed Pumps (P-FB-CSH-1,-2)		
Type of Chemical	Sodium Hydroxide	
Maximum Dose, mg/L	35	
Number of Pumps (1 Standby)	2	
Type	Peristaltic	
Flow, GPH, Each	1 - 10	
Maximum Discharge Pressure, PSIG	100	
Alkalinity Flow Meters (M-FB-CSH-1,-2)		
Type	Magnetic	
Number (1 Standby)	2	
Calibration Range, 4-20 mA, GPH	0 - 10	
Flash Mixers (Q-FB-M1,-M2,-M3)		
Number of Tanks (1 Standby)	3	
Flow Range Per Tank (1 Out of Service), MGD	0.8 to 3.5	1.2 to 4.4
Detention Time, Seconds	40 - 160	30 - 110
Basin Volume at HWL, Gallons	1,570	
Tank Dimensions, L x W, Feet	7 x 5	
Tank Operating Depth, Feet	5 - 6	
Number of Mixers (1 Standby)	3	
Type	Vertical, Axial Flow	
Velocity Gradient, s^-1	>500	
Flocculators (Q-FB-F1,-F2,-F3,-F4 (Future))		
Number of Tanks (1 Standby)	3	4
Flow Range Per Tank (1 Out of Service), MGD	0.8 to 3.5	0.8 to 2.9
Detention Time, Minutes	8 - 13	
Basin Volume at HWL, Gallons	7,355	
Tank Dimensions, L x W, Feet	10	
Tank Operating Depth, Feet	8’-10” to 9’-10”	

Table TM-EEE-2.6 Unit Process Design Criteria		
Number of Flocculators (1 Standby)	3	4
Type	Vertical, Axial Flow	
Velocity Gradient, s^-1	50 - 80	
Variable Speed Range, RPM	3 - 33	
MF Common Feed Turbidity Analyzer		
Number	1	
Calibration Range, 4-20 mA, NTU	0 – 100	
MF Common Feed pH Analyzer		
Number	1	
Calibration Range, 4-20 mA, S.U.	0 - 14	
Membrane Filtration Units		
Feed Total Suspended Solids (excluding alum), mg/L	5 - 15	
Feed pH, S.U.	6.5 to 8.5	
Average Permeate Turbidity, NTU	0.2	
Maximum Permeate Turbidity, NTU	0.5	
Average Permeate Total Phosphorus, µg/L	50	
Type of Membrane	ZeeWeed® 500d	
Module Operating Process	Vacuum, Submerged, Ultrafiltration	
Membrane Type	Hollow Fiber	
Filtration Direction	Outside to Inside	
Backwash Type	Air-Scour with Liquid Backpulse	
Membrane Material	PVDF	
Nominal Pore Size, µm	0.04	
Fiber Diameter	1.9 mm OD / 0.8 mm ID	
Maximum Operating TMP, PSI	-8 to 8	
Feed Water pH Range Requirement, S.U.	5 - 9.5	
Feed Water Temperature Range Requirement, deg C/deg F	10 – 40 deg C / 50 – 104 deg F	
Peak Output at 10 deg C With One Train Off-line (< 24 Hours), MGD	3.33	5.09
Peak Flux, GFD at 10 deg C, One Train Off-line (< 24 Hours)	17	
Number of Membrane Trains On-line	3	4
Number of Cassettes Installed Per Train	4	4
Total Number of Installed Cassettes	12	16
Number of Modules per Cassette (Out of 64 Spaces)	56	56
Total Number of Installed Modules	672	896
Nominal Membrane Area Per Module, SQFT	440	
Spare Space	13%	
Membrane Tank Dimensions (ft L x W x H)	36 x 10 x 10.5	
Tank Operating Depth, Feet	8’-10” to 9’-10”	
Design Recovery, Minimum	90%	
MF Instrument/Test Compressed Air System		
Air Hold Test Interval, Hours	24	
Air Hold Test Regulator Setpoint, PSI	11	
Air Hold Test Duration, Minutes	5	
Air Hold Test Air Flow Per Train, SCFM	25-30	
MF Instrument/Test Air Compressors (Q-FB-IA-1,-2)		
Number (1 Standby)	2	
Type	Rotary Screw	
Air Flow at 150 PSIG, CFM	54	
Air Flow Required for Pneumatic Pumps, SCFM	3	
Air Flow Required for Pneumatic Valves, SCFM	4	
Air Flow Required for Integrity Testing, SCFM at 80 PSIG	13.5	
Air Receiver Size, Gallons	500	

Table TM-EEE-2.6 Unit Process Design Criteria		
MF Instrument/Test Air Dryers		
Number (1 Standby)	2	
Type	Refrigerated	
Capacity, CFM	54	
MF Instrument/Test Air Filters		
Number (1 Standby)	2	
Type	Coalescing	
Capacity, CFM	54	
Backpulse Pumps (P-FB-BP-1,-2,-3)		
Backpulse Interval, Minutes	15 - 60	
Backpulse Duration, Seconds	15	
Backpulse Flux, GFD	15 - 35	
Number of Pumps (1 Standby)	2	3
Type	End-Suction Centrifugal	
Flow, GPM, Each	1,000 – 2,500	
Backpulse Flow Meter (M-FB-BP-1)		
Number	1	
Type	Magnetic	
Calibration Range, 4-20 mA, GPM	0 – 3,000	
Backpule Tank		
Volume, Gallons	5,000	
MF Blowers (Q-FB-AIR-1,-2)		
Air Scour Interval Per Train, Hours	15 - 60	
Air Scour Duration Per Train Per Day, Minutes	15 - 60	
Air Scour Blower Air Flow Per Module, Maximum, SCFM	8.9	
Air Scour Blower Air Flow Per Cassette, Maximum, SCFM	570	
Number of Blowers (1 Standby)	2	
Type	Rotary, Positive-Displacement	
Air Scour Blower Air Flow Per Train, Maximum, SCFM	2,280	
MF Blowers Air Flow Meter (M-FB-AIR-1)		
Number (1 Standby)	2	
Meter Type	Insertion Thermal Mass Flow Meters	
Calibration Range, 4-20 mA, SCFM	0 – 2,500	
MF Blowers Air Pressure Transmitter		
Number	2	
Calibration Range, 4-20 mA, PSI	0 - 15	
MF Train Level Transmitters		
Number	3	4
Calibration Range, 4-20 mA, Feet	0 – 14	
MF Train Permeate Turbidity Analyzers		
Number	3	4
Calibration Range, 4-20 mA, NTU	0 – 10	
MF Train Permeate Pressure Transducers		
Number	3	4
Calibration Range, 4-20 mA, PSI	-15 – 15	
MF Permeate Pumps (P-FB-MFE-1,-2,-3, (-4 Future))		
Number of Pumps (1 Standby)	3	4
Type	End-Suction Centrifugal	
Flow, GPM, Each	400 - 1,200	
MF Permeate Flow Meter (M-FB-MFE-2,-3,-4, (-5 Future))		
Number of Meters	3	4
Type	Magnetic	
Flow, GPM, Each	0 - 1,500	

Table TM-EEE-2.6 Unit Process Design Criteria		
MF Common Permeate Flow Meter (M-FB-MFE-1)		
Number of Meters	1	
Type	Magnetic	
Calibration Range, 4-20 mA, GPM	0 – 4,000	
MF Common Permeate Turbidity Analyzers		
Number (1 Standby)	2	
Calibration Range, 4-20 mA, NTU	0 – 10	
MF Common Permeate pH Analyzer		
Number	1	
Calibration Range, 4-20 mA, S.U.	0 - 14	
MF Common Permeate Temperature Transmitter		
Number	1	
Calibration Range, 4-20 mA, deg C	0 - 50	
MF Maintenance Clean Procedure		
MW Interval, Hours	24	
MW Duration, Minutes	40-120	
MW Chemical	Sodium Hypochlorite	
MW Temperature, deg. C	10 - 26	
MW Sodium Hypochlorite Concentration, %	0.01 (100 mg/L)	
MW CIP Pump Run Duration Per Train Per Day, Minutes	70	
MW Sodium Hypochlorite Feed Pump Run Duration, Minutes	5	
MW 12.5% Sodium Hypochlorite Usage Per MW, Gallons	13.5	
MW 38% Sodium Bisulfite Usage Per MW, Gallons	3.2	
MF Recovery Clean In Place (CIP) Procedure		
CIP Interval, Days	30	
CIP Duration, Hours	5-8	
CIP Chemicals	Citric Acid followed by Hypochlorite	
CIP Citric Acid Concentration, %	0.2 (2,000 mg/L)	
CIP Citric Acid Temperature, deg. C	35-40	
CIP Pump Run Duration Per Train Per Day, Minutes	70	
CIP Citric Acid Chemical Feed Pump Run Duration, Minutes	5	
CIP 50% Citric Acid Usage Per CIP, Gallons	52.3	
CIP Neutralization Chemical	Sodium Hydroxide	
CIP Sodium Hydroxide Feed Pump Run Duration, Minutes	0.5 - 15	
CIP 50% Sodium Hydroxide Usage Per CIP, Gallons	18.5	
CIP Sodium Hypochlorite, %	0.05% (500 mg/L)	
CIP Chlorination Temperature, deg C	35 - 40	
CIP Pump Run Duration Per Train Per Day, Minutes	70	
CIP Sodium Hypochlorite Feed Pump Run Duration, Minutes	5	
CIP 12.5% Sodium Hypochlorite Usage Per CIP, Gallons	67.5	
CIP Dechlorination Chemical	Sodium Bisulfite	
CIP Sodium Bisulfite Feed Pump Run Duration, Minutes	3-15	
CIP 38% Sodium Bisulfite Usage Per CIP, Gallons	16.2	
MF Clean-In-Place (CIP) Pumps (P-FB-CIP-1,-2)		
CIP (Recirculation) Pump Number (1 Standby)	2	
Type	End-Suction, Centrifugal	
Flow, GPM, Each	3,240	
MF CIP Flow Meter (M-FB-CIP-1)		
Type	Magnetic	
Calibration Range, 4-20 mA, GPM	0-3,500	
MF CIP Chlorine Residual Analyzer		
Number	1	
Calibration Range, 4-20 mA, mg/L	0 – 1,000	
MF CIP pH Analyzer		
Number	1	
Calibration Range, 4-20 mA, S.U.	0 – 14	

Table TM-EEE-2.6 Unit Process Design Criteria		
MF CIP Temperature Transmitter		
Number	1	
Calibration Range, 4-20 mA, deg C	0 – 60	
MF CIP/Neutralization Tank		
Material	FRP	
Tank Volume, Gallons	28,000	
MF CIP Water Heater		
Type	In-Line	
Size, KW	210	
MF CIP/Neutralization Tank Level Transducer		
Type	Pressure Transducer	
Calibration Range, 4-20 mA, FT	0 - 25	
MF CIP Chemical Feed Pumps		
Number of Pumps (1 Standby for Each Chemical)	8	
Type	Air-Operated, Diaphragm	
Sodium Hypochlorite (12.5%) Feed Rate, GPM	13.5	
Citric Acid (50%) Feed Rate, GPM	10.4	
Hydrochloric Acid (33%) Feed Rate, GPM	3.6	
Sodium Hydroxide (50%) Feed Rate, GPM	1.25	
Sodium Bisulfite (38%) Feed Rate, GPM	1.08	
MF CIP Bulk Chemical Feed Tanks		
Number	5	
Material	HDXLPE	
Acid, NaOH, $NaHSO_3$ Feed Tank Size, Gallons	500	
Sodium Hypochlorite Feed Tank, Size, Gallons	1,000	
MF CIP Chemical Flow Meters		
Number	5	
Type	Magnetic	
Calibration Range, 4-20 mA, GPM	0 – 15.0	
Reject/Drain Pumps (P-FB-DP-1,-2,-3,-4 (Future))		
Number of Pumps (1 Standby)	3	4
Type	Self-Priming, End-Suction, Centrifugal	
Flow, GPM, Each	600 – 1,250	
Reject/Drain Pump Station Flow Meter (M-FB-DP-1)		
Type	Magnetic	
Calibration Range, 4-20 mA, GPM	0 – 4,000	
Utility Water Pumps (P-FB-WU-1,-2)		
Number of Pumps (Lead, Lag)	2	
Type	End-Suction, Centrifugal	
Flow, GPM, Each	50	
Operating Discharge Pressure, PSI	90 - 100	
Utility Water Pump Station Flow Meter (M-FB-WU-1)		
Type	Magnetic	
Calibration Range, 4-20 mA, GPM	0 - 120	
Utility Water Pump Pressure Transmitter		
Type	In-Line	
Calibration Range, 4-20 mA, PSI	0 - 150	
UV Disinfection Modules (Existing for Spokane River Discharge) (Q-FB-UV1-1,-2,-3,-4,-5,-6)		
Peak Design Flow, MGD	3.33	
Number of Modules for Discharge to Spokane River (1 Standby)	6	
Flow Per Module, Approximate, MGD/Module	0.75	
Type	Low Pressure, Low Intensity, Vertical	
Number of Channels (1 for Spokane River Discharge)	1	

Table TM-EEE-2.6 Unit Process Design Criteria		
Channel Length, Each, Feet	60	
Channel Width, Feet	2'-1/2"	
Side Water Depth, Inches	58 - 62	
Number of Lamps Per Module	40	
Effluent Fecal Coliform, CFU/100 ml, Monthy Geom. Mean	200	
Effluent Fecal Coliform, CFU/100 ml, Weekly Geom. Mean	400	
UV Wavelength, nm (90 %)	253.7	
Minimum UV Dose Required, μW-s/cm^2 (mJ/cm^2)	36,800	
Minimum UV Transmittance for Dose, %	60	
Module Power Consumption, KW	3	
Lamp Output, UVC Watts	26.7	
Lamp Output Factor, Fp	0.7	
Lamp Fouling Factor, Ft	0.7	
Level Control Weir Length, Feet	60	
UV Disinfection Modules (New for Reuse) (Q-FB-UV2-1,-2,-3,-4,-5,-6,-7,-8)		
Peak Design Flow, MGD	3.33	5.1
Number of Modules for Discharge to Spokane River (1 Standby)	8	11
Flow Per Module, Approximate, MGD/Module	0.5	
Type	High Intensity, Low Pressure, Vertical	
Number of Channels (1 for Reclaimed Water System)	1	
Channel Length, Each, Feet	63	
Channel Width, Feet	2'-1/2"	
Side Water Depth, Inches	58 to 62	
Number of Lamps Per Module	40	
Effluent Total Coliform, CFU/100 ml, 7-Day Median	2.2	
Effluent Total Coliform, CFU/100 ml, Maximum	23	
UV Wavelength, nm (90 %)	253.7	
Minimum UV Dose Required, μW-s/cm^2 (mJ/cm^2)	80	
Minimum UV Transmittance for Dose, %	65	
Module Power Consumption, KW	6.88	
Lamp Output, UVC Watts	52	
Lamp Output Factor, Fp	0.9	
Lamp Fouling Factor, Ft	0.8	
UV System Level Transducer		
Type	Ultrasonic	
Calibration Range, 4-20 mA, Inches	0 - 68.5	
UV Transmittance Analyzer		
Type	Photometer	
Calibration Range, 4-20 mA, %	0 - 100	
Level Control Weir		
Level Variation, Inches	2	
Flow Range, MGD	0 – 5.1	
UV System Air Scour Blower (Q-F-UV-AIR-01)		
Type	Positive Displacement Blower	
Air Flow, SCFM	100	
Discharge Pressure, PSIG	6.5	
Reclaimed Water Pumps (P-FB-RW-1,-2,-3, -4)(Future)		
Number of Pumps (1 Standby)	3	4
Type	Vertical Turbine	
Flow, GPM, Each	800 - 1,200	
Reclaimed Water Pump Flow Meter (M-FB-RW-1) (Future)		
Type	Magnetic	
Calibration Range, 4-20 mA, GPM	0 – 4,000	

Table TM-EEE-2.6 Unit Process Design Criteria		
Reclaimed Water Pump Pressure Transmitter (Future)		
Type	In-Line	
Calibration Range, 4-20 mA, PSI	0 - 100	
Sodium Hypochlorite Feed Pumps for UW/RW (P-FB-CH-1, (-2 Future))		
Dose, mg/L	5 – 10	
Bulk Solution Concentration,% (Sodium Hypochlorite)	12.5	
Bulk Solution Tank Size, Gallons (Common with MF System)	1,000	
Number of Pumps (1 Standby)	1	2
Type	Peristaltic	
Flow, GPH, Each	1 - 10	
Maximum Discharge Pressure, PSIG	100	
Sodium Hypochlorite Flow Meters (M-FB-CH-1,-2 (Future))		
Number	2	
Type	Magnetic	
Calibration Range, 4-20 mA, GPH	0 - 10	
Effluent Sampler (S3) for RW System (Future)		
Type	Flow-Proportional, Refrigerated, Composite	

Notes:
(1) Shaded cells indicate no change due to increase in design flow. Equipment redundancy and sizing is suitable for Phase 3 Future 20-Year design.
(2) In-line mixer configuration is preliminary and may be modified during design.

Filtration Building Layout: The preliminary filtration building layout is provided in Drawing FP1 and is attached to this technical memorandum. The Electrical Room, Restroom/Utility Room, and Blower Compressor Room are located at grade on the upper level to facilitate access and equipment installation. The chemical storage and feed areas are located slightly below the upper floor level within a shallow sump for secondary containment. The remaining systems – the in-line strainer area, flash mixing and flocculation tanks, membrane tanks, and membrane pumping systems are located on the lower level area with the floor slab approximately 18-feet below grade.

Grating/Guardrail: Corrosion resistant fiber-reinforced plastic is recommended to be provided over the chemical feed and storage area, flash mixing and flocculation basins, membrane tanks, and the reject pump station wetwell. Grating over the membrane tank area can be placed a minimum of 3'-6" below top of wall so that guard rail is not required around the basins. Guardrail, where required for stairs and along upper walkways, is recommended to be corrosion-resistant aluminum.

Overhead Crane: One or two overhead cranes with electric hoist and trolley will be provided for lifting the membrane system cassettes, pumps, mixers, strainers, and plastic tanks out of the lower level area and carrying them to the set-down area in front of the overhead doors on the west side of the building. The crane can be supported by the building structure or can be a free standing bridge crane.

Doors: Overhead doors are recommended to be provided on the east side of the building near the chemical storage and feed area for equipment access and chemical supply replacement, and on the west side of the building for equipment loading and unloading. Double-doors are recommended at the ends of the Blower/Compressor Room and Electrical Rooms for equipment installation and replacement. Man-doors for building access are recommended at roughly each corner of the main process room.

Stairs: Stairs are recommended at a minimum of two (2) locations into the lower level areas so that these areas will not be confined spaces.

Ventilation: Because of the open tanks, it is recommended that the building be provided with adequate ventilation to prevent corrosion. Initiation of the ventilation system fans may be by a humidistat (similar to a thermostat for temperature). The sizing of the heating system must be adequate to maintain building temperatures above crystallization temperatures for bulk chemicals and prevent the freezing of pipes and equipment. The main process room will not be air-conditioned, although cooling may be required for the electrical room. The building will be required to meet the applicable requirements of the Washington State Non-Residential Energy Code.

Process Drains: Drains with mud valves will be provided for the concrete process tanks to allow the removal of the tanks from service for cleaning as required. The tanks will be drained to the reject pump station. Overflow from the tanks will also flow to the reject pump station.

Domestic Plumbing: A restroom with a reduced pressure backflow prevention device, toilet, sink, and hot water heater is recommended to be provided, and supplied with potable water. This will be the only restroom in this area of the treatment facility, and is therefore recommended at this location. The drains from the domestic plumbing will be routed to the plant drain pump station next to the digester control building. Only building process drains will go to the reject pump station. Emergency shower and eyewash facilities will be provided adjacent to the chemical storage area and supplied with tempered potable water.

Building Utility Water Pumps: Two (2) small utility water pumps will be furnished to provide water for interior wash-down and carrier/dilution water for chemical feed systems. The pumps will pump permeate from the back-pulse tank to the hose bibs and chemical feed dilution panels.

Chemical Storage: The bulk chemicals used in the chemical feed systems and their storage requirements are listed in Table TM-EEE-2.7. The following general provisions are recommended for the storage of the bulk chemicals:

- Chemicals should be stored in enclosed storage containers.
- Interior storage containers should be corrosion-resistant fiberglass reinforced plastic (FRP) or cross-linked polyethylene tanks. Bulk storage tanks should be provided with quick-disconnect connection (for filling by tank truck), drain, liquid-level sight glass, low liquid level indication, vent, access manway.
- Storage space should be provided for at least 30 days of chemical supply.
- Bulk storage of incompatible chemicals (i.e., alkalines with acids) should have separate secondary containment areas.
- Secondary containment for interior storage should be provided to contain, at minimum, the volume of the largest chemical storage container.
- Floor surfaces in containment areas should be impervious, slip-proof, corrosion-resistant epoxy-coated, and sloped towards a drain.
- Secondary containment drains should be provided with mud valves to prevent discharge of bulk chemicals to the building drain system. Provisions should be provided for adequate dilution and/or neutralization of chemical spills prior to draining containment area.
- Interior building temperatures should be maintained above minimum temperatures to prevent crystallization of bulk chemical solutions (11° C (53° F) for 50% sodium hydroxide).
- Emergency shower and eyewash facilities should be provided adjacent to the chemical storage areas and supplied with tempered potable water.

Table TM-EEE-2.7. Chemical Feed System Hazard Categories and Storage Quantities						
System	Chemical	CAS[1] No.	NFPA[2] Hazard Classification[3]	IFC[4] Hazard Category	Estimated Annual Usage[5]	Maximum Quantity Stored[6]
Membrane Filtration Cleaning	Sodium Hypochlorite (10-12%)(pH~11-12)	7681-52-9	2-0-1	Corrosive H2, Reactive 1	5,000 gallons	1,000 gallons
	Citric Acid (50%) (pH~2)	77-92-0	2-0-0	Corrosive H2	2,000 gallons	500 gallons
	Hydrochloric Acid (33%) (pH~0.1)	7647-01-0	3-0-1	Corrosive H3, Reactive W1	700 gallons	500 gallons
	Sodium Bisulfite (38%)(pH~4)	7631-90-5	2-0-0	Corrosive H2	1,200 gallons	500 gallons
	Sodium Hydroxide (50%) (pH~13.7)	1310-73-2	3-0-1	Corrosive H3, Reactive W1	1,300 gallons	500 gallons
Coagulant Feed System	Aluminum Sulfate (48%) (pH~2-2.4)	10043-01-03	2-0-0	Corrosive H2	48,000 gallons	6,000 gallons
Alkalinity Feed System	Sodium Hydroxide (50%) (pH~13.7)	1310-73-2	3-0-1	Corrosive H3, Reactive W1	16,000 gallons	6,000 gallons
Reclaimed Water System	Sodium Hypochlorite (10-12%) (pH~12.5)	7681-52-9	2-0-1	Corrosive H2, Reactive 1	10,000 gallons	1,000 gallons

1. Chemical Abstracts Service.
2. National Fire Protection Association (NFPA) 704, Standard System for the Identification of the Hazards of Materials for Emergency Response, 2012 Edition.
3. Health-Flammability-Reactivity, 0 = Insignificant, 1 = Slight, 2 = Moderate, 3 = High, 4 = Extreme.
4. International Fire Code (IFC) Chapter 50 - Hazardous Materials-General Provisions, 2012 Edition.
5. Quantities are based on the Phase 2 annual average design flow.
6. Based on minimum 30-day storage and chemical shipment quantities.

Electrical Requirements

Power: Normal and standby power will be provided to all the equipment listed in Table TM-EEE-2.6. The capacity of the standby generators will be sufficient to operate all of the equipment in each unit process at full loadings, minus the standby units where applicable, and all of the support systems in the Filtration Building as well as other critical loads elsewhere in the plant.

National Electric Code (NEC) Classification: All areas within the Filtration Building are unclassified in accordance with NFPA 820, *Standard for Fire Protection in Wastewater Treatment and Collection Facilities*. All unit processes within the building are preceded by primary and aerobic treatment.

Motors and Variable Frequency Drives (VFDs): All motors will be premium efficient, inverter-duty rated where applicable, TEFC, 3-phase, 60 Hz, 460 volt or 115 volt. VFDs will be provided for process equipment motors, where appropriate for operation or energy efficiency.

Motor Control Center (MCC): The motor control center(s) will be located on the upper level of the Filtration Building in the Electrical/MCC Room. Nearly all of the 3-phase motors in the building will be controlled at the MCC. Local hand-off-remote switches are recommended for all process equipment to facilitate operation and testing since the MCC will not be within sight of the equipment.

Control Panels: Manufacturer-provided control panels will be furnished for the membrane filtration system, air compressors, and new UV disinfection system. Local control panels may also be provided for the coagulant and alkalinity feed systems. The control panels will be rated NEMA 4X (corrosion-resistant and water-tight). All instrumentation and equipment provided by the manufacturer-provided control panels will be controlled by the programmable logic controller (PLC) furnished with the panel. All other equipment and instrumentation will be controlled by the Filtration Building control panel PLC (PLC-FB). This control panel will be networked with the other plant PLCs, SCADA System, and manufacturer-

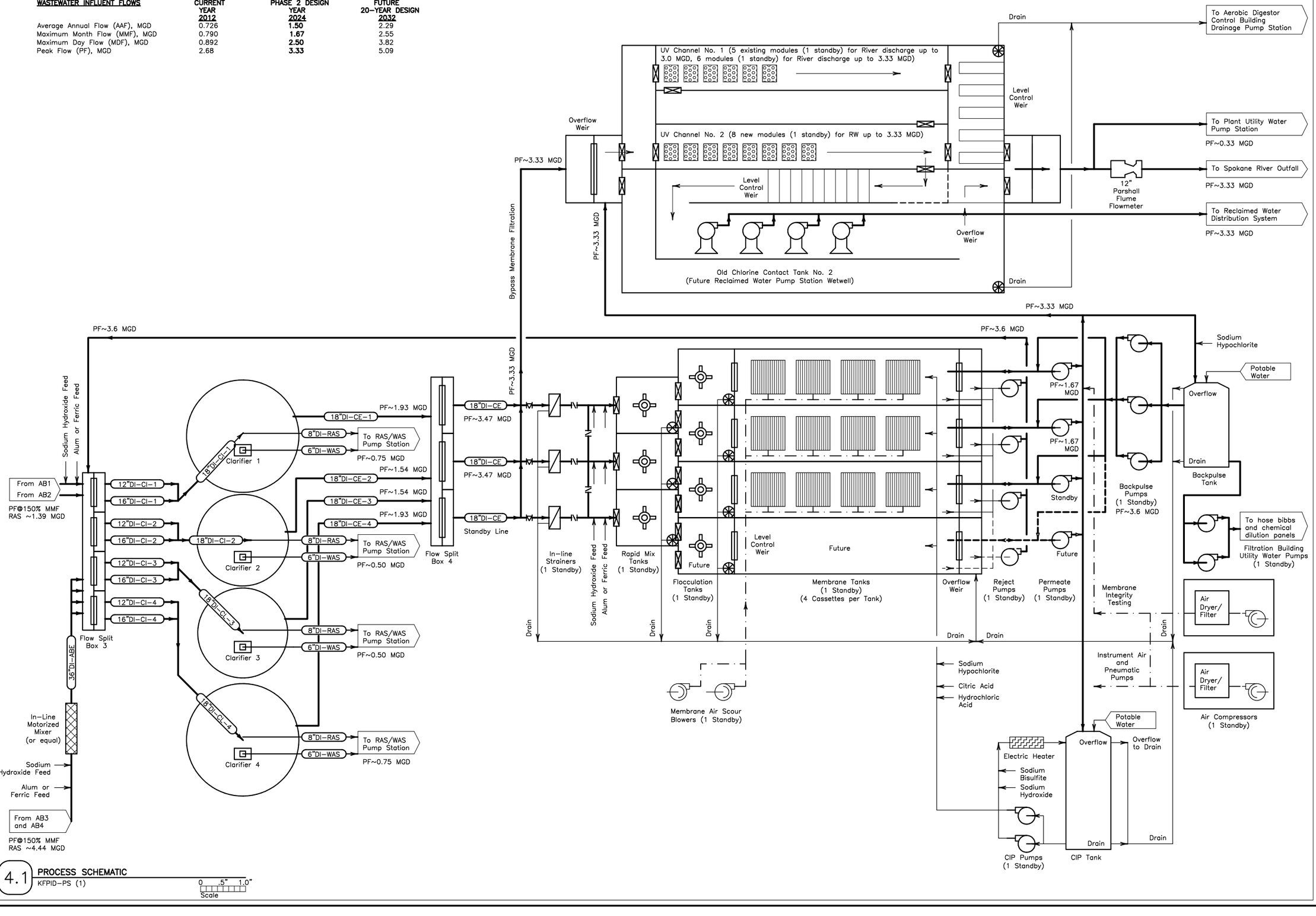
provided control panels for remote monitoring and control. The control panels will be provided with Uninterruptible Power Supply (UPS) units, surge suppression, and standby power.

Operation During Construction: Construction of the treatment system upgrades will be scheduled and performed to minimize negative impacts to plant operations and prevent violations of the District's NPDES permit. The following events may have an effect on plant operations and will require careful planning:

- Installation of flash mixing and chemical injection ahead of the secondary clarifiers. This will require temporary bypass pumping facilities so that one or both of the larger aeration basins 3 and 4 can remain in service during installation.
- Raising to the lower weir in flow split box 4 to match the other two weirs and evenly distribute the flow to the downstream process trains. This will require temporary bypass pumping facilities from the upstream side of the flow split box to the downstream UV disinfection system inlet box during the modifications.
- Cutting and installing fittings in the existing flow split box 4 effluent pipe to the UV disinfection system. This will require temporary bypass pumping facilities from the upstream side of the flow split box to one of the downstream UV disinfection system channels (bypassing the inlet box) during the installation.
- Modifications to the UV disinfection system inlet box to incorporate a new overflow weir and permeate line inlet. This will require temporary bypass pumping facilities from flow split box 4 to one of the downstream UV disinfection system channels (bypassing the inlet box) during the modifications.
- Modifications to UV channel no. 2 for installation of a separate disinfection system for reclaimed water and overflow to the reclaimed water pump station. This will require moving all of the UV modules from channel no. 2 to channel no. 1 and routing flow through channel no. 1 during the modifications.

The unit processes in the Filtration Building can be fully commissioned on clean water by pumping potable water into one or both of the unused discharge pipes from flow split box 4 that lead to the new filtration system and pumped through the permeate line to the UV disinfection system inlet box.

WASTEWATER INFLUENT FLOWS	CURRENT YEAR 2012	PHASE 2 DESIGN YEAR 2024	FUTURE 20-YEAR DESIGN 2032
Average Annual Flow (AAF), MGD	0.726	**1.50**	2.29
Maximum Month Flow (MMF), MGD	0.790	**1.67**	2.55
Maximum Day Flow (MDF), MGD	0.892	**2.50**	3.82
Peak Flow (PF), MGD	2.68	**3.33**	5.09



4.1 **PROCESS SCHEMATIC**
KFPID-PS (1)
Scale 0 .5" 1.0"

ALLISON MARY ZIOMEK
STATE OF WASHINGTON
34579
REGISTERED PROFESSIONAL ENGINEER
11/15/2013

ESVELT ENVIRONMENTAL ENGINEERING LLC
7605 East Hodin Drive
Spokane, Washington 99212
Ph:(509)926-3049 Fax:(509)922-3073

Project Engineer:
CENTURY WEST ENGINEERING CORPORATION
11707 East Montgomery Drive
Spokane, Washington 99206

PROCESS SCHEMATIC

Water Reclamation Facility Phase 2 Upgrade
Liberty Lake Sewer and Water District, Liberty Lake, WA

revisions

drawing status
Final

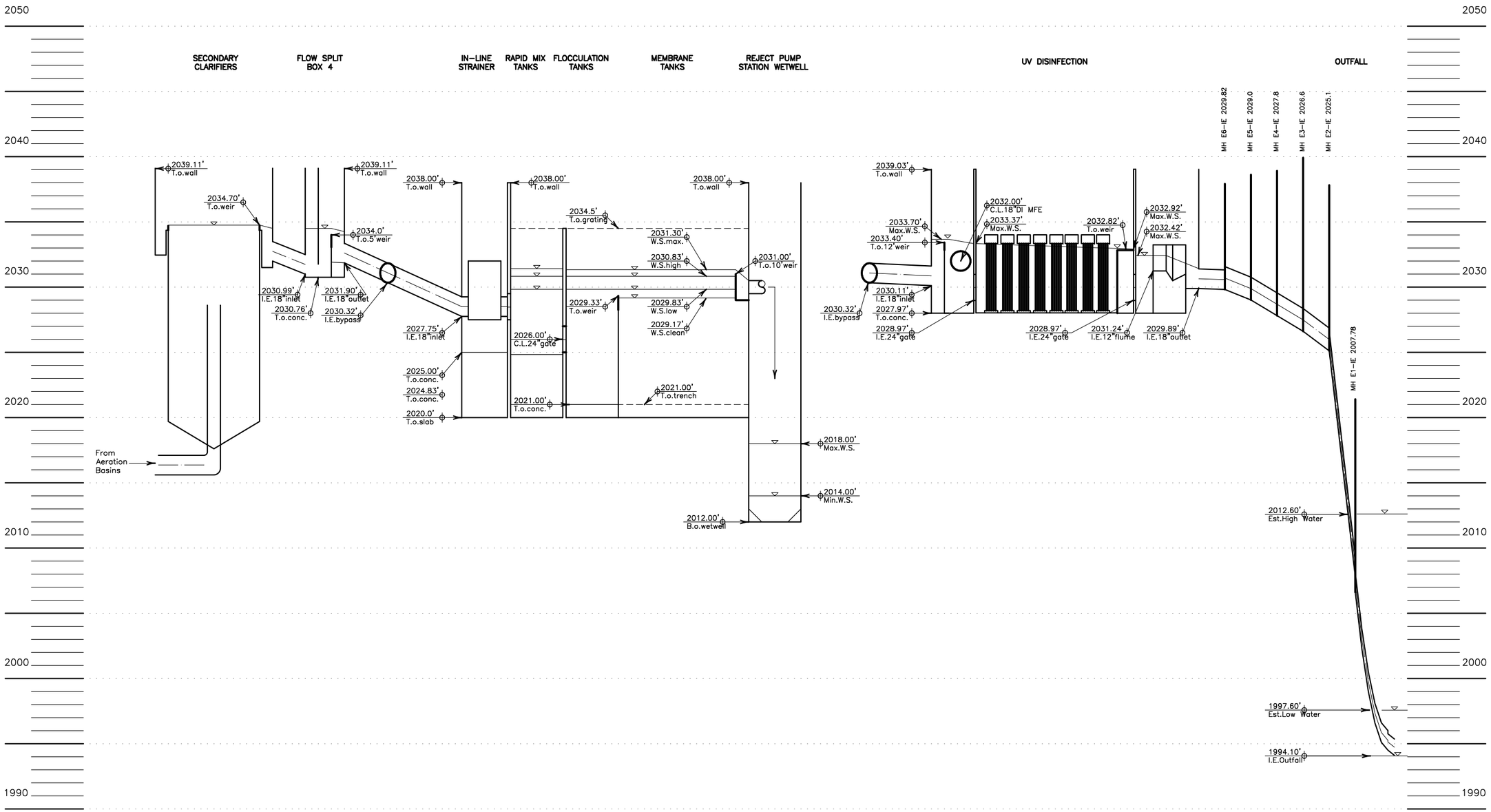
released for
PreDesign

release date
11/15/13

sheet
OP2

NOTES (for this Profile)

(N1) Elevations adjusted to current NAD (North American Datum) by +3.61' adjustment from previous drawings.



4.1 **PHASE 2 HYDRAULIC PROFILE**

LIBHydProf-HU (48) NO SCALE

11/15/2013

ESVELT ENVIRONMENTAL ENGINEERING LLC
7605 East Hodin Drive
Spokane, Washington 99212
Ph:(509)926-3049 Fax:(509)922-3073

Project Engineer:
CENTURY WEST ENGINEERING CORPORATION
11707 East Montgomery Drive
Spokane, Washington 99206

HYDRAULIC PROFILE

Water Reclamation Facility Phase 2 Upgrade
Liberty Lake Sewer and Water District, Liberty Lake, WA

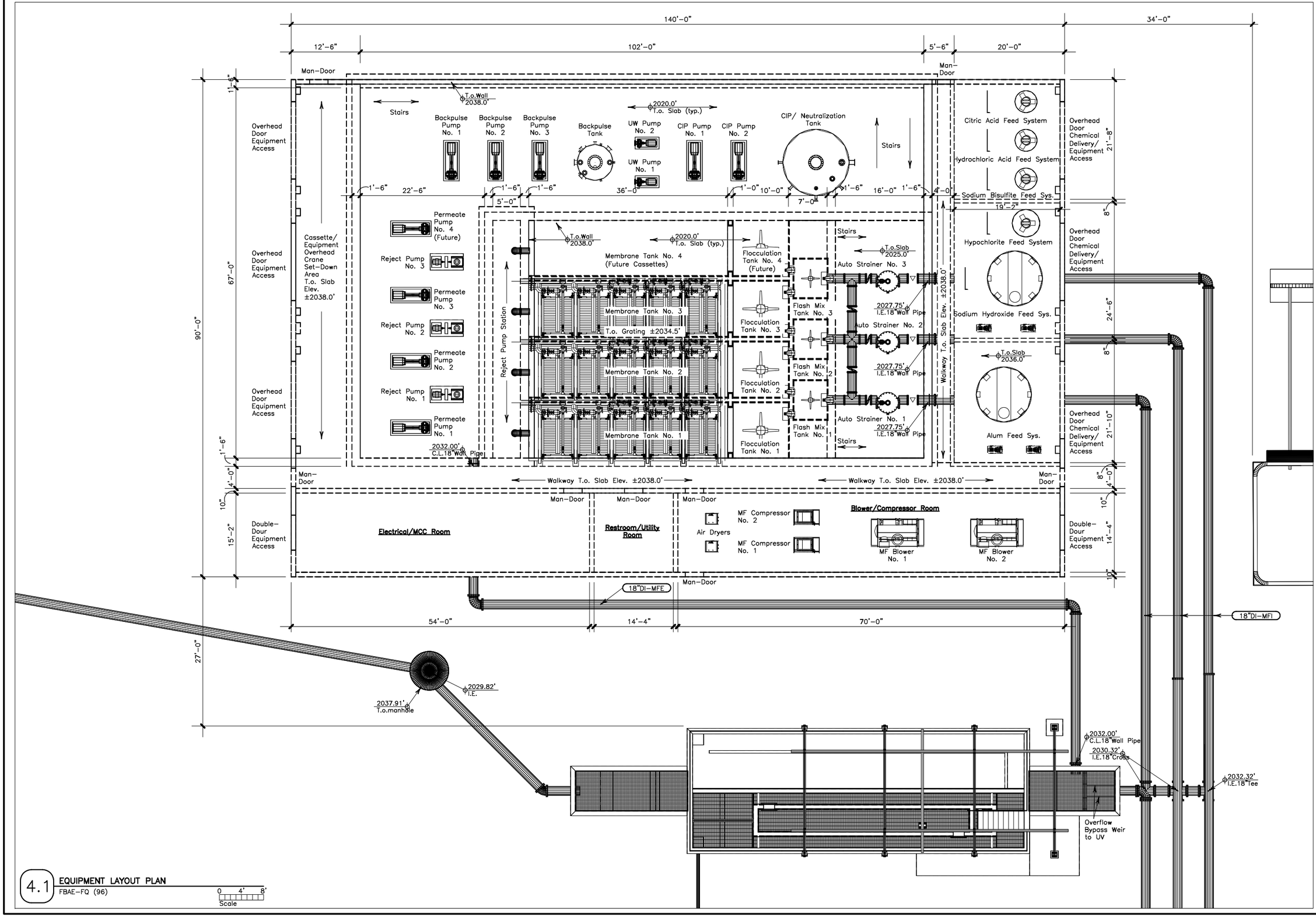
revisions

drawing status
Final

released for
PreDesign

release date
11/15/13

sheet
OP3



4.1 EQUIPMENT LAYOUT PLAN
FBAE-FQ (96)
Scale 0 4' 8'

11/15/2013

ESVELT ENVIRONMENTAL ENGINEERING LLC
7605 East Hodin Drive
Spokane, Washington 99212
Ph:(509)926-3049 Fax:(509)922-3073

Project Engineer:
CENTURY WEST ENGINEERING CORPORATION
11707 East Montgomery Drive
Spokane, Washington 99206

EQUIPMENT LAYOUT DRAWING
FILTRATION BUILDING

Water Reclamation Facility Phase 2 Upgrade
Liberty Lake Sewer and Water District, Liberty Lake, WA

revisions

drawing status
Final

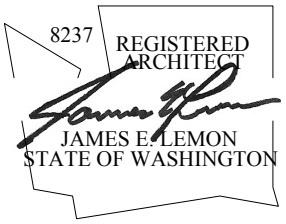
released for
PreDesign

release date
11/15/13

sheet
FP1

B2 ARCHITECTURE INC.

Project:	Liberty Lake Sewer and Water District Water Reclamation Facility Phase 2 Improvements Design
Technical Memorandum No.:	B2-3
Regarding:	Initial 2012 International Building Code Analysis Initial 2012 Washington State Energy Code Analysis Miscellaneous Design Codes Architectural Design
Prepared For:	Century West Engineering Corporation
Prepared By:	B2 Architecture, Inc. James Lemon
Date:	November 15, 2013
Project No.:	30221.036.01 (1303-16wsec)



This technical memo presents the Architectural design considerations for the Phase 2 improvements to the Liberty Lake Sewer and Water Facility. These improvements incorporate the design and construction of a new Filtration Building. The proposed building is approximately 90' x 140' in size.

For the purpose of this technical memo, only specific portions of the following codes have been addressed. Readers should realize the following technical memo is to be used in conjunction with the following, but not limited, codes. The technical memo is to be considered advisory or preliminary in nature. All applicable federal, state and local building codes shall be followed through the design process. Through this design process and at the time of final agency review the above referenced project may change. It should also be recognized that no matter how detailed the building codes may be, the design team and building officials must, to some extent, exercise his or her own judgment in determining code compliance.

Where there is a conflict between a general requirement and a specific requirement, the specific requirement will be applied. Where, in any specific case, different sections or codes specify different materials, methods of construction or other requirements, the most restrictive will be used.

The following, but not limited, codes relate to the Architectural design:

- 2012 International Building Code (IBC) with Washington State amendments to the 2012 IBC or Chapter 51-50 WAC.
- 2012 International Fire Code (IFC) with Washington State amendments to the 2012 IFC or Chapter 51-54A WAC.
- 2012 International Energy Conservation Code (IECC) with Washington State amendments (WS) also known as 2012 WSEC - Commercial or Chapter 51-11C WAC – Commercial Provisions.
- City of Liberty Lake, Zoning Requirements.
- Washington State Department of Labor & Industries, WAC 296-24 – General Safety & Health Standards..

2012 INTERNATIONAL BUILDING CODE:

Chapter 3 – Use and Occupancy Classification

Below is a summary table of the aggregate quantities of materials that will be stored/used in the Filtration Building as well as the maximum allowable quantities (MAQ) stated in the 2012 IBC for a single control area. Projected quantities provided by TM EEE-2.

Table 307.1 (2) Specifies the maximum quantities of hazardous materials, liquids or chemicals allowed per control area before having to classify the building, or a portion of a building as a high-hazard occupancy.

2012 IBC, TABLE 307.1(2)			
Maximum Allowable Quantity per Control Area of Hazardous Material Posing a Health Hazard			
Material	Hazard Category	Use-Closed Systems Allowed [d]	LLSWD Maximum Quantity Stored in 30 Days
		Liquid Gallons [e]	
Sodium Hypochlorite (10.3%)	Corrosive	500 gallons Total	1,000 gallons
Citric Acid (50%)	Corrosive		500 gallons
Hydrochloric Acid (33%)	Corrosive		500 gallons
Sodium Bisulfite (38%)	Corrosive		500 gallons
Sodium Hydroxide (50%)	Corrosive		500 gallons
Total:		500 gallons **(1,000 gallons)**	**3,000 gallons**

Footnotes:

[d] The aggregate quantity in use and storage shall not exceed the quantity listed for storage.

[e] Maximum allowed quantity shall be increased 100 percent in buildings equipped throughout with an approved automatic sprinkler system in accordance with IBC Section 903.3.1.1.

As show in the above table and in the inventory report, the storage and use of hazardous materials exceeds the maximum allowable quantities stated in Chapter 50 of the 2012 International Fire Code, as well as in Chapter 3 of 2012 International Building Code for the following hazard categories:

- Non-Sprinkled Building: Corrosive Liquids, Highly Toxic Liquids, Toxic solids, Toxic Liquids and Combustible III-A Liquids.
- Sprinkled Building: Corrosive Liquids, Highly Toxic Liquids, and Toxic Liquids.

As the quantities are exceeding the maximum allowable quantities for both a sprinkled and non-sprinkled building, the main Filtration Room is classified as High-Hazard Group **H-4** occupancy.
The most logical classification for the Electrical/MMC, Blower Room and Utility Room would be **S-2** (Low-Hazard Storage).

Below is a description of the purposes and functions as outlined in the IBC that relates the closest to the proposed uses of the Filtration Building.

IBC 307.1 – High-Hazard Group H

High-hazard Group H occupancy includes, amoun others, the use of a building or structure, or a portion thereof, that involves the storage of materials that constitute a physical or health hazard in quantities in excess of those allowed in control areas, based on the maximum allowable quantity limits for controlled areas set forth in Table 307.1(1) and 307.1 (2).

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IBC 307.6 – High-Hazard Group H-4

Buildings or structures which contain materials that are health hazards shall be classified as Group H-4. Such materials shall include, but not be limited to, the following.

Corrosive
Highly Toxic Materials
Toxic Materials

IBC 311.3 – Low-Hazard Storage, Group S-2

Includes, among others, buildings used for the storage of noncombustible materials.
Group S-2 storage uses shall include, but not limited to, storage of the following:

Electrical Coils
Electrical Motors
Metal Cabinets
Metal Parts
Metals
Oil-filled and other types of distribution transformers

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Chapter 4 – Special Detailed Requirements Based on Use and Occupancy

IBC 415.3, Group H: *Automatic fire detection system shall be provided in accordance with Section 907.2*

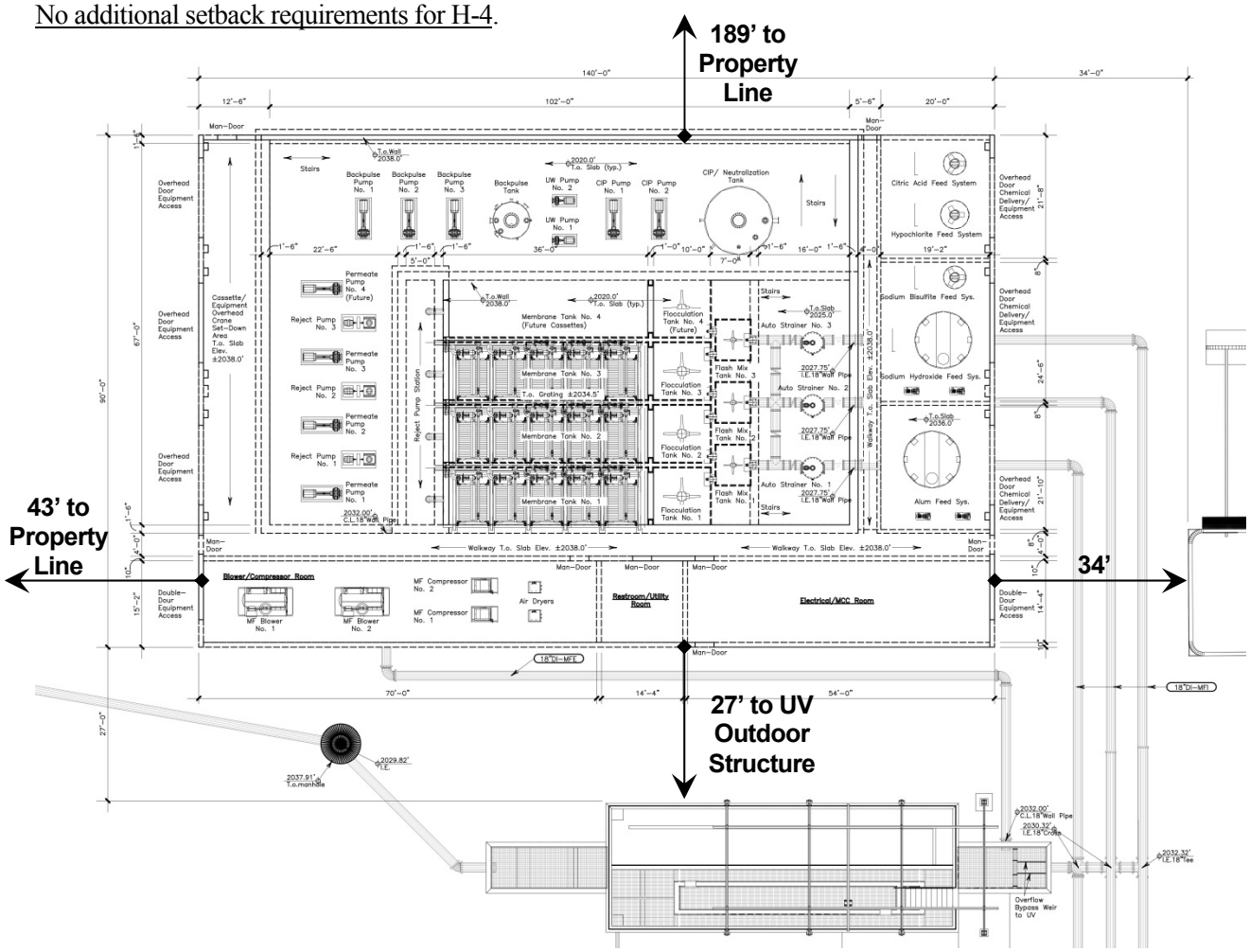
IBC 415.4, Group H: *Occupancies shall be equipped throughout with an automatic sprinkler system in accordance with Section 907.2.*

[F] IBC 415.5.1, Group H: Occupancy Minimum Fire Separation Distance.

Regardless of any other provision, building containing Group H occupancies shall be set back to the minimum Fire Separation Distance as set forth in Section 415.5.1.1 through 415.5.1.1. Distances shall be measured from the walls enclosing the occupancy to lot lines, including those of a public way.

Due to the potentially volatile nature of hazardous materials, specific setback requirements are necessary for Group H occupancies. These provisions take precedence over provision in the code that may specify a minimum fire separations distance based on building construction type and exposure (Table 602). Separation distances are measured between structures and not to imaginary lot lines.

No additional setback requirements for H-4.



IBC 415.9.3, Group H-4: Floors in Storage Rooms.

Floors in storage areas for corrosive liquids and highly toxic or toxic materials shall be of liquid-tight, noncombustible construction.

Chapter 5 – General Building Heights and Areas

IBC 503 – General Building Height and Area Limitations, Table 503.

Construction Type: V-B

Allowable Building Heights and Areas

Group H-4 (High-Hazard):

Height:	40 feet
Area Allowed:	6,500 sf
Allowable Stories:	2 stories

Group S-2 (Low-Hazard Storage)

Height:	40 feet
Area Allowed:	13,500 sf
Allowable Stories:	2 stories

IBC 504 – Building Height.

Where a building is equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1, the values specified in Table 503 for maximum building height is increased by 20 feet and the maximum number of stories in increased by one (1).

Group H-4 (High-Hazard):

Height: 60 feet

Area: 6,500 sf

Allowable Stories: 3 stories.

IBC 506 – Building Area Modifications.

The building areas limited by Table 503 shall be permitted to be increased due to frontage (I_f) and automatic sprinkler system protection (I_s) in accordance with Equation 5-1. $A_a = \{A_t + [A_t \times I_f] + [A_t \times I_s]\}$

A_a = *Allowable Building Area per Story (sf)*

$A_a = \{6500 + [6500 \times 0.88] + [6500 \times 3]\}$

$A_a = 31{,}720$ *sf*

IBC 506.2 – Frontage Increase.

Every building shall adjoin or have access to a public way to receive a building area increase for frontage. Frontage increase shall be determined in accordance with Equation 5-2. $I_f = [F/P - 0.25]\ W/30$

W = Weighted average of the width of the public way or open space.

W = [(30)(140)]+[(30)(90)]+[(27)(140)]+[(17)(90)]/460lf

W = 26.5 ft

$I_f = (0.75)(26.5/30)$

$I_f = 0.88$ or 88%

IBC 506.3 – Automatic Sprinkler System Increase.

Where a building is equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1, the building area limitation in Table 503 is permitted to be increased by an additional 200 percent ($I_s = 2$) for buildings with more than one story above grade plane and an additional 300 percent ($I_s = 3$) for buildings with no more than one story above grade plane.

$I_s = 3$

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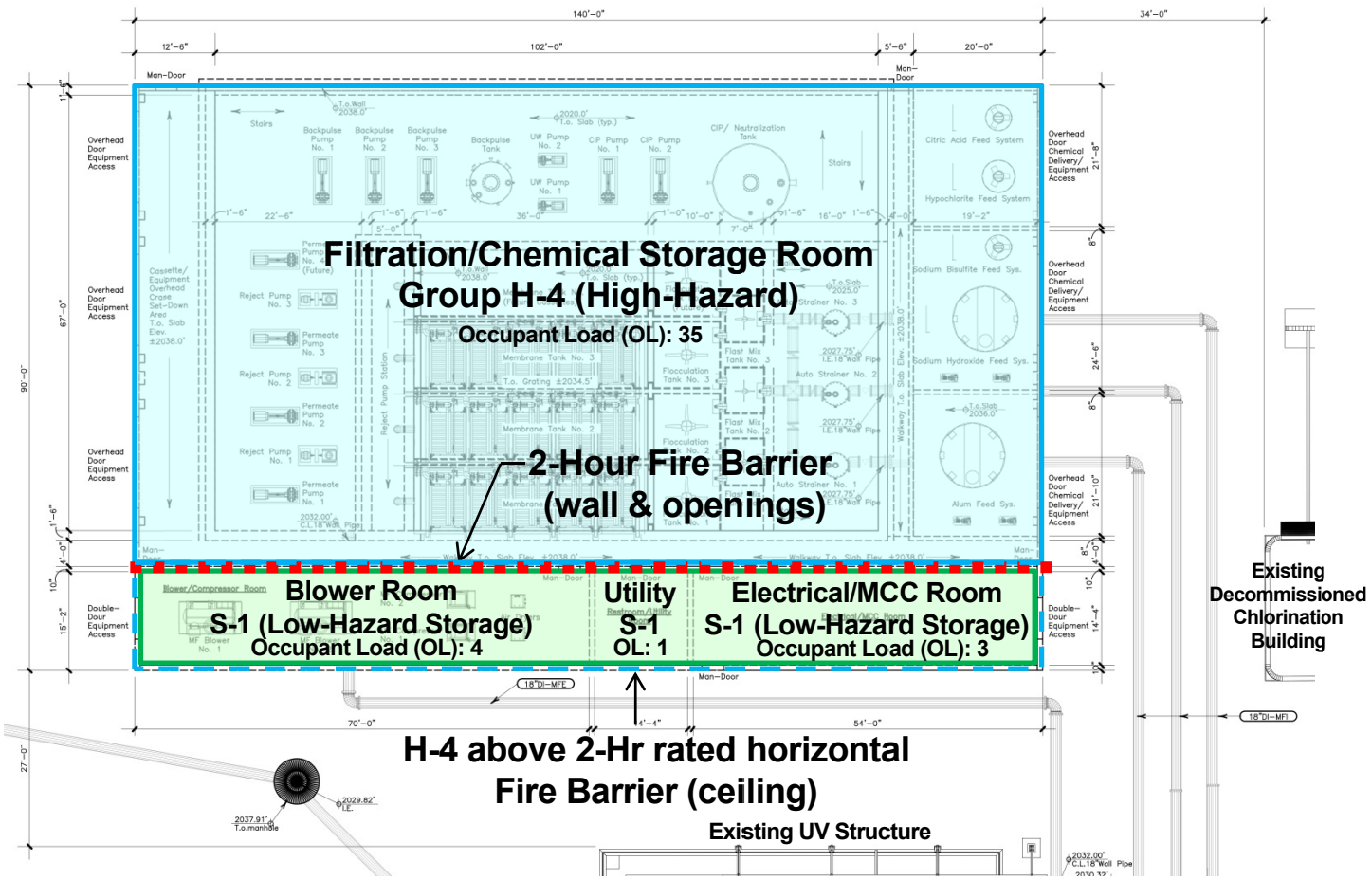
TOTAL ALLOWABLE AREA: 31,720 SF
ACTUAL DESIGN AREA: 12,600 SF (OK) (90' x 140')

IBC 508.4 Separated Occupancies

Buildings or portions of buildings that comply with the provisions of this section shall be considered separate occupancies.



IBC Table 508.4

OCCUPANCY	A, E		I-1, I-3, I-4		I-2		R[a]		F-2, S-2[b], U		B, F-1, M, S-1		H-1		H-2		H-3	H-4	H-5	
	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS
A, E	N	N	1	2	2	NP	1	2	N	1	1	2	NP	NP	3	4	2	3	2	NP
I-1, I-3, I-4	—	—	N	N	2	NP	1	NP	1	2	1	2	NP	NP	3	NP	2	NP	2	NP
I-2	—	—	—	—	N	N	2	NP	2	NP	2	NP	NP	NP	3	NP	2	NP	2	NP
R[a]	—	—	—	—	—	—	N	N	1[c]	2[c]	1	2	NP	NP	3	NP	2	NP	2	NP
F-2, S-2[b], U	—	—	—	—	—	—	—	—	N	N	1	2	NP	NP	3	4	2	3	2	NP
B, F-1, M, S-1	—	—	—	—	—	—	—	—	—	—	N	N	NP	NP	2	3	1	2	1	NP
H-1	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	NP	NP	NP	NP	NP	NP
H-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	1	NP	1	NP
H-3, H-4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1[d]	NP	1	NP
H-5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP

S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.
NS = Buildings not equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.
N = No separation requirement.
NP = Not permitted.
a. See Section 420.
b. The required separation from areas used only for private or pleasure vehicles shall be reduced by 1 hour but to not less than 1 hour.
c. See Section 406.3.4.
d. Separation is not required between occupancies of the same classification.

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Chapter 6 – Types of Construction

IBC Table 601

TABLE 601 FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A[d]	B	A[d]	B	HT	A[d]	B
Primary structural frame[g] (see Section 202)	3[a]	2[a]	1	0	1	0	HT	1	0
Bearing walls									
Exterior[f, g]	3	2	1	0	2	2	2	1	0
Interior	3[a]	2[a]	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions Exterior	See Table 602								
Nonbearing walls and partitions Interior[e]	0	0	0	0	0	0	See Section 602.4.6	0	0
Floor construction and associated secondary member (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	$1^1/_2$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	HT	1[b,c]	0

IBC Table 602 – Fire-Resistance Rating Required for Exterior Walls Based on Fire Separation Distance.

TABLE 602		
FIRE-RESISTANCE RATING REQUIRED FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE		
Fire Separation Distance = X (feet)	Type of Construction	Occupancy Group H [f]
X ≥ 30 (30' to imaginary and lot line) [1]	All (V-B)	0 Hr

Footnotes:

[d] For special requirements for Group H occupancies, See Section 415.5.

[f] For special requirements for Group H occupancies, see Section 514.5.

[1] Existing Chlorination Building is no longer used as originally intended and has been repurposed to a storage building. Due to the type of material stored in the old chlorination building the use would be classified as S-2. The existing exterior walls are constructed of non-combustible, bearing steel studs with exterior metal wall panels. Based on the existing construction and building separation purposes the exterior of the existing Chlorination Building wall has been categorized as 1 hour.

Chapter 7 – Fire and Smoke Protection Features

IBC 707.2 Materials

Fire barriers shall be of materials permitted by the building type of construction.

IBC 707.3.10 Fire Areas.

The fire barriers or horizontal assemblies, or both, separating a single occupancy into different fire areas shall have a fire-resistance rating of not less than that indicated in Table 707.3.10. The fire barriers or horizontal assemblies, or both, separating fire areas of mixed occupancies shall have a fire-resistance rating of not less than the highest value indicated in Table 707.3.10 for the occupancies under consideration.

Separation of a single occupancy into small fire areas can be an acceptable method for avoiding the use of sprinklers. This is a classic type of design decision: sprinklers versus compartmentation. If the separation is provided in accordance with Table 707.3.10, each fire area may be evaluated separately for purposes of determining the applicable provision of the code. [2012 IBC Commentary]

TABLE 707.3.10
FIRE-RESISTANCE RATING REQUIREMENTS FOR FIRE BARRIER ASSEMBLIES OR HORIZONTAL ASSEMBLIES BETWEEN FIRE AREAS

OCCUPANCY GROUP	FIRE-RESISTANCE RATING (hours)
H-1, H-2	4
F-1, H-3, S-1	3
A, B, E, F-2, H-4, H-5, I, M, R, S-2	2
U	1

IBC 714.3.1.2 – Through-Penetration Firestop System

Through penetrations shall be protected by an approved penetration firestop system installed as tested in accordance with ASTM E 814 or UL 1479, with a minimum positive pressure differential of 0.01 inch of water and shall have an F rating of not less than the required fire-resistance rating of the wall penetrated.

Chapter 9 – Fire Protection Systems

IBC 901.6.3 Group H.

Supervision and monitoring of emergency alarm, detection and automatic fire-extinguishing system in Group H occupancies shall be in accordance with the International Fire Code.

Group H occupancies are required to be both supervised and monitored by an approved supervising station or, when approved, shall initiate an audible and visual signal at a constantly attended on-site location.

IBC Table 903.2 – Summary of Occupancy-related Automatic Sprinkler Thresholds

H-4: Sprinklers Required.
Exceptions: None.

[F] IBC 903.3 Installation Requirements.

Automatic sprinkler systems shall be designed and installed in accordance with Section 903.1 through 903.3.6.

Table 903.1: NFPA 13

Extent of Protection:	*Equipped throughout. See Exempt Locations.*
Scope:	*All Occupancies*
Sprinkler Design:	*Density/Area Concept*
Sprinklers:	*All Types*
Duration:	*30 Minutes*
Advantages:	*Property and Life Protection*

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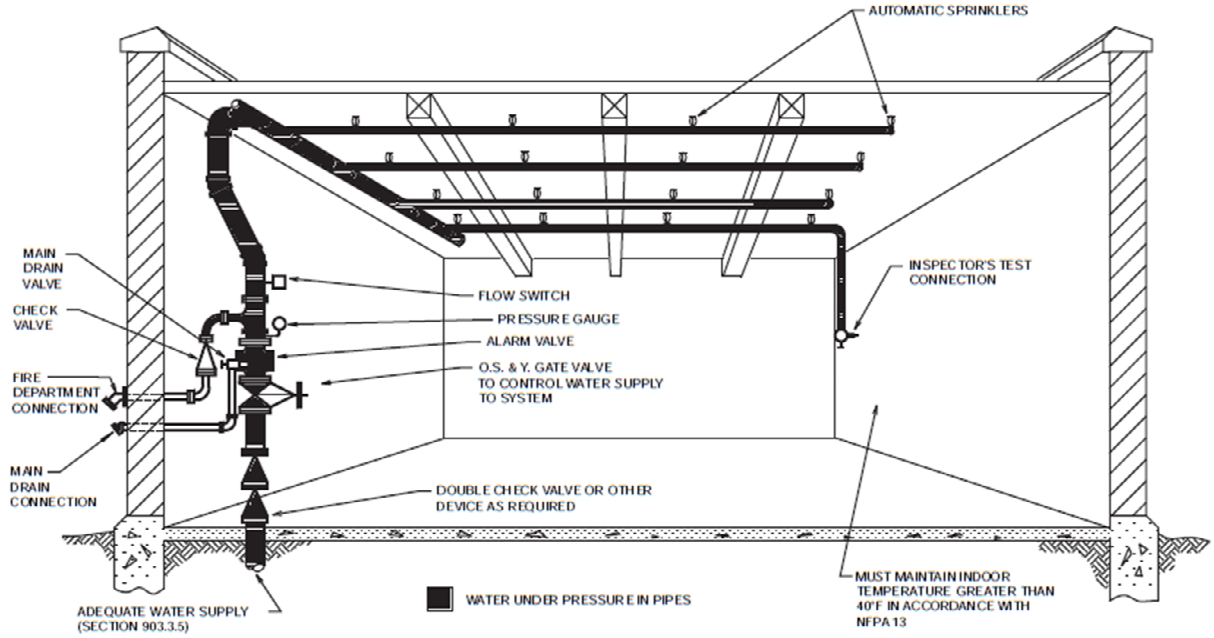

For SI: °C = [(°F) - 32]/1.8.

Figure 903.3.1.1
TYPICAL WET PIPE SYSTEM

Chapter 10 – Egress

IBC 1004.1.2 – Maximum Floor Area Allowance per Occupant.

H-4, Filtration/Chemical Storage Room:	(74' x 140') 10,360sf/300 = 35 occupants
S-2, Blower Room:	(14'-4" x 70') 1,003/300 = 4 occupants
S-2, Electrical/MCC Room:	(14'-4" x 54') 774/300 = 3 occupants
S-2, Utility Room:	(14'-4"x14'-4") 205/300 = 1 occupant

IBC 1005.3.1 Stairways.

Means of egress stairways shall be calculated by multiplying the occupant load served by such stairway by a means of egress capacity factor of 0.3 inch per occupant.

1009.4 Width, Exception 1: Stairways serving an occupant load of less than 50 shall have a width of not less than 36 inches.

IBC 1009.7.2 Riser Height and Tread Depth.

Stair riser heights shall be 7 inches maximum and 4 inches minimum. Rectangular tread depths shall be 11 inches minimum measured horizontally between the vertical planes of the foremost projection of the adjacent treads and at a right angle to the treads nosing.

IBC 1009.7.5.3 – Solid Risers, Exception 2.

Solid risers are not required for occupancies in Group H and S occupancies other than areas accessible to the public. There are not restrictions on the size of the opening in the riser.

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IBC 1009.8 – Stairway Landings.

There shall be a floor or landing at the top and bottom of each stairway. The width of landings shall not be less than the width of the stairways they serve. Every landing shall have a minimum width measured perpendicular to the direction of travel equal to the width of the stairway. Where the stairway has a straight run the depth need not exceed 48 inches.

IBC 1009.9.1 – Stairway Walking Surface, Exception 2.

In Group H and S occupancies openings in treads and landings shall not be prohibited provide a sphere with a diameter of 1 1/8 inch cannot pass through the opening.

IBC 1009.10 – Vertical Rise.

A flight of stairs shall not have a vertical rise greater than 12 feet between floor levels or landings.

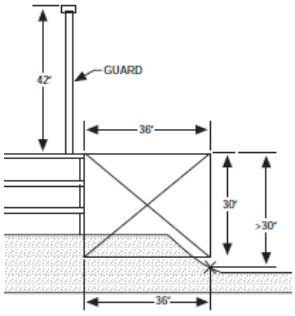
IBC 1012.6 – Handrail Extensions.

Handrails shall extend 12 inches beyond the top riser and continue to slope for the depth of one tread beyond the bottom riser.

IBC 1013.2 Guards - Where Required.

Guards shall be located along open –sided walking surfaces, including mezzanines, equipment platforms, stairs, ramps and landings that are located more than 30 inches measured vertically to the floor or grade below at any point within 36 inches horizontally to the edge of the open side.

Exception 1. On the loading side of loading docks or piers.



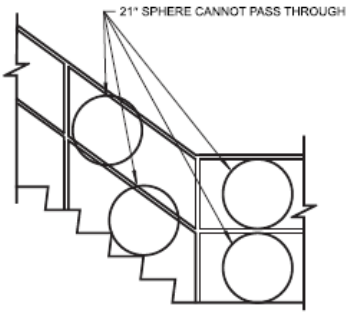
IBC 1013.3 Guards – Height.

Required guards shall not be less than 42 inches high, measured vertically as follows.

1. *From the adjacent walking surfaces.*
2. *On stairs, from the lien connecting the leading edges of the tread nosing; and*
3. *On ramps, from the ramp surface at the guard.*

IBC 1013.4 Opening Limitations, Exception 3 & 4.

3. *All elevated walking surface for access to and use of electrical, mechanical or plumbing systems or equipment, guards shall not have openings which allow passage of a sphere 21 inches in diameter.* For a 42 inch high guard, a top and intermediate rail are only required.
4. *In areas that are not open to the public with occupancies in Group H or S, and for alternating tread devices and ship ladders, guards shall not have openings which allow passage of a sphere 21 inches in diameter.*



WAC 296-307 – Toeboard.

Toeboard: means a vertical barrier at floor level along exposed edges of a floor opening, wall opening, platform, runway, or ramp to prevent materials from falling.

Railings must have a toeboard wherever, beneath the open sides:

(a) A person can pass; or

(b) There is moving machinery; or

(c) Materials falling onto equipment could create a hazard.

Toeboards height is at least 4 inches nominal from it top edge to the level of the floor, platform, runway, or ramp. Toeboards must be securely fastened in place and with a maximum of 1/4 inch clearance above floor level. It must be made of any substantial material that is either solid or with openings that are a maximum of one inch in diameter.

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IBC 1008.1.1 Size of Doors.

The minimum width of each door opening shall be sufficient for the occupant load thereof and shall provide a clear width of 32 inches.

36 inch doors will be specified throughout the project, thus exceeding the minimum clear width requirements.

IBC 1008.1.2 Door Swing.

Doors shall swing in the direction of egress travel where serving a room or area containing a Group H occupancy.

IBC 1008.1.10 Panic and Fire Exit Hardware.

Door serving a Group H occupancy shall not be provided with a latch or lock unless it is panic hardware or fire exit hardware.

Electrical rooms with equipment rated 1,200 amperes or more and over 6 feet wide that contain overcurrent devices, switching devices or control devices with exit or exit access doors shall be equipped with panic hardware or fire exit hardware. The doors shall swing in the direction of egress travel.

IBC 1005.3.2 Other Egress Components.

Means of egress components other than stairways shall be calculated by multiplying the occupant load served by such component by a means of egress capacity factor of 0.2 inch per occupant.

IBC 1014.3 – Common Path of Egress Travel.

The common path of egress travel shall not exceed the common path of egress travel distances in Table 1014.3.

H-4 = 75 ft (with sprinkled system)

S-1 = 100 ft (with sprinkled system)

IBC 1016 – Exit Access Travel Distance.

Travel distance within the exit access portion of the means of egress system shall be in accordance with this section.

H-4 = 175 ft (with sprinkled system)

S-2 = 300 ft (without sprinkled system – non-sprinkled in these rooms)

It is important to understand the relationship between the common path of travel limitations of Section 1014.3 and exit access travel distance limitations of this section. Both measurements start at the same location, i.e., the most remote location in any occupied space. Both are measured in the exit access portion of the means of egress system. The common path of travel is measured to the point where the occupant has two distinct exits. Travel distance is measured all the way until the exit is reached. The common path of travel measurement can end within a space or at a corridor where a single means of egress space has its door to a corridor that provides access to two exits.

IBC 1015.1 – Exit and Exit Access Doorways.

Two exists or exit access doorways from any space shall be provided where one of the following conditions exists.

1. *The occupant load of the space exceeds one of the values in Table 1015.1.*
   H-4 = 10 (maximum occupant load) Occupant load = 35. Therefore, a minimum of two (2) exits are required.
   S-2 = 29 (maximum occupant load) Occupant load separate S-2 areas is less. Therefore, a minimum of one (1) exit is required from each room. See National Electrical Code (NEC) for possible additional requirements.

2. *The common path of egress travel exceeds one of the limitations of Section 1014.3.*
   To be monitored and determined at time of design.

3. *Where required by Section 1015.3, 1015.4, 1015.5 or 1015.6.*
   1015.3 Boiler, incinerator and furnace room. Two exits access doorways are required in boiler, incinerator and furnace rooms where the area is over 500 sf and any fuel-fired equipment exceeds 400,000 Btu.
   1015.4 Refrigeration machinery rooms. No.
   1015.5 Refrigerated room or spaces. No.
   1015.6 Day care means of egress. No.

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IBC 1015.2.1 – Two Exits or Exit Access Doorways (Separation).

Exception 2. Where a building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1 or 903.1.2, the separation distance of the exit door or exit access doorways shall not be less than one-third of the length of the maximum overall diagonal dimension of the area served.

Filtration Room: 147'-8" Diagonal/3 = 49'-3" minimum door separation.

Chapter 11 – Accessibility

IBC 1103.2.9 – Equipment Spaces.

Spaces frequented only by personnel for maintenance, repair or monitoring of equipment are ***not required to be accessible****. Such spaces include, but are not limited to, elevator pits, mechanical, electrical or communications equipment rooms, piping or equipment catwalks, water or sewage treatment pump rooms and stations, transformer vaults, and highway and tunnel utility facilities.*

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SUMMARY

The intent of this section is to provide our initial understanding of the 2012 International Building Code requirements and how it will be applied to the building intended to be designed and constructed as part of the Liberty Lake Sewer and Water District (LLSWD) – Water Reclamation Facility (WRF), Phase 2 Improvement project.

The above building code analysis has determined the following IBC requirements.

CODE VERSION: 2009 I–CODES			
BUILDING:			**FILTRATION BUILDING**
SIZE:			90'–0" X 140'–0"
TOTAL BUILDING PERIMETER:			460 LF
OCCUPANCY CLASSIFICATION:	[Chapter 3]		H–4 (High Hazard) S–2 (Low–Hazard Storage)
FIRE RATING (EXT. WALL):	[Table 602]		0 (Not Required)
SEPARATION:			NOT REQUIRED
TYPE OF CONSTRUCTION:	[Chapter 6]		V–B
BASIC ALLOWABLE AREA:	[Table 503]		(H–4) 6,500 SF
AREA INCREASE:	[Section 506]		
FRONTAGE:	[506.2]	I_f =[F/P - 0.25]W/30 | W=23.5ft | I_f =[0.75]26.5/30 | I_f =0.88 or 88%	5,720 SF
SPRINKLERS:	[506.3]	I_s = 3 (300%)	19,500 SF
TOTAL ALLOWABLE AREA:			31,720 SF
ACTUAL BUILDING AREA:			**(OK)12,600 SF**
MAXIMUM BUILDING STORY:	[Table 503][504]		3 STORY
ACTUAL BUILDING STORY:			1 STORY
MAXIMUM BUILDING HEIGHT:			40'–0"
ACTUAL BUILDING HEIGHT:	(AVER. GRADE TO AVER. ROOF)		To be Determined
FIRE–RESISTANCE REQUIREMENTS:	[Table 601]		
PRIMARY STRUCTURAL FRAME:			0 (NONE)
EXTERIOR BEARING WALLS:			0 (NONE)
INTERIOR BEARING WALLS:			0 (NONE)
EXTERIOR NON–BEARING WALLS:	[Table 602]		0 (NONE)
INTERIOR NON–BEARING WALLS:			0 (NONE)
FLOOR CONSTRUCTION:			0 (NONE)
ROOF CONSTRUCTION:			0 (NONE)
FIRE PROTECTION:	[415.4]		Sprinkled
MAXIMUM TRAVEL DISTANCE:	[Table 1016.1]		(H–4) 175 ft (S–1) 300 ft
MAXIMUM COMMON PATH OF TRAVEL:	[Section 1014.3]		(H–4) 75 ft (S–2) 100 ft
FUNCTION OF SPACE	[Table 1004.1.2]		Storage Areas, Mechanical Equipment Room
OCCUPANT LOAD:	[Table 1004.1.2]		(H–4, Filtration/Chemical Storage Room) = 35 (S–2, Blower, Electrical/MCC and Utility Room) = 8 total
OCCUPANT LOAD CALCULATIONS:	[Table 1004.1.2]		[1](12,600 SF/300)
NO. OF REQUIRED EXITS FROM ROOM:	[Table 1015.1]		Filtration/Chemical Storage Room: 2 Blower Room: 1 Electrical/MCC Room: 1 Utility Room: 1

[1] Occupant Load Factor for H–4 and S–1 are the same (300).

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2012 WASHINGTON STATE ENERY CODE:

The intent of this memo is to provide our initial understanding of the 2012 WSEC - Building Envelope requirements and how it will be applied to the building(s) intended to be designed and constructed as part of the Liberty Lake Sewer and Water District (LLSWD) – Water Reclamation Facility (WRF), Phase 2 Improvement project.

The proposed upgrades to the facility entail, but not limited to, modifications to the existing treatment systems and buildings, installation of new equipment, and the construction of a new Filtration Building (FB).

There are three methods of demonstrating compliance with the WSEC: Prescriptive method, the Envelope UA Calculation method, and simulated energy performance analysis method. The prescriptive path utilizes published values of mandatory insulation and fenestration values for the various building envelope components based upon climate zones. This method is the fastest and simplest, but most conservative. The UA alternative, as compared to the prescriptive method, requires more time to complete the calculations, but allows the code user to calculate the total building thermal envelope UA (the sum of the proposed component U values multiplied by the component areas) which would have to be lower than the total UA resulting from using the U factor provided in a table (target value). This allows for trade-offs in the building envelope insulation and fenestration values. Finally, the simulated energy performance analysis is the most flexible method, offering credits for favorable building orientation, low infiltration rates, shading, high efficiency mechanical equipment and lighting. The performance method utilizes computer software, requires specialized knowledge, familiarization and is the most costly. The below values for each envelope component of the building are the minimum prescriptive values that must be met to comply with the WSEC.

This memo addresses the 2012 WSEC Building Envelope requirement. Mechanical, Service Water Heating, Power and Lighting requirements are also addressed in the 2012 WSEC. See the following WSEC sections for additional requirements:

Section C403 - Mechanical System
Section C404 - Service Water Heating
Section C405 - Electrical Power and Lighting Systems
Section C408 - System Commissioning

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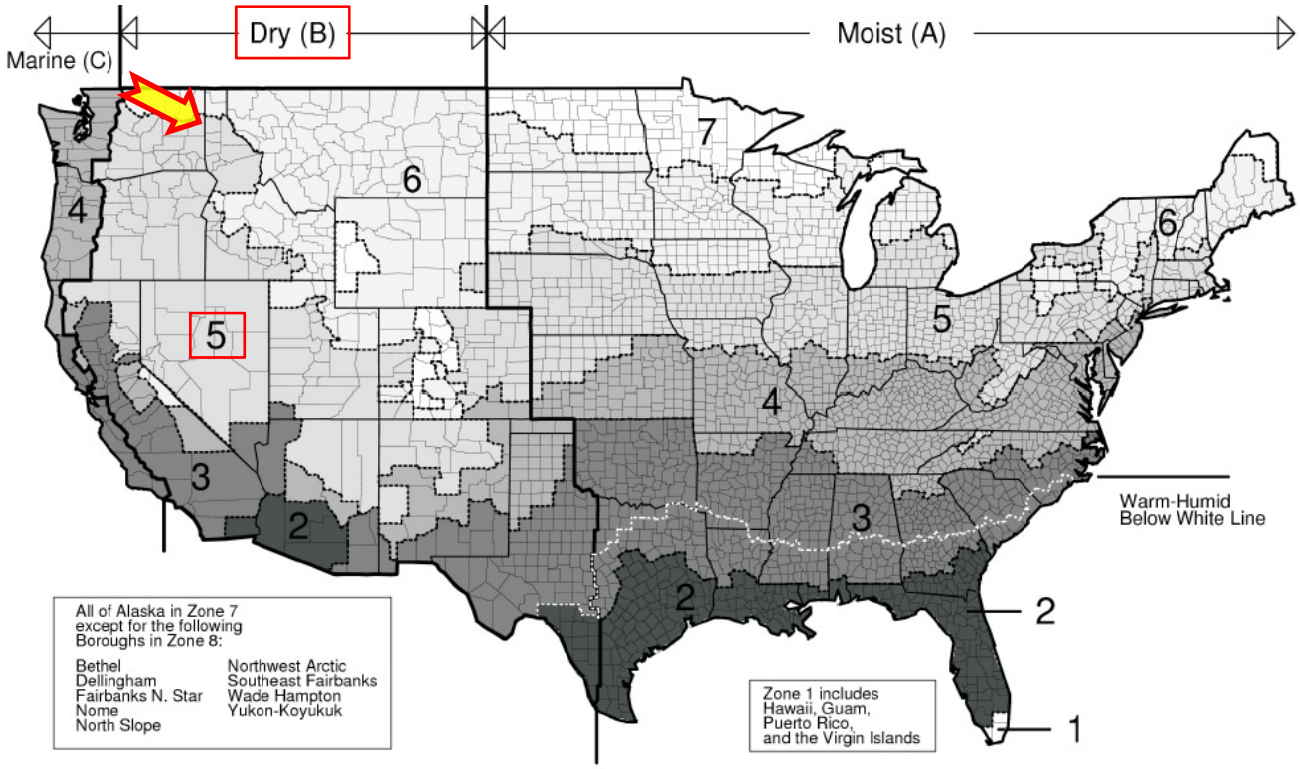
CHAPTER 3 – GENERAL REQUIREMENTS

Section C301 CLIMATE ZONE (Figure C301.1)

Climate Zone: ***5B***

C301.1 General

Climate zones from Figure C301.1 shall be used in determining the applicable requirements from Chapter 4.



CHAPTER 4 – COMMERCIAL ENERGY EFFICIENCY

Walls, Below Grade (See Appendix A - Table C402.1.2 and Table C402.2)

Mass Wall: Insulation Material: ***R-9.5 ci (continuous insulation)***

Wall Assembly: ***U-0.104*:**

C303.2.1: *Protective covering shall cover exposed exterior insulation and extend a minimum of 6 inches below grade.*

Proposed Wall Materials:
Concrete Masonry Units (CMU), Concrete

Remarks:
In order to meet the R-10 requirement a minimum of 2" (R-5 per 1") of extruded polystyrene insulation board will be required. Since interior condition is not conductive to any kind of furred wall system with insulation; insulation will need to be installed on the exterior.

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Slab-on-Grade Floors (See Appendix A - Table C402.1.2 and Table C402.2)

Unheated Slabs: Insulation Material: ***R-10 for 24" below***.

Floor Assembly: ***F-0.54***

C402.2.6: *The insulation shall be placed on the outside of the foundation or on the inside of the foundation wall. The insulation shall extend downward from the top of the slab for minimum distance as shown in the table or to the top of the footing, whichever is less, or downward to at least the bottom of the slab and then horizontally to the interior or exterior for the total distance shown in the table.*

Exception: *Where the slab-on-grad floor is greater than 24 inches below the finished exterior grade, perimeter insulation is not required.*

Proposed Slab Materials:
Concrete or reinforced concrete on grade

Remarks:
In order to meet the R-10 requirement a minimum of 2" (R-5 per 1") of extruded polystyrene foundation insulation board will be required. As stated in C402.2.6 a thermal break is created between the vertical foundation wall and horizontal slab due to the requirement of the insulation starting at the top of the slab. This typically can be accommodated when a furred out wall is constructed on the interior of the walls and can cover the top of the exposed rigid insulation to protect it and allow proper floor material installation. However, the majority of rooms found in wastewater treatment buildings are not furred out and are kept to CMU only for durability, ease of washing down and to create a water resistant wall system. If the rigid insulation thermal break was installed it would be damaged or deteriorate over time due to moisture, room cleaning and collect debris. It is recommended that we discuss the possibility of a waiver from the AHJ to start the insulation from the bottom of the slab and then install traditional fiberboard between the vertical wall and slab as a thermal break and bond break.

Walls, Above Grade (See Appendix A - Table C402.1.2 and Table C402.2)

Mass : Insulation Material: ***R-9.5 ci. (continuous insulation)***

Wall Assembly: ***U-0.104[d]***

d. Exception: Integral insulated concrete block walls complying with ASTM C90 with all cores filled and meeting both of the following:

1. At least 50 percent of cores must be filled with vermiculite or equivalent fill insulation; and

2. The building thermal envelope encloses one or more of the following uses: warehouse, …… water and wastewater treatment facility, storage facility…. .

Proposed Wall Materials:
Concrete Masonry Units (CMU)

Remarks:
The filtration building currently is slated to be constructed of medium weight Concrete Masonry Units complying with ASTM C90. It is anticipated that not more than 50% of the CMU cores will require reinforcing and grout; the remaining 50%+ cores will be filled with a foamed-in-place insulation system. The code referenced vermiculite has a U-value of approximately 0.23 Btu/hft^2°F (115 pcf CMU). The proposed foamed-in-place insulation has a U-Value of 0.21 (Northwest Concrete Masonry Association-Tek 6-2B), therefore exceeding the requirement of exception d.1.

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By complying with Table C402.1.2, Exception d.1 & d.2 the minimum required U-Value of 0.104 does not have to be met, therefore the exterior walls can be constructed with CMU and will not require additional wall framing and insulation on either side of the exterior wall.

Roofs (See Appendix A - Table C402.1.2 and Table C402.2)

Insulation entirely above deck: Insulation Material: ***R-30 ci (continuous insulation)***

Roof Assembly: ***U-0.034***

Proposed Wall Materials:
Standing seam metal roof with concealed fasteners installed over rigid insulation supported by metal decking.

Remarks:
The current roof assembly concept is slated to match past filtration building construction techniques. This roof assembly entails the use of sloped (gable configuration) open-web steel joist with metal decking covered continuously with R-30 extruded polystyrene board prior to installing an city approved standing seam metal roof system.
R-30 = 6" of extruded polystyrene insulation -or- 5" of extruded polyisocyanurate insulation (R-31)

Opaque Doors (See Appendix A - Table C402.1.2 and Table C402.2)

Swinging: ***U-0.37***

C402.2.7 Opaque Doors. *Opaque doors (doors having less than 50 percent glass area) shall meet the applicable requirements for doors as specified in Table C402.2 and be considered as part of the gross area of above-grade walls that are part of the building envelope.*

Roll-up or Sliding: ***R-4.75***

Proposed Wall Materials:
Swing: Heavy duty insulated metal passage door with polystyrene core.
Roll-up or Sliding: Double metal skin door filled with polyurethane foam, perimeter weather seals.

Remarks:
A fully operable polystyrene insulated metal passage doors will meet the 0.37 U-factor requirements. The approximate R-Value for a typical heavy duty metal coiling overhead doors is R-7 or a heavy duty metal section overhead door averages around R-17+. All overhead door systems would also incorporate a perimeter weather seal system.

Minimum Skylights

C402.3.2 Minimum Skylight Fenestration Area. *For single story building only, in an enclosed space greater than 10,000 sf, directly under a roof with ceiling heights greater than 15 feet, and used as an ……the total daylight zone under skylights shall be not less than half the floor area and shall provide a minimum skylight area to daylight zone under skylight of either.*

Remarks:
Skylights will not be required. The Filtration Building does not meet any of the defined uses listed in the WSEC. In addition, the combined open space will not exceed 10,000 sf.

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Air Barrier and Leakage Test

C402.4.1 Air Barrier. *A continuous air barrier shall be provided throughout the building thermal envelope. The air barrier shall be permitted to be located on the inside or outside of the building envelope, located within the assemblies composing the envelope, or any combination thereof. The air barrier shall comply with Sections C402.4.1.1 and C402.4.1.2.*

C402.4.1.1 Air Barrier Construction. *The continuous air barrier shall be constructed to comply with the following:*

1. *The air barrier shall be continuous for all assemblies that are the thermal envelope of the building and across the joints and assemblies.*
2. *Air barrier joints and seams shall be sealed, including sealing transitions in places and changes in materials. Air barrier penetrations shall be sealed in accordance with Section C402.4.2 the joints and seals shall be securely installed in or on the joints for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation.*
3. *Objects installed that penetrate the air barrier, provision shall be made to maintain the integrity of the air barrier.*

C402.4.1.2 Air Barrier Compliance Options. *A continuous air barrier for the opaque building envelope shall comply with Section C402.4.1.2.3.*

C402.4.1.2.3 Building Test. *The completed building shall be tested and the air leakage rate of the building envelope shall not exceed 0.40 cfm/ft^2 at a pressure differential of 0.3 inches water gauge in accordance with ASTM E 779 or an equivalent method approved by the code official. A report that includes the tested surface area, floor area, air by volume, stories above grade, and leakage rates shall be submitted to the building owner and the Code Official. If the tested rate exceeds that defined here, a visual inspection of the air barrier shall be conducted and any leaks noted shall be sealed to the extent practicable. An additional report identifying the corrective actions taken to seal air leaks shall be submitted to the building owner and Code Official and any further requirements to meet the leakage air rate will be waived.*

Proposed Wall Materials:
Closed cell polyurethane backer rod covered with silicone rubber joint sealant

Remarks:
Because of multiple overhead doors and dampered louvers for the required air changes, this building will probably not pass the Air Leakage test. It is recommended that we discuss the possibility of a waiver of the test with the AHJ and suggest that a visual inspection of the air barrier sealing be used for compliance.

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Air Infiltration Rate for Fenestration Assemblies

Table C402.4.3 Maximum Air Infiltration Rate for Fenestration Assemblies

FENESTRATION ASSEMBLY	*MAXIMUM RATE (CFM/FT^2)*	*TEST PROCEDURE*
Windows	*0.20[a]*	*AAMA/WDMA/CSA101/I. S.2/A440 or NFRC 400*
Sliding doors	*0.20[a]*	
Swinging doors	*0.20[a]*	
Skylights – with condensation weepage openings	*0.30*	
Skylights – all other	*0.20[a]*	
Curtain walls	*0.06*	*NFRC 400 or ASTM E 283 at 1.57 psf (75 Pa)*
Storefront glazing	*0.06*	
Commercial glazed swinging entrance doors	*1.00*	
Revolving doors	*1.00*	
Garage doors	*0.40*	*ANSI/DASMA 105, NFRC 400, or ASTM E 283 at 1.57 psf (75 Pa)*
Rolling doors	*1.00*	

For SI: 1 cubic foot per minute = 0.47L/s, 1 square foot = 0.093 m^2

a. *The maximum rate for windows, sliding and swinging doors, and skylights is permitted to be 0.3 cfm per square foot of fenestration or door area when tested in accordance with AAMA/WDMA/CSA101/I.S.2/A440 at 6.24 psf (300 Pa).*

Opening in Building Envelope

C402.4.5.2 Outdoor Air Intakes and Exhausts. *Outdoor air supply, exhaust openings and relief outlets shall be provided with Class IA motorized dampers which close automatically when the system is turned off. Return air dampers shall be equipped with motorized dampers. Damper shall have a maximum leakage rate of 4 cmf/ft^2 at 1.0 inch water gauge when tested in accordance with AMCA 500D.*

Exceptions:

1. *Gravity (nonmotorized) dampers having a maximum leakage rate of 20 cmf/ft^2 at 1.0 inch water gauge when tested in accordance with AMCA 500D are permitted to be used for relief openings in buildings less than three stories in height above grade if equipment has less than 5,000 cfm total supply flow.*
2. *Gravity (nonmotorized) dampers for ventilation air intakes shall be protected from direct exposure to wind.*
3. *Gravity (nonmotorized) dampers smaller than 24 inches in either dimension shall be permitted to have a leakage rate of 40 cmf/ft^2 at 1.0 inch water gauge when tested in accordance with AMCA 500D.*

Vestibules

C402.4.7 Vestibules. *All building entrances shall be protected with an enclosed vestibule, with all doors opening into and out of the vestibule equipped with self-closing devices.*

Exceptions:

2. *Doors not intended to be used by the public, such as doors to mechanical or electrical equipment rooms, or intended solely for employee use.*
6. *Doors used primarily for facility vehicular movement or materials handling and adjacent personnel doors.*
7. *Building entrances in buildings that are less than four stories above grade and less than 10,000 sf in area.*

Remarks:
No Vestibule required.

SUMMARY

The intent of this memo is to provide our initial understanding of the 2012 WSEC - Building Envelope requirements and how it will be applied to the building(s) intended to be designed and constructed as part of the Liberty Lake Sewer and Water District (LLSWD) – Water Reclamation Facility (WRF), Phase 2 Improvement project.

The above building envelope compliance analysis has determined the following WSEC requirements can be met with the desired construction material and methods listed.

1. Foundation walls will be required to be insulated on the inside or outside of the wall with 2" of extruded polystyrene insulation. If located on the exterior, proper protection will need to be provided for the exposed portions.
2. CMU walls will only need to be foam filled to comply with WSEC requirements. No additional wall framing or insulation will be required on either side of the exterior CMU walls.
3. Standing seam metal roof panel system can be installed over R-30 rigid insulation.
4. Standard commercial insulated metal doors and insulated overhead sectional or coiling doors will comply with the WSEC requirements.
5. No skylights or entrance vestibules will be required.
6. Minimum air infiltration rates as required by the WSEC will need to be met for windows, swing doors, overhead doors and rolling doors.
7. a. Automatic closing motorized dampers will be required on outside air supply, exhaust openings and relieve outlets. b. Return air dampers shall be equipped with motorized dampers.
   c. Relief louvers shall be protected and can use gravity dampers if the system is less than 5,000 cfm.

It is our recommendation that the following WSEC requirements be discussed with the City of Liberty Lake to determine if a variance would be allowed to the current code requirements due to the specific characteristics and use of this type of building.

1. Reduce 2" extruded insulation thermal break requirement around the perimeter of the interior slab to asphalt-impregnated fiberboard thermal break and isolation joint or allow perimeter insulation to be laid horizontal directly under the slab, starting at the inside face of the foundation and projecting in 24".

2. Replace the air barrier leakage test and with a simple and more effective visual inspection process. A visual inspection would be required if the leakage test exceeded the defined limits, which we anticipate due to all the passage doors, vehicle doors and louvers required for this type of facility.

TABLE C402.1.2
OPAQUE THERMAL ENVELOPE ASSEMBLY REQUIREMENTS[a]

CLIMATE ZONE	5 AND MARINE 4		6	
	All Other	Group R	All Other	Group R
Roofs				
Insulation entirely above deck	U-0.034	U-0.031	U-0.032	U-0.031
Metal buildings	U-0.031	U-0.031	U-0.029	U-0.031
Attic and other	U-0.021	U-0.021	U-0.021	U-0.021
Walls, Above Grade				
Mass	U-0.104[d]	U-0.078	U-0.078	U-0.071
Metal building	U-0.052	U-0.052	U-0.052	U-0.044
Steel framed	U-0.055	U-0.055	U-0.049	U-0.044
Wood framed and other	U-0.054	U-0.054	U-0.051	U-0.044
Walls, Below Grade				
Below-grade wall[b]	Same as above grade	Same as above grade	Same as above grade	Same as above grade
Floors				
Mass	U-0.031	U-0.031	U-0.031	U-0.031
Joist/framing	U-0.029	U-0.029	U-0.029	U-0.029
Slab-on-Grade Floors				
Unheated slabs	F-0.54	F-0.54	F-0.54	F-0.52
Heated slabs[c]	F-0.55	F-0.55	F-0.55	F-0.55

a. Use of opaque assembly *U*-factors, *C*-factors, and *F*-factors from Appendix A is required unless otherwise allowed by Section C402.1.2.

b. Where heated slabs are below grade, below-grade walls shall comply with the *F*-factor requirements for heated slabs.

c. Heated slab *F*-factors shall be determined specifically for heated slabs. Unheated slab factors shall not be used.

d. **Exception:** Integral insulated concrete block walls complying with ASTM C90 with all cores filled and meeting both of the following:

1 At least 50 percent of cores must be filled with vermiculite or equivalent fill insulation; and

2 The building thermal envelope encloses one or more of the following uses: Warehouse (storage and retail), gymnasium, auditorium, church chapel, arena, kennel, manufacturing plant, indoor swimming pool, pump station, water and waste water treatment facility, storage facility, storage area, motor vehicle service facility. Where additional uses not listed (such as office, retail, etc.) are contained within the building, the exterior walls that enclose these areas may not utilize this exception and must comply with the appropriate mass wall U-factor from Table C402.1.2.

TABLE C402.2
OPAQUE THERMAL ENVELOPE REQUIREMENTS[a, f]

CLIMATE ZONE	5 AND MARINE 4		6	
	All Other	Group R	All Other	Group R
Roofs				
Insulation entirely above deck	R-30ci	R-38ci	R-30ci	R-38ci
Metal buildings (with R-3.5 thermal blocks)[a, b]	R-25 + R-11 LS	R-25 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS
Attic and other	R-49	R-49	R-49	R-49
Walls, Above Grade				
Mass	R-9.5ci	R-13.3ci	R-11.4ci	R-15.2ci
Metal building	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-19 + R-16ci
Steel framed	R-13 + R-10ci	R-19 + R-8.5ci	R-13 + R-12.5ci	R-19 + R-14ci
Wood framed and other	R-21 int	R-21 int	R-13 + R-7.5ci or R-20 + R-3.8ci	R-21 + R-5ci
Walls, Below Grade				
Below-grade wall[d]	Same as above grade	Same as above grade	Same as above grade	Same as above grade
Floors				
Mass	R-30ci	R-30ci	R-30ci	R-30ci
Joist/framing	R-30[e]	R-30[e]	R-38[e]	R-38[e]
Slab-on-Grade Floors				
Unheated slabs	R-10 for 24" below	R-10 for 24" below	R-10 for 48" below	R-15 for 48" below
Heated slabs[d]	R-10 perimeter & under entire slab	R-10 perimeter & under entire slab	R-10 perimeter & under entire slab	R-10 perimeter & under entire slab
Opaque Doors				
Swinging	U-0.37	U-0.37	U-0.37	U-0.37
Roll-up or sliding	R-4.75	R-4.75	R-4.75	R-4.75

For SI: 1 inch = 25.4 mm. ci = Continuous insulation. NR = No requirement.
LS = Liner system--A continuous membrane installed below the purlins and uninterrupted by framing members. Uncompressed, unfaced insulation rests on top of the membrane between the purlins.

a. Assembly descriptions can be found in Chapter 2 and Appendix A.

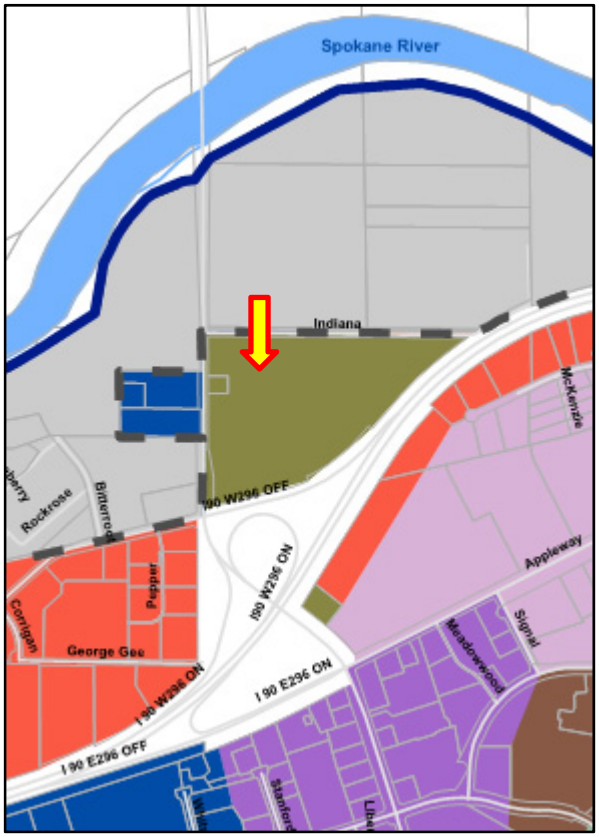
b. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.2.

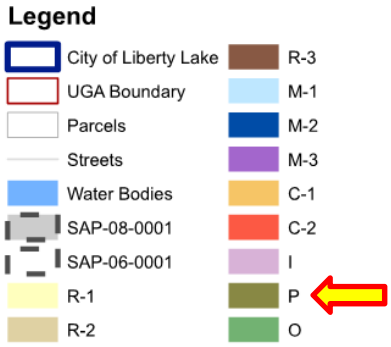
c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-ft^2°F.

d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.

CITY OF LIBERTY LAKE STANDARDS

The current LLSWF property is zoned as P (Public/Semi-Public Institutional) District. See below partial Zoning Map.





M2 = Community Center Mixed Use
SAP-08-0001 = Specific Area Plan - Liberty Village

City Standards (but not limited to) Article 10-2K – P District

Development Setbacks (10-2K-6):
Front: 20 feet
Rear: 5 feet (20 feet from residential zones)
Side: 5 feet (20 feet from residential zones)

Building Height (10-2K-7): 100 feet, except when a lot is adjacent to a R-1 (single family residential) zone.

Architectural Guidelines and Special Standards (10-2K-10):
Materials & Colors: *All proposed building materials should be durable and of good quality and appropriate to the surroundings. Exterior building materials and colors comprise a significant part of the visual impact of a building. Therefore they should be aesthetically pleasing and compatible with materials and colors of adjoining buildings and other buildings within the City.*

Acceptable Roofing Materials: *Architectural Metal Roof Panel.* Per conversation with Amanda Tainio, 5/13/13.

Prohibited Roof Materials: *Corrugated Metal*

Acceptable Siding Materials: *Concrete Block, Architectural Metal Panels (upon design review and approval)*

Prohibited Siding Materials: *Corrugated Metal*

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ARCHITECTURAL DESIGN:

This portion of the technical memorandum presents the Architectural design considerations for the Phase 2 improvements to the Liberty Lake Sewer and Water Facility. These improvements incorporate the design and construction of a new Filtration Building. The architectural design for this building should provide a consistent design theme that will be compatible with the surrounding site and closely match the construction materials and overall concepts currently at the existing plant. Possible exterior treatment elements currently used throughout the existing facility include; reinforced concrete, concrete masonry blocks, and Architectural metal wall panels.

The processes that will take place in the new Filtration Building will produce elevated moisture and humidity levels thus elevating the possibility of corrosion. Another aspect of the facility is it will be required to be minimally heated, or cooled for large heat load areas such as the Electrical/MCC Room. Due to the nature of the processing operations, materials will need to contribute to the following characteristics:

- Corrosion Resistant
- Durability
- Cost Effective
- Low Maintenance (Life-Cycle) Cost
- Structural Integrity
- Fire Resistant
- Pest Resistant

Walls and Floors:
Selection of concrete and/or Concrete Masonry Unit (CMU) building materials for the wall construction would allow all of the above characteristics to be met and exceeded. Currently the buildings within the plant, constructed of CMU do not employ exposed integral colored cmu, but are painted on the exterior and interior. Integral colored cmu provides the lowest maintenance (life cycle) cost to maintain over the life span of the product. However, in order to closely match some of the existing facilities the exterior of the CMU walls could be painted to match. Should the exterior walls be painted to match the existing buildings, detailed research and consultation with paint manufactures will need to be pursued. The current paint system on the exterior of the Dewatering building is starting to flake or peel off the cmu wall and it will need to be determined what paint systems to use to avoid this same issue.

Roofing System
Proposed options for the roof configuration and associated materials are;

- Gable roof with a slope between 1:12 through 3:12. Roof Material would consist of prefinished Architectural metal roof system with concealed fastener clips.
  - Durability: Very High
  - Life Span: 40-60 years
  - Cost: Approximately $9.05/sf
  - Evacuates water and snow very well. Rain gutters and downspouts on eave sides. Snow stops can be added above doors and walkways for safety.
  - Maintenance: Very little (clean gutters if needed)
  - Visibility/Profile: High
- Parapet walls and flat roof system with a slope between ½:12 through 1:12. Roof material would consist of single-ply membrane roof system. Currently all the existing buildings at the plant employ this type roof configuration. The existing Dewatering Building currently has a single ply roof, all the other existing building have Spray Polyurethane Foam (SPF) roof system that are deteriorating and failing. Technical Memo B2-1 currently proposes that these SPF roof systems be removed and a single-ply roof system be installed.
  - Durability: Moderate
  - Life Span: 20-30 years, up to 40.
  - Cost: Approximately $5.75/sf
  - Holds water and snow.

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- Maintenance: Medium – required periodical inspections to keep roof and drains clean and clear. Patch wear spots or holes toward end of life span.
- Visibility/Profile: Low

With either of the above roof systems, due to moisture and humidity reasons, galvanized metal decking would be used over the structural framing system. Above the metal deck a rigid insulation board would be installed over the metal decking prior to the single ply or metal roofing installation.

Miscellaneous Building Components and Coatings:
Due to the potential of elevated moisture and humidity the following materials are not recommend:

- Gypsum wall board
- Wood
- Suspended Ceiling Tile System

Exposed metal framing components, such as roof joist, columns, and beams will need to be galvanized or coated with a high-performance industrial coating system. In addition, other building components constructed of metal such as; metal decking, door, door frames and stair system will need to be galvanized to the G-90 standard. It has been determined that clear anodized aluminum hand and guardrails are the most cost effective and corrosion resistant system available. Floor and Stair grating would be constructed of corrosion resistant fiberglass or aluminum. Miscellaneous screw and fasteners should be fabricated of stainless steel to prevent corrosion.

SUMMARY

Given the use of the building and due to the durability and economy of concrete masonry unit construction, load bearing CMU is recommended for the wall systems of the Filtration Building. Integral colored cmu provides the lowest maintenance (life cycle) cost to maintain over the life span of the product. However, in order to closely match some of the existing facilities the exterior of the CMU walls could be painted to match. Should an exterior coating system be chosen a smooth faced cmu would be installed and then painted white with a possible red strip to match the exterior of the other existing cmu buildings. The interior surfaces of the CMU would be coated with a modified polyamine epoxy that provides a glaze-like corrosion resistant coating that provides excellent chemical, stain- and abrasion-resistance. With both sides of the CMU painted, careful attention and product consultation will be needed to determine the specific exterior paint preparation and finishes to specify.
In regards to roof configuration and system, either the gable with metal panels or parapet walls with a flat roof covered with a single-ply roof system are good candidates. On other wastewater treatment plants the sloped metal roof is preferred mostly due to the durability, low maintenance, longevity, and ability to evacuate water and snow off the roof. However, a metal roof system would deviate from the current architectural theme and would not match as well as a parapet wall and flat roof, single-ply system.

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GENERAL SAFETY AND HEALTH STANDARDS, CHAPTER 296-24 WAC

Washington Administrative Code (WAC) 296-24 standards were created pursuant to the Washington Industrial Safety and Health Act enacted in 1973 (WISHA). The Washington State Department of Labor & Industries (L&I), Division of Occupational Safety and Health (DOSH) is responsible for administering the requirements under WISHA. These regulations are primarily for the safety of employees. The new Filtration Building will be designed with these regulations in mind so that the plant can be operated in compliance.

WAC 296-24, PART J-1 WORKING SURFACES, GUARDING FLOORS & WALL OPENINGS, LADDERS:

WAC 296-24-73501 This section applies to ALL permanent places of employment, except where domestic, mining, or agricultural work only is performed. Construction work isn't to be deemed as a permanent place of employment. Measures for the control of toxic materials are considered to be outside the scope of this section.

WAC 296-24-75003 Every ladderway floor opening or platform shall be guarded by a standard railing with standard toeboard on all exposed sides (except at entrance to opening), with the passage through the railing either provide with a swinging gate or so offset that a person can't walk directly into the opening.

WAC 296-24-75007 Protection of open-sided runways. Railings must be provided with a toeboard wherever, beneath the open sides,

(a) A person can pass; or
(b) There is moving machinery; or
(c) Materials falling onto equipment could create a hazard.

A standard toeboard shall be a minimum or 4 inches nominal in vertical height from its top edge to the level of the floor, platform, runway, or ramp. It shall be securely fastened in place and with not more than one-quarter-inch clearance above floor level. It may be made of any substantial material either solid or with openings not over one inch in greater dimensions.

WAC 296-24-75011 Railing, Toeboards, and cover specifications. A standard railing shall consist of top rail, intermediate rail, and posts, and shall have a vertical height of 42 inches.
A stair railing shall be of construction similar to a standard railing, the vertical height shall be not more than 34 inches nor less than 30 inches from upper surface of top rail to surface of tread in line with face of riser at forward edge of tread.

WAC 296-24-765 Fixed Industrial Stairs:

WAC 296-24-76503 This section contains specifications for the safe design and construction of fixed general industrial stairs. This classification includes interior and exterior stairs around machinery, tanks, and other equipment, and stairs leading to and from floors, platforms, or pits.

This section does not apply to stairs used for Fire Exits, to construction operations, to private buildings or residences.

Stairs of public and private buildings at loading or receiving docks, in maintenance areas, etc., or stairs that are used exclusively by employees, are considered "fixed industrial steps" and must meet these requirements of this section.

WAC 296-24-76509 Stair Width. Fixed stairways shall have a minimum of 22 inches.

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WAC 296-809 CONFINED SPACE:

A *Confined Space* is a space that is *all* of the following:

- Large enough and arranged so an employee could fully enter the space and work.
- Has limited or restricted entry or exit. Examples of spaces with limited or restricted entry are tanks, vessels, silos, storage bins, hoppers, vaults, excavations, and pits.
- Not primarily designed for human occupancy.

Numerous confined spaces exist on the project being designed. All manholes, tanks, basins and open channels that do not provide code compliant stairs and cannot be climbed out of easily are examples of confined spaces. All confined spaces must be identified and determined if they are permit-required or non-permit confined spaces.

Spaces such as manholes are accessed through a hatch have to have an opening large enough to allow a large person wearing self-contained breathing apparatus (SCBA) to pass through. An attendant will need to be designated to maintain communication with the employee working in the confined space to make sure they're safe. Communications between the attendant and entrants has to be maintained throughout entry. Ventilation must be provided in confined spaces during entry. If entry to a given confined space will be on a regular basis, the space should have permanently installed ventilation equipment. Extraction equipment is required during entry into a confined space. This equipment is usually in the form of a tripod or hoist, which cannot be subject to power outage. Adequate concrete or other hard surface area will need to be provided to support a tripod for extraction at all manholes. In a situation which retrieval lines and harnesses generally required under this rule are usually impractical for use in tanks. The internal configuration of the tanks and their internal baffles and other structures would prevent rescuers from hauling out injured entrants. The rescue team needs to be trained in the use of retrieval lines and harnessed for removing injured employees though manholes and tight location.

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LSB Consulting Engineers, PLLC

523 East Third Avenue • Spokane, WA 99202 509-323-9292

Project: Liberty Lake Sewer and Water District
Water Reclamation Facility
Phase 2 Improvements Design

Technical Memorandum No. TM LSB-1 New Filtration Building
Structural Description and Code Review

Prepared For: Century West Engineering Corporation (CWEC)

Prepared By: LSB Consulting Engineers
Joseph D. Scholze, PE, SE

Date: 11-14-13

Purpose of Technical Memorandum:

This technical memo presents the structural design considerations for the Phase 2 improvements to the Liberty Lake Sewer and Water Facility. These improvements incorporate the design and construction of a new Filtration Building. The proposed building is approximately 90' x 130' in size. A large portion of the floor area will be lowered about 18' below existing grade to accommodate the process equipment and the required tanks. This portion of the floor will be partially covered with galvanized steel beams and grating. A single or pair of bridge cranes with an anticipated capacity of 2 tons will be needed to install and service the process equipment residing at the lower levels. These bridge cranes may be self supporting off the floor or alternately might be hung from the roof structure. If the bridge crane is supported from the roof structure, special attention must be made to the deflection of the roof joists and beams under snow loading and crane loading.

A Blower/Compressor Room, MCC/Electrical Room, and Utility/Restroom will be provided along the south side of the building. These rooms will be enclosed with 8" CMU walls on the interior side and a composite metal deck with concrete slab will be used to form the ceiling. This area above the ceiling lid might be used for light storage, mechanical equipment, or just left open. If this area is to be used, stair access will need to be provided and a guardrail and gate system installed along the open north side.

The excavation for the Filtration Building will be approximately 20' deep but the lower levels of the building have been situated far enough away from the existing structures such that no underpinning or braced excavations are anticipated. Per the geotechnical report, ground water is not likely to be present in the deep excavation.

Description of Design or Code Requirements:

Structural Design Criteria:

- Building Code: 2012 International Building Code as adopted by the State of Washington
- Design Load Standard: ASCE 7-10, as referenced in the 2012 IBC
- Occupancy or Risk Category: IV

- Design Loads:

Floor Areas:	100 PSF
Roof Areas:	30 PSF basic flat roof snow loading
	(Snow drifting considerations where required)
	Importance Factor = 1.20
Basic Wind:	115 MPH (3 second gust), Exposure C, Enclosed Building
Basic Seismic:	Site Class C, Seismic Design Category C
	Importance Factor = 1.50
	Intermediate Reinforced Masonry Shear Walls

- Foundations: Soil Bearing Pressure = 4000 PSF
  Frost Depth = 2'-0"
- Lateral Earth Pressures: At-Rest Pressure = 50 PCF
  Passive Soil Pressure = 460 PCF
  Soil/Concrete Friction Factor = .40

Design Alternatives Evaluated:

Roof Profile

The roof profile will depend greatly on how rain and snow runoff water can be handled on the site. Rain gutters with downspouts or internal roof drains with overflows will be required. A majority of the existing on site buildings have low slope roofs with parapet walls. It may be desirable to match this type of roof system.

1. Gable Roof with minimum 1:12 roof slope and maximum 3:12 roof slope
2. Low Slope Roof with minimum ½ : 12 roof slope

Foundation System

Per the geotechnical report, the building can be supported with conventional spread footings. Footings are to bear on native gravel soils or compacted structural fill. The walls around the lowered floor area will be designed as concrete retaining walls. Special attention will be needed to the design of these walls as walls of this height can deflect laterally a significant amount at the top as they are backfilled.

Lateral Force Resisting System

The perimeter CMU walls will be used as shear walls to withstand wind and seismic forces. Since the building is classified as Seismic Design Category C, seismic loads are not overly substantial and standard CMU walls with conventional reinforcement will be adequate.

Building Material Alternatives

The building materials listed below were considered for inclusion into the new Filtration Building. This list of materials is not meant to be comprehensive, only a list of various alternatives which have been considered for the project.

1. Roofing Systems
   a) Cold-formed metal roofing with high-performance "Kynar 500" (polyvinylidene fluoride) baked-on enamel, standing seam or delta-rib.
   b) Single-ply membrane roof (mechanically fastened or adhered)

2. Roof Spanning Members
   a) Clear span double pitched steel bar joist: open web steel joists @ 5'± o.c.
   b) Open web steel joist with joist girder or wide flange beam interior bearing: Open web steel joists @ 5'± o.c.

3. Wall Systems - Exterior Bearing and Non-bearing Walls
   a) CMU: Concrete Masonry Units
   b) Precast Concrete: Prefabricated or site cast concrete wall panels

4. Insulation Systems
   a) Roof
      i. Rigid board insulation: polystyrene or polyisocyanurate

   b) Walls
      i. CMU cells filled with foamed-in-place or poured-in insulation where required for R-value
      ii. Insulated precast concrete sandwich panels
      iii. Metal skin insulated sandwich panels

5. Ceilings
   a) None - open to structure
   b) Gypsum wallboard and paint at restrooms
   c) Composite metal deck with concrete slab at Compressor and Electrical Rooms

The greatest economy is achieved in a building when the building materials selected are of standard ordinary construction so that special construction techniques are not required.

For larger buildings with long required clear spans, open web steel joists with metal roof deck are an economical choice. When placed in wet environments, both the deck and steel joists should be galvanized or a specialty paint used. The maximum length joists that can be galvanized are in the range of 40-50'. Long span steel joist (>40-50') will require a field splice to allow for shipping and galvanizing. The galvanized joists and deck can be painted in-place if desired.

Exterior walls for the building will be of concrete masonry units (CMU). CMU walls are economical to build and provide a very durable and moisture resistant surface on both the interior and exterior sides. The CMU exterior surface can be smooth, ribbed, or "split faced". CMU exterior surfaces can be painted or the units can be integrally colored if desired. Since this building has a humid interior environment, the interior CMU finish should be painted with an impermeable paint. This paint system would be an epoxy system consisting of a block filler prime coat, and two coats of epoxy paint. Care must be taken when painting both the exterior and interior walls of a CMU building if the interior environment is wet. If the interior and exterior paint systems are both impermeable, moisture will be trapped inside the CMU wall, and the paint systems will fail in a short time.

CMU walls can be either standard or insulated, depending on the level of insulation required for a particular building. Standard block is easier to work with, and less expensive, but has a low R value. Insulated block has R values on the order of R8, but loses this insulating value at door jambs, lintels, and other places where structural requirements necessitate the removal of insulation and solid grouting of the cells. Since this building needs to comply with the 2012 WSEC, at least 50% of the CMU cells will need to be filled with foamed-in-place insulation. To meet this energy requirement, it will be beneficial to use 12" CMU for the exterior walls and space the vertical reinforcement as wide as possible to allow more cells to be insulated.

Roofing systems are somewhat dictated by the type of roof profile selected. For example, metal roofing works well for gable roofs with steeper roof slopes. Rain water can be collected in a gutter system and directed to a drainage area where it can be accommodated. Snow guards can be installed to help prevent snow from sliding off the roof but they are not always effective. Sliding snow can be a safety hazard and a maintenance problem if it has to be removed from around the building.

Single ply membrane roofs work well for low slope roofs with perimeter parapet walls. Roof drains with overflows collect the water and allow it to be piped internally down and out of the building to a preferred drainage area. Membrane roofs require annual maintenance to insure the drains and overflows are free flowing.

Design Recommendations:

Option #1: Low Slope Roof with Steel Joists, Center Beams & Columns

- Single ply membrane roof, ½ : 12 roof slope
- Rigid insulation over galvanized metal deck
- 45' span parallel chord open web (galvanized) steel trusses @ 5' ± o.c.
- Wide flange steel beams or joist girders (galvanized) under the ridge with interior steel columns
- 12" CMU exterior walls with 2' - 3' parapets approximately 24' high

Option #2: Gable Roof with Steel Joists, Center Beams & Columns

- Metal roofing over rigid insulation and galvanized metal deck – minimum 1:12 roof slope
- 45' span parallel chord open web (galvanized) steel trusses @ 5' ± o.c.
- Wide flange steel beams or joist girders (galvanized) under the ridge with interior steel columns
- 12" CMU exterior walls approximately 20' high on the side walls

Option #3: Low Slope Roof with Double Pitched Steel Joists clear spanning the 90' width of building

- Single ply membrane roof – ½ : 12 roof slope
- Rigid insulation over galvanized metal deck
- 90' span double pitched open web (galvanized) steel trusses @ 5' ± o.c.
- 12" CMU exterior walls with 2' – 3' parapets approximately 24' high. The 90' clear span will require that the steel joists be field-spliced for shipping and galvanizing.

CENTURY WEST
ENGINEERING CORPORATION

LEADING THROUGH EFFECTIVE SOLUTIONS

Project: Liberty Lake Sewer and Water District
Phase 2 Upgrade Design

Technical Memorandum No. TM CWEC-1
Site Civil Improvements Description

Prepared For: Liberty Lake Sewer and Water District

Prepared By: Century West Engineering Corporation (CWEC)
Dennis Fuller, PE
Nicole Moore, EIT

Date: 11-6-13

Purpose of Technical Memorandum:

As a part of the scope of work for Phase 2 of the Wastewater Treatment Improvements, Century West evaluated the civil site work necessary for the construction of the new Filtration Building. Our evaluation included the review of Phase 1 plans, surveying, determining necessary building access, stormwater drainage, demolition of existing structures, utility modifications, and a cost estimate for the work. Below is a description of the site work required for building the new Filtration Building.

Design Recommendations:

Site Topography and Proposed Elevation:

The proposed design of the new Filtration Building has the main floor slab at an elevation of 2,038.00 feet. The current grading of the site area is shown on Exhibit B. Most of the area is currently at 2,037 feet therefore the amount of grading the surrounding area for stormwater drainage will be minimal.

Demolition of Chlorination Building Overhead Crane:

There are two overhead cranes located on the north side of the existing Chlorination Building. In order for trucks to have full access to the new filtration building, the crane and reinforced concrete support closest to the proposed filtration building (west crane) will be removed. The steel monorail of the crane goes directly into the building through the front double doors and ends inside the back wall of the building. To reduce the cost of this demolition, the monorail will be cut at the front double doors so no structural changes will need to

be made to the building. The monorail can then be detached from the support and will be recycled. The support has a concrete footing that extends below the existing roadway. The support will need to be cut flush at the pavement, or just below. The surrounding pavement may need to be cut back in order to complete this task. Once the support has been removed, the pavement area will be replaced.

Utility Modifications:

Utility modifications for the new filtration building will include re-routing the potable water main around the proposed area for the building, as well as running a new line into the building for the restroom and eye wash stations. The restroom's proposed location is on the second floor. The potable water line is currently located beneath the existing access road to the north of the Ultraviolet (UV) Disinfection channels. During construction, the water line will be excavated and capped off at either side of the building construction area. The water line is looped around the perimeter of the facility, therefore capping will not disrupt water service to other areas and temporary routing of potable water will not be necessary.

The domestic sewage line from the restroom will be routed to the existing 6" line that drains to the drainage wet well (Item N26 on Exhibit A) located west of the aerobic digester control building. This is shown on Exhibit A.

Electrical power for the new building will be directed from the utility box located north of Clarifier Number One or from behind the Chlorination Building.

Roadway/Driveway Modifications:

The current roadway north of the UV tank will be demolished and a new roadway will be built that will accommodate passage around the north side of the filtration building. This road will be thirty (30) feet wide to accommodate chemical delivery trucks and other vehicles necessary for maintenance. Pavement will also be modified on the West side of the filtration building for access to both sets of double doors for truck access. All pavements will match the current road grade and will slope for runoff to be directed towards the Basin 14 Swale. Modifications are shown on the attached Exhibit C.

Other Demolition:

In order to accommodate the new filtration building and pavement access, irrigation lines, light poles, and a drywell will be demolished or relocated. The irrigation lines that lay to the north of the UV basin are

controlled by one automatic valve located to the west of the basin. There is roughly 300 feet of line and 12 sprinkler heads that must be removed during site grading. The two light poles and the drywell locations are also shown on Exhibit C. The light poles will be relocated during construction. The drywell, which is currently located in Drainage Basin 7 of the facility, will be removed.

Site Stormwater Drainage:

The new Filtration Building will be located within storm runoff Drainage Basin No. 14 and Drainage Basin 7 of the site. The stormwater from Drainage Basin 14 is managed by a swale and drywell and the stormwater from Drainage Basin 7 is managed by the drywell that is to be removed. The existing swale in Drainage Basin 14 will be extended to allow for additional runoff created by the new building, roadway, and the runoff that is currently managed by the Drainage Basin 7 drywell. The building will be guttered and the runoff will be directed by piping beneath the new roadway to the swale.

Requirements for Future Reclaimed Water System:

A future Reclaimed Water System storage reservoir will be located to the north or northeast of the new Filtration Building. Because there will be new paving around the perimeter of the building, a dry line for the Reclaimed Water System will be installed to avoid cutting through the new pavement when a reuse system is installed. The line is required to be placed at least 18 inches below the potable water line or sleeved at least 10 feet on either side of the potable water line.

Conduit for power will also be installed underneath the new roadway running from the existing power location west of the UV Disinfection Tank to the building.

The Reclaimed Water line and power conduit are shown parallel to the existing effluent line on Exhibit A, however the positions can be moved based on piping and other design considerations.

We have attached drawings and a cost estimate for this work to this memo.

NOTES

(N1) EXISTING CHLORINATION BUILDING

(N2) NEW DEWATERING BUILDING, SEE DP DRAWINGS

(N3) EXISTING AEROBIC DIGESTER NO. 2, SEE DP DRAWINGS

(N4) EXISTING AEROBIC DIGESTER CONTROL BUILDING, SEE FP SHEETS

(N5) EXISTING AEROBIC DIGESTER NO. 1, SEE FP SHEETS

(N6) NEW SECONDARY CLARIFIER NO. 4, SEE CP SHEETS

(N7) EXISTING SECONDARY CLARIFIER NO. 3, SEE CP SHEETS

(N8) EXISTING FLOW SPLIT BOX NO. 4, SEE CP1 AND CP2 FOR MODIFICATIONS

(N9) EXISTING UV CONTACT TANK

(N10) EXISTING SECONDARY CLARIFIER NO. 2, 2, SEE CP SHEETS

(N11) NEW SECONDARY CLARIFIER NO. 1, SEE CP SHEETS

(N12) EXISTING SECONDARY CONTROL BUILDING, SEE RP SHEETS

(N13) EXISTING FLOW SPLIT BOX NO. 3, SEE AP1, AP2 AND AP10 FOR MODIFICATIONS

(N14) NEW MIXED LIQUOR PUMP STATION, SEE SHEET AP9

(N15) EXISTING MAINTENANCE BUILDING

(N16) NEW AERATION BASIN 3 & 4, SEE AP SHEETS

(N17) EXISTING AERATION BASIN 1 & 2, SEE AP SHEETS

(N18) NEW MIXED LIQUOR PUMP STATION, SEE SHEET AP10

(N19) EXISTING FLOW SPLIT BOX NO. 2, TO BE REMOVED. SEE SHEET A1

(N20) NEW BLOWER BUILDING, SEE BP SHEETS

(N21) EXISTING SLUDGE BEDS, SIX TO BE REMOVED, SEVEN TO REMAIN IN PLACE. SEE OD1.

(N22) EXISTING EQUALIZATION CONTROL BUILDING, SEE XP SHEETS

(N23) EXISTING EQUALIZATION BASIN 1 & 2, BASINS ARE TO BE CONVERTED TO ANAEROBIC BASINS. SEE SHEET AP6.

(N24) EXISTING HEADWORKS, SEE HP SHEETS FOR MODIFICATIONS

(N25) EXISTING OPERATIONS BUILDING

(N26) EXISTING DRAINAGE WET WELL, SEE FP SHEETS FOR MODIFICATIONS

(N27) <1>

(N28) NEW

(N29) EXISTING FLOW SPLIT BOX NO. 2

(N30) <1>

(N31) NEW DRAIN SUMPS, SEE AP SHEETS.

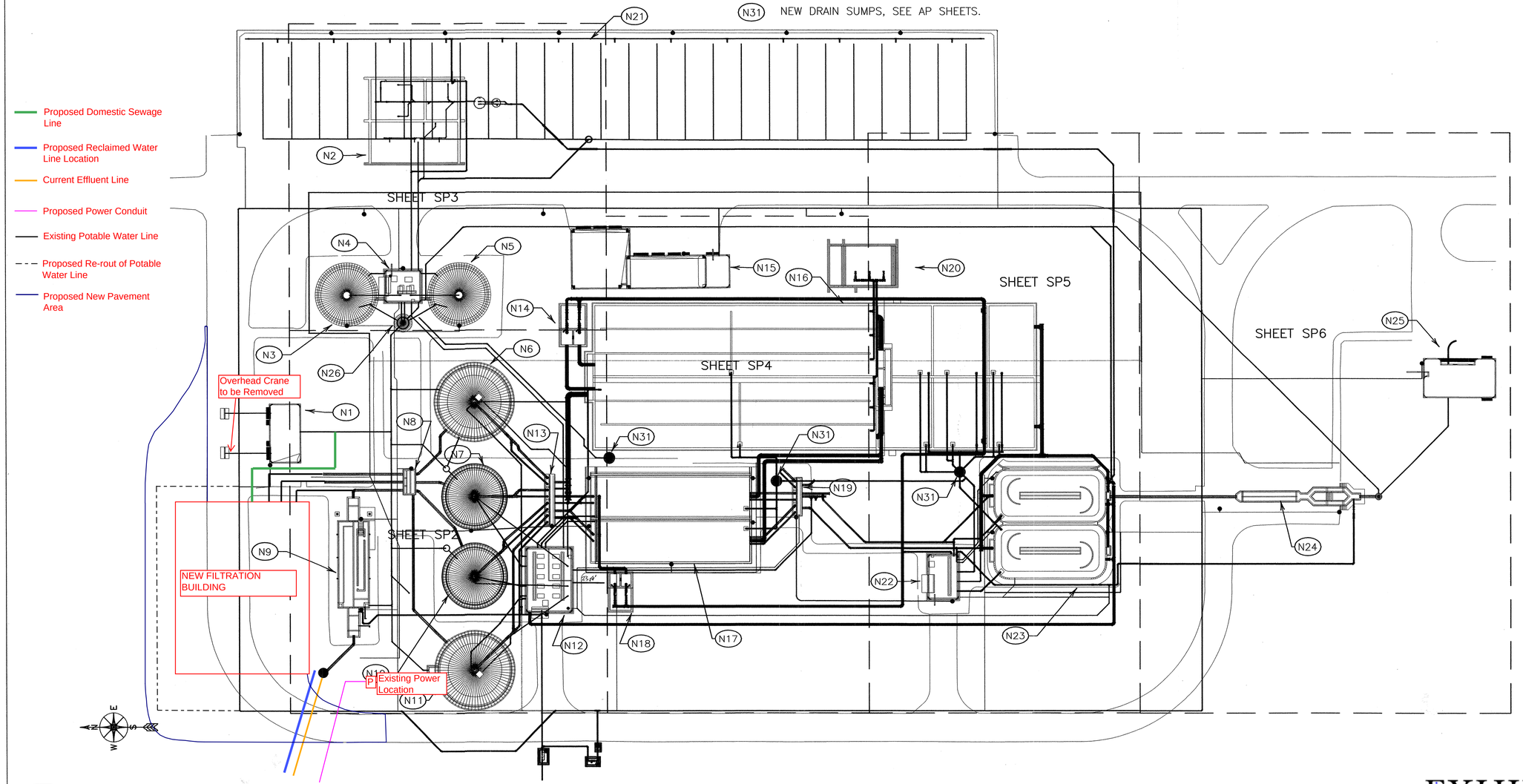
GENERAL NOTES AND ABBREVIATIONS

FIELD VERIFY LOCATION OF EXISTING PIPE AT ALL CONNECTIONS WITH NEW PIPES.

X EXISTING

P PROPOSED (PIPE TO BE INSTALLED)

R/A REMOVE/ABANDON. PIPES LABELED R/A ARE TO BE REMOVED WITHIN THE LIMITS OF EXCAVATION ONLY.



4.1 YARD PIPE LAYOUT PLAN
PIPE LAYOUT
0 20' 40'
Scale

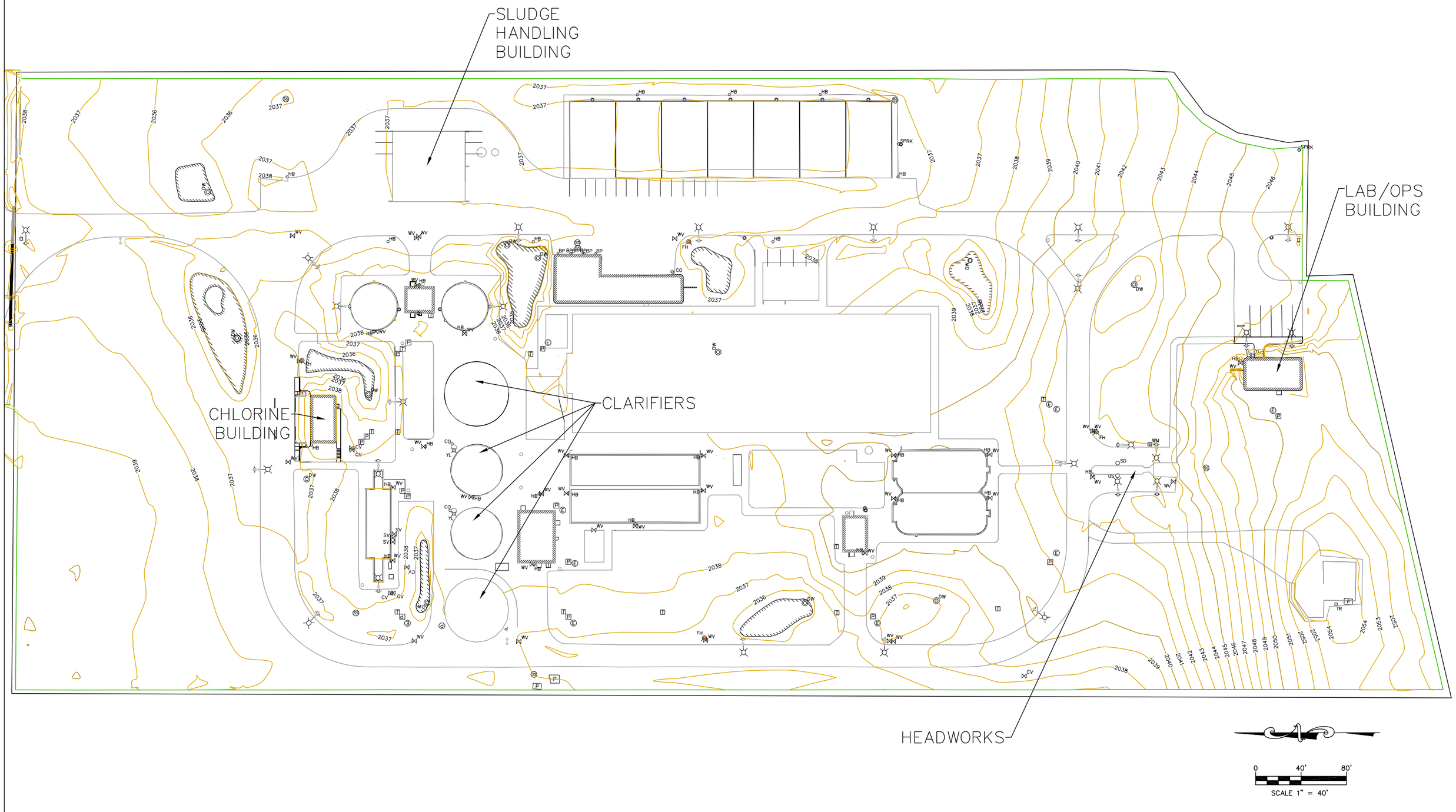
EXHIBIT A

BRIAN P. ILGEN STATE OF WASHINGTON 40129 REGISTERED PROFESSIONAL ENGINEER
EXPIRES 6-15-06

Project Engineer:
CENTURY WEST
ENGINEERING CORPORATION
1825 N. Hutchinson Road, 2nd Floor
Spokane, Washington 99212

YARD PIPING OVERALL LAYOUT PLAN
Wastewater Treatment Plant Improvements
Liberty Lake Sewer and Water District, Liberty Lake, WA

revisions
A1
drawing status
final
released for conform
release date
10/8/04
sheet
SP1
Sheet 32 of 265



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NO.	DATE	BY	APPR	REVISIONS

DESIGNED BY:	DATE: 9/24/13
DRAWN BY:	DWG NAME:
CHECKED BY:	SCALE:
PROJECT NO:	

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11707 E. MONTGOMERY DRIVE | 509.624.0355 (FAX)
SPOKANE VALLEY, WA 99206 | WWW.CENTURYWEST.COM

LIBERTY LAKE SEWER & WATER DISTRICT
PHASE 2

TOPOGRAPHY
EXHIBIT B

DWG. NO.

SHEET NO.
1 OF 1

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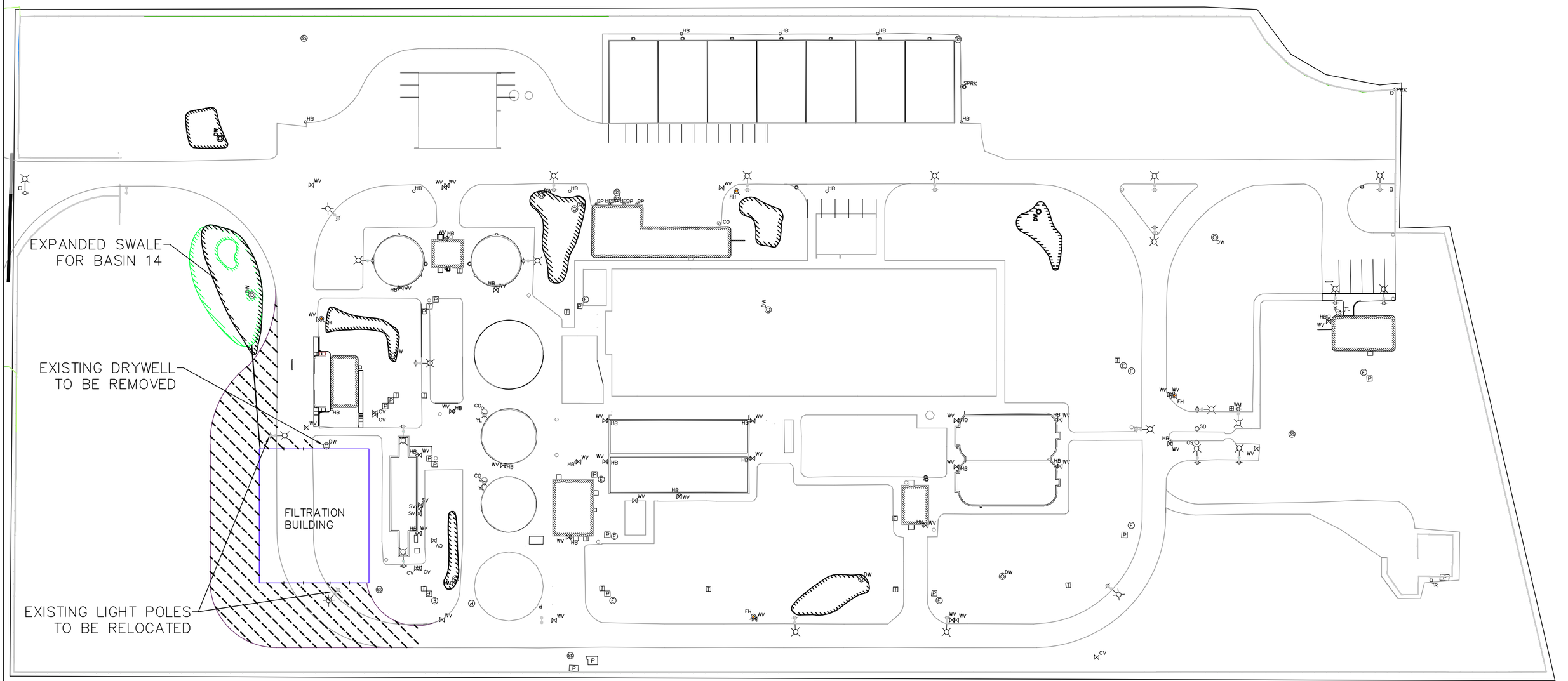

LEGEND

- PROPOSED PAVEMENT
- EXISTING PAVEMENT
- EXISTING DRAINAGE SWALE
- PROPOSED EXPANDED SWALE

0 40' 80'

SCALE 1" = 40'

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DRAWN BY:	DWG NAME:
CHECKED BY:	SCALE:
PROJECT NO:	

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11707 E. MONTGOMERY DRIVE | 509.624.0355 (FAX)
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LIBERTY LAKE SEWER & WATER DISTRICT
PHASE 2
PROPOSED ROAD & DRAINAGE IMPROVEMENTS
EXHIBIT C

DWG. NO.

SHEET NO. 1 OF 1

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Preliminary Cost Estimate

Project Name: **LLSWD Phase 2 Civil Site Improvements**

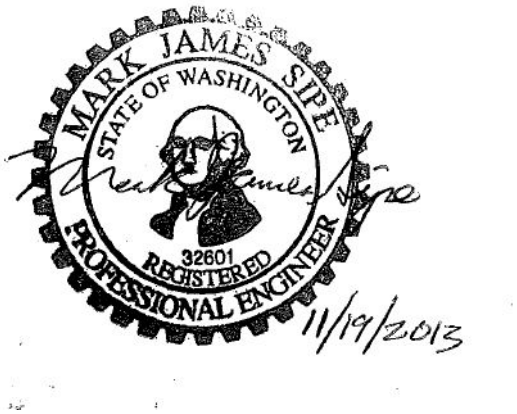
Prepared By: **Century West Engineering Corp.**
Preparation Date: **October 10, 2013**

ITEM #	ITEM DESCRIPTION	UNIT OF MEASURE	PLANNED QUANTITY	ESTIMATED UNIT PRICE	ESTIMATED ITEM PRICE
1	MOBILIZATION	L.S.	1	$ 3,000.00	$ 4,300
2	CLEARING AND GRUBBING	L.S.	1	$ 3,000.00	$ 3,000
3	DEMOLITION OF EXISTING STRUCTURES	L.S.	1	$ 3,000.00	$ 3,000
4	ROADWAY AND SWALE EXCAVATION & EMBANKMENT, INCL. HAUL	C.Y.	300	$ 30.00	$ 9,000
5	CRUSHED SURFACING TOP COURSE	Ton	800	$ 20.00	$ 16,000
6	HMA CL. 1/2", 0.25 FT. DEPTH, PG 64-28	Ton	350	$ 85.00	$ 29,750
7	SOLID WALL PVC STORM SEWER PIPE 12 IN. DIAM	L.F.	90	$ 50.00	$ 4,500
8	6" PVC Drainage Piping	L.F.	200	$ 15.00	$ 3,000
9	GRASS HYDROSEEDING	S.Y.	2,100	$ 3.00	$ 6,300
10	18" C-900 PRESSURE PIPE	L.F.	70	$ 60.00	$ 4,200
11	6" ELECTRICAL CONDUIT	L.F.	70	$ 30.00	$ 2,100
12					$ -
13					$ -
14					$ -
15					$ -
16					$ -
17					$ -
18					$ -
19					$ -
20					$ -
	TOTAL CONSTRUCTION ESTIMATE				**$ 85,150**

Inflation Adjustment Factor (4%/yr)	2 years	**$ 6,812**
Sales Tax (8.7%)		**$ 8,001**
Construction Sub-Total		**$ 99,963**
Engineering & Administration Contingency (25%)		$ 24,991
TOTAL COST ESTIMATE		**$ 125,000**

Cost Estimate Assumptions:

COFFMAN ENGINEERS



Project: Liberty Lake Sewer and Water District
Water Reclamation Facility
Phase 2 Improvements Design

Technical Memorandum No. ME-1

Prepared For: Century West Engineering Corporation (CWEC)

Prepared By: Coffman Engineers
Bryan Phillips
Mark Sipe

Date: 11-19-2013

Purpose of Technical Memorandum:
The purpose of this memorandum is to briefly describe the design approach for the HVAC and plumbing systems for the new filtration building and to provide our initial understanding of the 2012 WSEC Commercial Provisions as they pertain to the HVAC equipment to be installed in the new and existing facilities of the LLWSD plant. This includes the adoption of the 2012 International Energy Conservation Code (IECC) with Washington State amendments. This memo addresses sections C403 – Mechanical System, C404 – Service Water Heater and C408 – System Commissioning. This memo is a preliminary review of the facility as it has currently been described. The design and application of the code to this project may necessitate revisions and changes as the project design develops.

Systems will be provided to the filtration building to keep the building conditioned and ventilated. It is anticipated that the building will not be continually occupied. The building will be provided with electric unit heaters to prevent freezing and provide comfort heat when it is needed. General ventilation will be provided by an exhaust fan/supply fan combination or an exhaust fan and intake louver combination. Selection of this will depend upon the floorplan of the building and the area classification of the spaces it contains. Plumbing systems will consist of general drainage in the form of floor and trench drains as well as dedicated drains for process equipment. Potable water will be provided for wash down sinks, washdown hosebibbs and emergency fixtures as the architectural layout determines.

Chapter 4 – Commercial Energy Efficiency, Section C403, Mechanical Systems

Description of Design or Code Requirements: C403.2.1 Calculation of heating and cooling loads.

> Design loads shall be determined in accordance with the procedures described in ANSI/ASHRAE/ACCA Standard 183. The design loads shall account for the building envelope, lighting, ventilation and occupancy loads based on the project design. Heating and cooling loads shall be adjusted to account for load reductions that are achieved where energy recovery systems are utilized in the HVAC system in accordance with the ASHRAE *HVAC Systems and Equipment Handbook*. Alternatively, design loads shall be determined by an *approved* equivalent computation procedure, using the design parameters specified in Chapter 3.

Design Alternatives Evaluated: The load calculations will be performed in accordance with standard 183. This calculation along with process and facility requirements will be used to select mechanical equipment for the conditioning of the facility.

Description of Design or Code Requirements: C403.2.2 Equipment and System Sizing

> The output capacity of heating and cooling equipment and systems shall not exceed the loads calculated in accordance with Section C403.2.1. A single piece of equipment providing both heating and cooling shall satisfy this provision for one function with the capacity for the other function as small as possible, within available equipment options.

Design Recommendations: The equipment for the HVAC system will be selected to closely match the calculated load to an available equipment size.

Description of Design or Code Requirements: C403.2.3 HVAC equipment performance requirements

> Equipment shall meet the minimum efficiency requirements of Tables C403.2.3(1), C403.2.3(2), C403.2.3(3), C403.2.3(4), C403.2.3(5), C403.2.3(6), C403.2.3(7) and C403.2.3(8) when tested and rated in accordance with the applicable test procedure. Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of Table C403.2.3(9). The efficiency shall be verified through certification and listed under an *approved* certification program or, if no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements. Where components, such as indoor or outdoor coils, from different manufacturers are used, calculations and supporting data shall be furnished by the designer that demonstrates that the combined efficiency of the specified components meets the requirements herein.
>
> Gas-fired and oil-fired forced air furnaces with input ratings, 225,000 Btu/h (65 kW) and all unit heaters shall also have an intermittent ignition or interrupted device (IID), and have either mechanical draft (including power venting) or a flue damper. A vent damper is an acceptable alternative to a flue damper for furnaces where combustion air is drawn from the conditioned space. All furnaces with input ratings, 225,000 Btu/h (65 kW), including electric furnaces, that are not located within the conditioned space shall have jacket losses not exceeding 0.75 percent of the input rating.

Design Recommendations: Equipment will be selected so that listed efficiencies comply with the requirements of the tables referenced above.

Description of Design or Code Requirements: C403.2.4 HVAC system controls

Each heating and cooling system shall be provided with thermostatic controls as specified in Section C403.2.4.1, C403.2.4.2, C403.2.4.3, C403.2.4.4, C403.4.1, C403.4.2, C403.4.3, C403.4.4, C403.4.5, C403.4.6, C403.4.7, C403.4.8, C403.4.9, or C403.4.10.

Design Recommendations: Thermostatic control will be used, however, the exemption for off-hour controls will be used since most of the spaces are not conditioned for occupancy, since this facility is more industrial in function, it is recommend that the exemption in C403.2.4.3 Off-hour controls be used to allow the thermostatic control to be designed to operate in a continuous manner rather than be designed to have the setback that is typically required.

Description of Design or Code Requirements: C403.2.4.4 Shutoff damper controls

Both outdoor air supply and exhaust ducts shall be equipped with motorized dampers that will automatically shut when the systems or spaces served are not in use or during building warm-up, cooldown, and setback.

Exceptions:

1. Gravity relief dampers serving systems less than 5,000 cfm total supply shall be permitted in buildings less than three stories in height.

2. Gravity dampers shall be permitted for buildings of any height located in Climate Zones 1, 2 and 3.

3. Gravity (nonmotorized) dampers in Group R occupancies where the design outdoor air intake or exhaust capacity does not exceed 400 cfm (189 L/s).

4. Systems serving areas which require continuous operation.

5. Combustion air intakes.

6. Operation of dampers shall be allowed during ventilation prepurge one hour before expected occupancy and for unoccupied period precooling during the cooling season.

7. Dampers are not required in systems where specifically prohibited by the *International Mechanical Code*.

Design Recommendations: We do not anticipate requiring a motorized damper on the intake for the make up air unit in the filtration building because of the exemption that the code allows for equipment that operates continuously.

Description of Design or Code Requirements: C403.2.5 Ventilation

Ventilation, either natural or mechanical, shall be provided in accordance with Chapter 4 of the *International Mechanical Code*. Where mechanical ventilation is provided, the system shall provide the capability to reduce the outdoor air supply to the minimum required by Chapter 4 of the *International Mechanical Code*.

Design Recommendations: It is anticipated that the ventilation rate required by the process and classification considerations will far exceed the ventilation requirement of the IMC. We will perform a review of the requirements of the international mechanical code to verify that the amount of ventilation air required is supplied to the space as a part of the ventilation air.

Description of Design or Code Requirements: C403.2.6 Energy Recovery

C403.2.6.1 Energy recovery ventilation systems. Any system with minimum outside air requirements at design conditions greater than 5,000 CFM or any system required by Table C403.2.6 shall include an energy recovery system. The energy recovery system shall have the capability to provide a change in the enthalpy of the outdoor air supply of not less than 50 percent of the difference between the outdoor air and return air enthalpies, at design conditions. Where an air economizer is required, the energy recovery system shall include a bypass or controls which permit operation of the economizer as required by Section C403.4. Where a single room or space is supplied by multiple units, the aggregate ventilation (cfm) of those units shall be used in applying this requirement.
Exception: An energy recovery ventilation following conditions:

1. Where energy recovery systems are prohibited by the *International Mechanical Code*.

2. Laboratory fume hood systems that include at least one of the following features:

2.1. Variable-air-volume hood exhaust and room supply systems capable of reducing exhaust and makeup air volume to 50 percent or less of design values.

2.2. Direct makeup (auxiliary) air supply equal to at least 75 percent of the exhaust rate, heated no warmer than 2°F (1.1°C) above room setpoint, cooled to no cooler than 3°F (1.7°C) below room setpoint, no humidification added, and no simultaneous heating and cooling used for dehumidification control.

3. Systems serving spaces that are heated to less than 60°F (15.5°C) and are not cooled.

4. Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site solar energy.

5. Heating energy recovery in Climate Zones 1 and 2.

6. Cooling energy recovery in Climate Zones 3C, 4C, 5B, 5C, 6B, 7 and 8.

7. Systems requiring dehumidification that employ energy recovery in series with the cooling coil.

8. Multi-zone systems with cold deck supply air and zone reheat where the minimum outdoor air is less than 70 percent of total supply air.

Design Recommendations: It is not anticipated that this requirement for energy recovery will apply to the filtration building due to volume of air that will be provided but this must be further evaluated as the building design progresses.

Description of Design or Code Requirements: C403.2.7 Duct and Plenum insulation and sealing

C403.2.7.1 Ducts, shafts and plenums conveying outside air from the exterior of the building to the mechanical system shall meet all air leakage and building envelope insulation requirements of Section C402, plus building envelope vapor control requirements from the *International Building Code*, extending continuously from the building exterior to an automatic shutoff damper or heating or cooling equipment. For the purposes of building envelope insulation requirements, duct surfaces shall meet the requirements for metal framed walls per Table C402.1.2. Duct surfaces included as part of the building envelope shall not be used in the calculation of maximum glazing area as described in Section 402.3.1.

Exceptions:

1. Outside air ducts serving individual supply air units with less than 2,800 cfm of total supply air capacity, provided these are insulated to R-7.

2. Unheated equipment rooms with combustion air louvers, provided they are isolated from conditioned space at sides, top and bottom of the room with R-11 nominal insulation.

Design Recommendations: Ducts conveying air from the exterior will be sealed and insulated in accordance with the energy code. This is anticipated to be minimal since the equipment will most likely be mounted on the interior portion of the exterior wall of the facility.

Description of Design or Code Requirements: C403.2.10.1 Allowable fan floor horsepower

Each HVAC system at fan system design conditions shall not exceed the allowable *fan system motor nameplate hp* (Option 1) or *fan system bhp* (Option 2) as shown in Table C403.2.10.1(1). This includes supply fans, return/relief fans, and fan-powered terminal units associated with systems providing heating or cooling capability. Single *zone* variable-air-volume systems shall comply with the constant volume fan power limitation.

Design Recommendations: The fans need to be selected to meet the minimum horsepower requirements as listed in Table C403.2.10.1(1).

Description of Design or Code Requirements: C403.2.10.2 Motor nameplate horsepower

For each fan, the selected fan motor shall be no larger than the first available motor size greater than the brake horsepower (bhp). The fan brake horsepower (bhp) shall be indicated on the design documents to allow for compliance verification by the *code official*.

Exceptions:

1. For fans less than 6 bhp (4413 W), where the first available motor larger than the brake horsepower has a nameplate rating within 50 percent of the bhp, selection of the next larger nameplate motor size is allowed.

2. For fans 6 bhp (4413 W) and larger, where the first available motor larger than the bhp has a nameplate rating within 30 percent of the bhp, selection of the next larger nameplate motor size is allowed.

3. For fans used only in *approved* life safety applications such as smoke evacuation.

Design Recommendations: The fans will be selected such that the motors are the next size motor up from the brake horsepower.

Description of Design or Code Requirements: C403.2.13 Electric motor efficiency

> Design A and B squirrel-cage, T-frame induction permanently wired polyphase motors of 1 hp or more having synchronous speeds of 3,600, 1,800 and 1,200 rpm shall have a nominal full-load motor efficiency no less than the corresponding values for energy efficient motors provided in NEMA Standard MG-1.
> **Exceptions:**
>
> 1. Motors used in systems designed to use more than one speed of a multi-speed motor.
>
> 2. Motors used as a component of the equipment meeting the minimum equipment efficiency requirements of Section C403.2.3 and Tables C403.2.3(1) through C403.2.3(9) provided that the motor input is included when determining the equipment efficiency.
>
> 3. Motors that are an integral part of specialized process equipment.
>
> 4. Where the motor is integral to a listed piece of equipment for which no complying motor has been approved.
>
> Fan motors less than 1 hp in series terminal units shall be electronically commutated motors, or shall have a minimum motor efficiency of 65 percent when rated in accordance with NEMA Standard MG-1 at full load rating conditions.

Design Recommendations: Where motors of selected equipment are not a part of the overall equipment efficiency, the motor will be specified to comply with the requirements of NEMA standard MG-1.

Chapter 4 – Commercial Energy Efficiency, Section C404, Service Water Heating

Description of Design or Code Requirements: C404.2 Service Water-heating equipment performance efficiency

> Water-heating equipment and hot water storage tanks shall meet the requirements of Table C404.2. The efficiency shall be verified through certification and *listed* under an *approved* certification program, or if no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the manufacturer.

Design Alternatives Evaluated: Various fuels have been considered, but it is our recommendation to use electricity as the heating source for the water heater. This was decided because there is not natural gas on the site and fuel oil requires maintenance and the installation of storage tanks specifically for the hot water heater

Design Recommendations: The requirements of Table C404.2 are prescriptive in regard to the performance required for the device. Electricity is available on the site and is a low maintenance option

for providing hot water generation; therefore an electric water heater meeting the performance criteria in table C404.2 will be selected.

Description of Design or Code Requirements: C404.3 Temperature Controls

> Service water-heating equipment shall be provided with controls to allow a setpoint of 110°F (43°C) for equipment serving dwelling units and 90°F (32°C) for equipment serving other occupancies. The outlet temperature of lavatories in public facility rest rooms shall be limited to 110°F (43°C).

Design Recommendations: The service water heater will be provided with controls to allow variation in the temperature of the water that is delivered to the hot water fixtures.

Description of Design or Code Requirements: C404.4 Heat traps

> Water-heating equipment not supplied with integral heat traps and serving noncirculating systems shall be provided with heat traps on the supply and discharge piping associated with the equipment.

Design Recommendations: The service water heating system will have heat traps. This will be detailed in the design documents.

Description of Design or Code Requirements: C404.5 Water heater installation

> Electric water heaters in unconditioned spaces or on concrete floors shall be placed on an incompressible, insulated surface with a minimum thermal resistance of R-10.

Design Recommendations: Insulation will be provided for the water heater in accordance with the energy code.

Chapter 4 – Commercial Energy Efficiency, Section C408, System Commissioning

Description of Design or Code Requirements: C408.1 General

> This section covers the commissioning of the building mechanical systems in Section C403, service water heating systems in Section C404, electrical power and lighting systems in Section C405 and energy metering in Section C409. Prior to passing the final mechanical and electrical inspections or obtaining a certificate of occupancy, the *registered design professional* or approved agency shall provide evidence of systems *commissioning* and completion in accordance with the provisions of this section.
> Copies of all documentation shall be given to the owner and made available to the *code official* upon request in accordance with Sections C408.1.2 and C408.1.3.

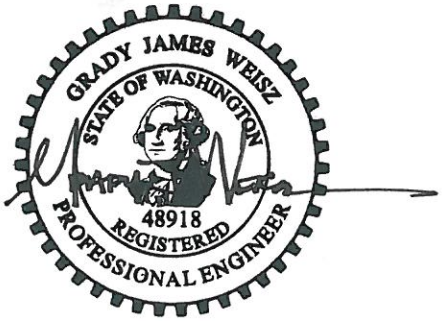
Design Recommendations: It is the recommended that the owner hire a commissioning agent to complete the commissioning process as described and required by the 2012 Washington State Energy Code. The commissioning agent will be responsible for documenting, developing and executing the commissioning

process and developing the report and documentation for this process in accordance with figure C408.1.2.1 Commissioning Compliance Checklist.

Additional Considerations

The filtration building classification is being considered as a hazardous group, H-4 due to the quantity of corrosives being stored. Depending upon the amount of corrosive material and the physical state, dedicated ventilation may be required. This would include ductwork, fans, louvers, dampers and controls for a complete and operational system. The materials used will be resistant to corrosion and the equipment explosion proof. Ventilation of the space may serve to reduce contaminants as well as reduce the area classification but specific solutions will need to be developed based upon the actual space.

Trindera ENGINEERING



Project: Liberty Lake Sewer and Water District
Water Reclamation Facility
Phase 2 Improvements Design

Technical Memorandum No. TM TE-3:

Upgrades to Electrical Service Distribution and Standby Power, Existing Site Electrical Modifications, Filtration Building Electrical Code Review

Prepared For: Century West Engineering Corporation

Prepared By: Trindera Engineering, Inc.
Grady Weisz, P.E.
Tyler Spence P.E.

Date: November 20, 2013

Memorandum Summary

The purpose of this Technical Memorandum is the following:

1. To state the electrical design criteria used for facility Phase 2 Improvements based on known project design requirements and site evaluation by Trindera Engineering Inc.
2. To summarize the evaluation of the existing facility electrical power system, both utility supplied and on site supplied.
3. To summarize facility power system design approaches that were considered for Phase 2 Improvements implementation.
4. To provide recommendations for electrical power system design for Phase 2 Improvements implementation.

Electrical Preliminary Design and Evaluation Criteria

The following codes and standards were primarily considered in the electrical pre-design evaluation process:

- Washington Administrative Code (WAC)
- Revised Code of Washington (RCW)
- National Electrical Code (NFPA 70 – 2008)
- Standard for Electrical Safety in the Workplace (NFPA 70E - 2009)
- Standard for Fire Protection in Wastewater Treatment Facilities and Collection Systems (NFPA 820 - 2008)

- IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems (IEEE Std 519-1992)
- International Building Code (IBC - 2012)

At minimum the following codes, standards, associations and agencies, and their relevant subsequent standards and codes will be utilized in the Phase 2 electrical design and construction, including the design and construction of the new Filtration Building:

- National Electrical Manufacturers Association (NEMA)
- Underwriters Laboratories (UL)
- Institute of Electrical and Electronic Engineers (IEEE)
- Washington Administrative Code (WAC)
- Revised Code of Washington (RCW)
- National Fire Protection Agency (NFPA)
- International Building Code (IBC - 2012)

Additional Considerations

1. Fire Protection Systems

The filtration building may be classified as a Hazard Group H-4 area based on the quantity and properties of stored chemicals within the treatment building. If this is the case the building will be required to have an automatic sprinkler system. To protect electrical equipment installed within the treatment building process room from the discharge of the automatic sprinkler system, we will design electrical equipment inside this room to be NEMA 4X rated. Equipment listed with this rating level will provide protection against rain, splashing water and hose directed water without damage to internal components. This equipment is typically made from stainless steel, plastics or fiberglass and therefore is also resistant to corrosion.

It is recommended that the electrical room does not contain an automatic sprinkler system. The electrical equipment installed inside this room does not typically come with a NEMA 4X rating, and therefore would be prohibitively expensive. Instead the conduits entering or exiting the room will have an intumescent material installed within to stop the spread of smoke, fire, toxic gas and water in or out of the electrical room through the conduits. This same approach may also be taken with the blower room, since this room itself does not contain any stored chemicals.

2. Utility Incentives

Avista Utilities (Avista), the facility utility power provider may offer monetary rebates and incentives for energy saving design implementation such as the use of variable frequency drives, premium efficiency motors and efficient lighting to reduce facility energy consumption. Trindera Engineering will work with Avista representatives to identify these potential rebates and incentives and structure the design and contract documents to aid in their procurement.

Electrical Power System Evaluation

Presently the facility receives its power from Avista overhead power lines that run north-south along Indiana Avenue, west of Harvard Road. These power lines are tapped to feed a pad mounted transformer west of the Secondary Control Building. Power conductors then run underground from this transformer at 480 volts to the Secondary Control Building into the facility main switchboard.

The main switchboard is rated for 1600 amps, with a 1200 amp main breaker. During the previous facility upgrade project, the engineering load calculations for instantaneous facility power consumption was approximately 1520 amps, including applied load diversity factors. Records obtained from Avista showed that the maximum measured instantaneous power from the last three years was 541 amps.

The secondary control building also houses a standby power main switchboard. This switchboard is fed from a Cummins diesel engine driver generator located in the same building. The generator can provide around 1130 amps at the system voltage. The power scheme for the facility is comprised of separate cables run from the normal power switchboard and the standby power switchboard to motor control centers (MCCs) in each of the buildings on the site. At the individual buildings both sets of cables are landed on an automatic transfer switch in the building MCC. When power is lost the MCC automatic transfer switches transfer their load from the normal power feeder cables, to the feeder cables from the generator.

Electrical Power System Preliminary Design Alternatives Evaluated

The primary process upgrade in the Phase 2 Improvements is a new tertiary level treatment system for the wastewater from the Liberty Lake, Washington area. This proposed system and associated building is by and large the driving factor in facility electrical modifications for the Phase 2 Improvements project. The new equipment to be used for this treatment system will necessitate power system capacity expansion. Based on Esvelt Environmental Engineering's preliminary research into expected electrical loads for these upgrades, we calculate the added load to the system to be approximately 600 amps at 480 volts, and up to 800 amps if allowance for future reclaimed water pumping is included.

For reliability purposes, the power system for Phase 2 Improvements will be designed so that all tertiary treatment system loads will be alternatively supplied by standby power from a diesel generator for a period of up to 24 hours, should normal utility power be lost.

Below are two major design decisions to be made about how the new loads should be powered at the facility:

1. Treatment Building Utility Power Configuration

   Alternative 1 – Existing (Normal Power) Switchboard Feed: This design would include modifying the existing normal power switchboard in the Secondary Control Building. A new circuit breaker would need to be added to the existing switchboard. New conductors would be routed from the breaker to the new treatment building, using a combination of new and existing underground conduits. The conductors would terminate on a new MCC with a transfer switch similar to other MCCs in the facility.

   Design Benefits:

   - Savings in underground conduit cost as existing raceways can be used.
   - Existing power scheme is used (continuity).

   Design Drawbacks:

   - Requires complicated staging and facility downtime while the existing main switchgear is modified.
   - Limited space in existing switchboard.
   - Risk of overloading main switchboard.
   - Additional implementation cost of remodel vs. new construction and staging.
   - Main breaker size would need to be increased.
   - Limited availability of spare raceways from the Secondary Control Building.
   - May require increasing the size of the existing utility transformer.

   Alternative 2 – New Service: This design would include the installation of new utility service and utility transformer adjacent to the new treatment building. New conductors would be run underground to the treatment building to a new disconnect switch or MCC with a transfer switch similar to other MCCs in the facility.

   Design Benefits:

   - Lower implementation cost (no remodel).
   - Construction can be completed independent of existing facility operation.
   - New equipment would be utilized.
   - Potential to implement a redundant power feed. For example, if the two systems are tied together, one switchboard can be shutdown for service while the facility is fed from the other service.

Design Drawbacks:

- Additional utility service and meter.
- Introduces a separate unique power system on site.

2. Treatment Building On Site Standby Power Configuration

Alternative 1 – Existing (Generator) Switchboard Feed: This design would include modifying the existing standby power switchboard in the Secondary Control Building. A new circuit breaker would need to be added to the existing switchboard. New conductors would be routed from the breaker to the new treatment building, using a combination of new and existing underground conduits. The conductors would terminate on a new MCC with a transfer switch similar to other MCCs in the facility.

Design Benefits:

- Savings in underground conductor cost as existing raceways can be used.
- Existing power scheme is used (continuity).

Design Drawbacks:

- Limited space in existing switchboard.
- Risk of overloading existing generator.
- Additional implementation cost of remodel vs. new construction and staging.

Alternative 2 – New Generator: This design would include the purchase and installation of a new outdoor standby generator capable of providing standby power to the new treatment building. New conductors would be run underground to the treatment building to a new disconnect switch or MCC with a transfer switch similar to other MCCs in the facility.

Design Benefits:

- Potential to implement a redundant standby power feed. For example, if the two systems are tied together, and one generator fails, the facility could be fed from the other generator.
- New generator may be more reliable than older generator.
- Reduced cost in shorter conductors from the generator to the treatment building electrical room.

Design Drawbacks:

- Cost of new generator.
- Additional operation and maintenance costs for a new generator.

Design Recommendations

1. Treatment Building Utility Power Configuration

In evaluating the two options, the calculated load from the existing facility added to the calculated load from the new treatment building is significantly larger than the existing service circuit breaker size. Actual load may not in fact be that large, but if the new treatment building loads are connected to the existing switchboard a greater potential exists to overload the main switchboard than if a separate service were utilized. This potentially reduces the overall reliability of the facility.

The existing switchboard also has limited space. The largest feeder breaker currently installed in the switchboard is an 800 amp unit. The new circuit breaker feeding the treatment building would be same size, or larger.

Based primarily on the two factors above our recommended approach is the following:

> ***Alternative 2 – New Service:*** Feed the new treatment building from a new service.

2. Treatment Building On Site Standby Power Configuration

In evaluating these two options, the predicted load from the new treatment building when added to the recorded peak measured utility values is near or above the capacity of the existing generator. If the new treatment building loads are connected to the existing generator a greater potential exists to overload the generator. This potentially reduces the overall reliability of standby power for the facility.

The existing standby power switchboard also has limited space. The largest feeder breaker currently installed in this switchboard is an 800 amp unit. The new circuit breaker feeding the treatment building would be same size, or larger.

If a new generator was installed as discussed in Alternative 2, it could be located very close to the new treatment building electrical room. In comparison with Alternative 1 the length of the large conductors that need to be installed could be greatly reduced. This comparative reduction in cost should be weighed to offset a portion of the cost for a new generator.

Based primarily on the three factors above our recommended approach is the following:

> ***Alternative 2 – New Generator:*** Feed the new treatment building from a new standby generator.

Water, Industrial and Domestic Wastewater, Reclaimed Water, Biosolids, Odors and Air Emissions: Treatment Design, Planning, Funding, Studies, Modeling, Operation, Permitting, Management

ESVELT ENVIRONMENTAL ENGINEERING, LLC
7605 EAST HODIN DRIVE, SPOKANE, WA 99212-1816
Phone: 509-926-3049
Fax: 509-922-3073

9/6/2013

Project: Liberty Lake Sewer and Water District
Phase 2 Upgrade Design

Tech. Memo: TM-EEE-1 Headworks Modifications – Screening and Flow Metering

Prepared For: Century West Engineering Corporation (CWEC)

Prepared By: Allison Esvelt, MSCE, PE, BCEE, Esvelt Environmental Engineering, LLC
Nicole Moore, EIT, Century West Engineering Corporation

Date: September 6, 2013

Purpose of Technical Memorandum: The purpose of this technical memorandum is to summarize the in-channel fine screen and flow meter alternatives for installation in the existing wastewater treatment system headworks channels to meet future design influent wastewater flows.

Existing Screening: The existing headworks screening consists of two (2) 24-inch wide screening channels. The channels were designed to each convey up to 3.0 MGD (reference Sheet 6 of the 1980 Wastewater Treatment Facilities Post Construction Drawings (1980 As-Built Drawings)) for a total peak flow capacity of 6.0 MGD. Under current operations, flow entering the channels is directed into the east channel. A Hycor Heliclean Model HLC300 perforated micro strainer fine screen with 6 mm openings was installed in the east channel in 1997. The capacity of the existing fine screen is estimated to be 1 MGD. In the west channel, there is a coarse bar screen with 1&1/4-inch openings, and a Parkson mechanical bar screen. The west channel is currently used for overflow, or when the fine screen in the east channel is removed from service.

Proposed Screening: The permitted and projected peak influent design flow for the plant through year 2028 is 4.0 MGD. It is therefore recommended that provisions be provided to screen up to this design flow by installing a 3.0 MGD peak flow capacity new fine screen in the west channel and utilizing the existing 1.0 MGD capacity screen in the east channel.

Elevations and Water Surface Levels at the headworks are listed below:

- Bottom of grit channel elevation is 2039.89’ North American Datum (NAD) (2036.28’ + 3.61’ per Sheet 23 of the 1980 As-Built Drawings).
- Grit chamber effluent weir plate bottom of opening is 2040.89’ (12” + 2039.89’ per Sheet 6 (OP3) and Sheet 19 (SC7) of the 2004 Phase 1 Upgrade As-Built Drawings).
- Water surface depth in the grit channels is estimated to be ±3.36’ and elevation ±2043.25’ at 3.0 MGD in each channel based on estimated flow over the weir plate.
- Bottom of the fine screen channel elevation is 2041.81’ (2038.20’ + 3.61’ per Sheet 23 of the 1980 As-Built Drawings).

- Water surface depth immediately downstream of fine screens is estimated to be ±1.44' at 3.0 MGD in each channel.
- Water surface elevation immediately upstream of the existing fine screen (HLC300) is estimated to be ±2044.0' at 3.0 MGD (based on clean water headloss curves) in the existing fine screen channel. The headworks influent pipe is surcharged at this elevation by ±6-inches.
- The clean water headloss at 3 MGD through the proposed new fine screen at the downstream water level ±17-inches, based on manufacturer's submitted clean water headloss curves, is estimated to range between 5 to 11 inches. This is acceptable given the current and future design flows (up to 4.0 MGD total – 3.0 MGD in new screen channel and 1.0 MGD in existing screen channel) and hydraulic profiles.

Design Alternatives Evaluated: Table TM-EEE-1.1 below lists the fine screen alternatives evaluated.

Table TM-EEE-1.1. Fine Screen Alternatives Evaluated

Make/Type	Model	Basket Width	Basket Type/ Opening Size	Equipment Cost (1)
Lakeside Raptor Micro Strainer	24MS -0.25-110	21-inches	Perforated Plate, 6 mm	$102,000
Huber Rotamat Micro Strainer	Ro9/500XL/6	20-inches	Perforated Plate, 6 mm	$103,000
Hycor Helisieve Micro Strainer	HLS500	18-inches (Est.)	Perforated Plate, 6 mm	$100,000
Lakeside Raptor Rotating Drum Screen	36RDS-0.25-122	35-inches	Wedge Wire or Perforated Plate, 6 mm spacing	$131,000
Huber Rotamat Rotating Drum Screen	Ro2/1000/6	40-inches	Wedge Wire or Perforated Plate, 6 mm spacing	$135,000

(1) Includes cost adders for 316 stainless steel construction, heat tracing for transport tube, explosion proof motor and solenoids.

The equipment costs for the three (3) micro strainer alternatives listed in the table above are all relatively close and are approximately 30-percent less than the costs for the rotating drum screens. In addition, all the micro strainer alternatives can fit inside the existing 24-inch wide headworks screening channels. Therefore, the drum screens are eliminated from further consideration.

Screen Features: The following features are included in the equipment costs for the micro strainer fine screens:

- Shaftless screw conveyor;
- Perforated plate basket;
- Transport tube and discharge chute;
- Pivot stand;
- 316 stainless steel construction (conveyor, basket, transport tube, stand);
- 2 HP Class 1, Div 1 Motor;
- 3- or 2-Zone wash system with Class 1, Div 1 solenoid valves;
- Heat tracing for transport tube;
- Two (2) (upstream) float switches;
- Screenings bagger;
- NEMA 4X, Class 1, Div 2, 304 stainless steel, UL listed, main control panel;
- Fusible disconnect switch with door handle;
- Control power transformer;

- Surge suppressor;
- Allen-Bradley MicroLogix 1100 Programmable Logic Controller (PLC);
- Network connection for PLC;
- Reversing starter with overload protection;
- Selector switches and indicating lights;
- Heat tracing circuit breaker;
- Terminal block; and
- Manufacturer start-up, training, submittals, and operation/maintenance manuals.

Note: NFPA 820 requires electrical equipment within a 10-foot envelope around the screens and open channels to be rated for NEC Area Class I, Division 2. This would include the control panel that would be mounted at the backside of where the control panel for the existing screen is located. There are existing power and control conduit stub ups for the proposed new screen control panel at this location.

Installation Requirements: The following installation requirements are included in the project costs for installing one of the proposed micro strainers in the west headworks channel:

- Removing and disposing of existing grout and aluminum bar rack in west screening channel (to be performed by District staff).
- Removing and disposing of the existing mechanical bar screen in the west screening channel (to be performed by District staff).
- Installation of a new fine screen in the west channel.
- Installation of galvanized grating over bar rack area.
- Cutting existing grating for new fine screen transport tube.
- Furnishing new screenings bin.
- Plumbing and heat tracing for utility water line from stub up at existing screen near east channel.
- Plumbing in-line strainer, pressure regulating valve, shut-off valve, flexible tubing for water line.
- Electrical installation of control panel.
- Electrical installation of power from MCC-EB and control (Ethernet) from LCP-EB to panel.
- Electrical installation of explosion-proof conduit and wire for float switches.
- Electrical installation of explosion-proof flexible conduit and wire to solenoid valves/tube heat tracing.
- Electrical installation of explosion-proof flexible conduit and wire to screen motor.
- Electrical installation of heat tracing system for utility water line plumbing.

Cost Estimate: The cost estimate for the installation requirements listed above for installing the micro strainer fine screen is provided in Table TM-EEE-1.2.

Existing Influent Flow Metering: The existing headworks influent flow metering consists of an ultrasonic level transducer, transmitter, and weir plate. The weir plate height and notch size were specifically designed to enhance grit removal efficiency in the grit channels at design flows. The influent flow metering system is only accurate up to ±2.7 MGD due to the size of the notch in the weir plate. Above this rate, the water level rises above the top of the notch and flows over the entire width of the weir plate, resulting in the flow calculation performed by the flow metering system being incorrect. In addition, the existing Polysonics ultrasonic flow metering system was installed prior to the 2004 plant upgrade and is subject to inaccurate readings at low ambient temperatures.

Proposed Influent Flow Metering: The permitted and projected peak influent design flow for the plant is greater than the capacity of the existing flow monitoring system. Reporting of accurate influent flow

measurement is required as part of the treatment plant's National Pollutant Discharge Elimination System (NPDES) permit requirements and is critical for plant operations and planning. It is therefore recommended that provisions be provided to replace the existing influent flow metering system with a system that is capable of accurately measuring the projected peak hydraulic flow to the treatment plant.

Design Alternatives Evaluated: The following three (3) alternatives were evaluated for replacement of the existing influent flow metering system:

Alternative No. 1: Installation of a nested parshall flume at the downstream end and inside of the existing grit channels;
Alternative No. 2: Installation of nested parshall flume in an integral manhole downstream of the existing grit channels; and
Alternative No. 3: Installation of a magnetic flow meter inside a vault downstream of the existing grit channels.

Other alternatives such as installing a flume or magnetic flow meter upstream of the headworks were briefly evaluated and eliminated due to the hydraulic profile at that location. The existing influent pipe is partially surcharged at existing and future peak flows, and there is inadequate hydraulic elevation head drop on the downstream side of a potential flume at this location to prevent surcharging the flume and inaccurate flow readings, without significant realignment of the influent pipe profile.

For Alternative No. 3, under typical wastewater gravity flow monitoring applications, a magnetic flow meter would not be evaluated for this application. However, the hydraulic profile at this location shows that the pipe flows full between the headworks grit channels and the anaerobic basins. A preliminary review of the elevation head and hydraulic head loss between the grit chamber effluent weir elevation and the weir elevation in the anaerobic basins shows that a magnetic flow meter is suitable for this location. In addition, because the magnetic flow meter is downstream of influent screening and grit removal, clogging of the meter is less of a concern than if it were installed on raw wastewater. Regardless, the magnetic flow meter installation would be provided with a bypass, so that it could be removed from service, if needed, without halting flow through the treatment system.

Alternate No. 1 Installation Requirements: The following installation requirements are included in the estimated costs for influent flow metering alternate no. 1 and are listed in Table TM-EEE-1.3:

- Installation of nested parshall flume (12-inches up to 3.0 MGD inside 24-inches up to 6.0 MGD).
- Removal of 15-feet of grout inside of the grit channels, and interior channel wall.
- Installation and grouting of flume.
- Grouting transition from channel to flume.
- Installation of stainless steel stop gates and frames in each channel upstream of flume for channel isolation.
- Rental of a portable temporary trash pump/hose for flow bypass during construction.
- Installation of a new flow meter transmitter.
- Installation of a transducer at the flume with temperature compensating sensor.
- Start-up services for the transducer and transmitter.
- Electrical installation of the transmitter and transducer.

Alternate No. 2 Installation Requirements: The following installation requirements are included in the project costs for influent flow metering alternate no. 2 and are listed in Table TM-EEE-1.4:

- Excavation/trench safety for new 20-inch headworks effluent pipe extending north from grit channels to new metering manhole.
- Filling grit chamber drop box with grout for transition to new 20-inch effluent pipe.
- Plugging and cutting existing 20-inch grit channel effluent pipe.
- Removing and disposing of existing 20-inch effluent pipe.
- Core drilling and installing link-seal for new 20-inch wall pipe at end of grit channel.
- Installing new 20-inch ductile iron effluent pipe to metering manhole and between metering manhole and downstream drop manhole.
- Installation of flexible couplings at grit channels and new manholes.
- Installation of a new package manhole with integral nested parshall flume (12-inch up to 3.0 MGD inside 24-inch up to 6.0 MGD).
- Installation of drop manhole and interior grouting for inlet and outlet transition.
- Backfill and compaction for installation of manholes, pipe, and asphalt.
- Replacement of 6-inches of crushed surfacing top course.
- Replacement of 4-inches of asphalt.
- Trenching for conduit between new transducer and new transmitter.
- Rental of a portable temporary trash pump/hose for flow bypass during construction.
- Installation of the new flow meter transmitter.
- Installation of the transducer at the flume with temperature compensating sensor.
- Start-up services for the transducer and transmitter.
- Electrical installation of the transducer and transmitter.

Alternate No. 3 Installation Requirements: The following installation requirements are included in the project costs for influent flow metering alternate no. 3 and are listed in Table TM-EEE-1.5:

- Excavation for new vault with magnetic flow meter and bypass line (or for future meter) in 20-inch effluent line north of grit channels.
- Installation of new 20-feet long, 10-feet wide, and 8-feet deep precast, concrete vault with water-tight, traffic-rated hatch.
- Cutting existing 20-inch effluent pipe before and after vault.
- Removing and disposing existing 20-inch effluent pipe at vault.
- Installation of fittings to reduce to and from 20-inch line to 12-inch line size.
- Installation of fittings and plug valves to allow isolation or bypass of new magnetic flow meter.
- Sealing of vault penetrations around pipes.
- Installation of new 12-inch magnetic flow meter (flow range from 0.65 MGD to 6.0 MGD).
- Backfill and compaction for installation of vault and asphalt.
- Replacement of 6-inches of crushed surfacing top course.
- Replacement of 4-inches of asphalt.
- Trenching for conduit between new flow meter and new transmitter.
- Rental of a portable temporary trash pump/hose for flow bypass during construction.
- Installation of new flow meter transmitter at existing transmitter location.
- Start-up services for magnetic flow meter and transmitter.
- Electrical installation of magnetic flow meter and transmitter.

Recommendation: Based on metering accuracy and maintenance, alternative no. 3 is recommended for the following reasons:

- Magnetic flow meters proposed for this application would be accurate to within 0.2% of the flow measuring range whereas ultrasonic level transducers would be accurate to within ±0.04 inches or 5% of the flow measurement range.
- Magnetic flow meters maintain their calibration longer and measurements are less susceptible to changes in ambient temperature than ultrasonic level transducers.
- Installation of the parshall flume at the end of and inside the grit channels may be subject to flow measurement inaccuracy due to the grit channel separation wall upstream of the flume. Removing the wall would prevent being able to take one grit channel out of service for cleaning while the other channel is in service.
- Maintenance and calibration of the flume in the integral metering manhole would expose operators to sewage and off-gases in an enclosed space whereas the magnetic flow meter installation would be hard-piped minimizing operator exposure.
- The magnetic flow meter installation cost includes piping, fittings, and valves so that a future second flow meter may be installed in an adjacent bypass line in case the new flow meter is required to be removed from service. This feature is not cost effective for the flume alternatives.

Table TM-EEE-1.2 Cost Estimate for New Fine Screen Installation					
	Item	**Units**	**Unit Cost, $**	**Quantity**	**Cost**
1	Remove Existing 1' of Grout at Bar Rack	LS	$ 1,000	1.0	$ 1,000
2	Fine Screen - 3 MGD Capacity, 316SS, Perforated, 6mm, Explosion Proof	LS	$ 103,000	1	$ 103,000
3	Fine Screen Installation	LS	10%	103,000	$ 10,300
4	Install Grating Over Existing Bar Rack	SQFT	$ 60	8	$ 480
5	Cut Grating Opening for Screen Transport Tube	LS	$ 500	1	$ 500
6	New Screenings Bin	LS	$ 700	1	$ 700
7	1" GLV Water Line to New Screen	LS	$ 25	15	$ 380
8	1" GLV In-Line Strainer	LS	$ 120	1	$ 120
9	1" GLV Pressure Regulating Valve	LS	$ 450	1	$ 450
10	1" GLV Ball Valve	LS	$ 200	1	$ 200
11	1" GLV Miscellaneous Fittings	LS	$ 120	6	$ 720
12	Electrical Sub. - Mount Control Panel, Power & Control (Ethernet)	LS	$ 3,660	1	$ 3,660
13	Electrical Sub. - Exp. Proof Power Conduit/Wire to Screen Float Switches	LS	$ 1,565	1	$ 1,570
14	Electrical Sub. - Exp. Proof Flex. Conduit/Wire to Screen Solenoids/Tube Heater	LS	$ 2,734	1	$ 2,730
15	Electrical Sub. - Exp. Proof Flex. Power Conduit/Wire to Screen Motor (2 HP)	LS	$ 984	1	$ 980
16	Electrical Sub. - Heat Tracing System for Plumbing	LS	$ 2,393	1	$ 2,390
17	Electrical Sub. - Concrete Work Repair	LS	$ 1,340	1	$ 1,340
18	Electrical Sub. - Miscellaneous	%	10%	12,670	$ 1,270
19	Electrical Sub. - Overhead & Profit	%	25%	13,940	$ 3,490
20	Mark-Up on Electrical Subcontractor	%	15%	12,200	$ 1,830
21	Contractor O&P, Mob/Demob, Trench Safety	%	20%	137,110	$ 27,420
22	Contract Cost (2013$)				$ 131,790
23	Contract Cost (2016$)	%	3%	3	$ 144,020
24	State Sales Tax	%	8.70%	144,020	$ 12,530
25	Estimated Construction Cost				$ 156,550
26	Engineering-Design	%	10%	156,550	$ 15,660
27	Engineering-Construction	%	12%	156,550	$ 18,790
28	Contingency	%	20%	191,000	$ 38,200
29	Estimated Total Project Capital Cost (2016$)				$ 229,200

Table TM-EEE-1.3 Cost Estimate for Influent Flow Meter Alternate No. 1					
	Item	**Units**	**Unit Cost, $**	**Quantity**	**Cost**
1	Nested Parshall Flume (12” inside 24”)	LS	$ 9,532	1	$ 9,530
2	Removing 15' of Grout and Channel wall	LS	$ 1,900	1	$ 1,900
3	Installation/Grouting of Flume and Flowmeter	LS	$ 3,500	1	$ 3,500
4	Transition from Channel to Flume	LS	$ 1,350	1	$ 1,350
5	SS Stop Gates and Surface Mounted Frames	LS	$ 1,500	2	$ 3,000
6	Portable Temporary Trash Pump/Hose for Flow Bypass	DAY	$ 500	10	$ 5,000
7	Flowmeter Transmitter and Recorder	LS	$ 2,299	1	$ 2,300
8	Transducer	LS	$ 512	1	$ 510
9	Start-Up Services for Transducer/Transmitter	LS	$ 1,000	1	$ 1,000
10	Mark-Up on Instrumentation Subcontractor	%	15%	3,810	$ 570
11	Electrical Sub. - Exp. Proof Conduit/Wire to Transmitter/Mounting	LS	$ 505	1	$ 510
12	Electrical Sub. - Miscellaneous	%	10%	510	$ 50
13	Electrical Sub. - Overhead & Profit	%	25%	560	$ 140
14	Mark-Up on Electrical Subcontractor	%	15%	700	$ 110
15	Contractor O&P, Mob/Demob, Trench Safety	%	20%	29,470	$ 5,890
16	Contract Cost (2013$)				$ 29,470
17	Contract Cost (2016$)	%	3%	3	$ 32,210
18	State Sales Tax	%	8.70%	32,210	$ 2,800
19	Estimated Construction Cost				$ 35,010
20	Engineering-Design	%	10%	35,010	$ 3,500
21	Engineering-Construction	%	12%	35,010	$ 4,200
22	Contingency	%	20%	42,710	$ 8,540
23	Estimated Total Project Capital Cost (2016$)				$ 51,300

Table TM-EEE-1.4 Cost Estimate for Influent Flow Meter Alternate No. 2					
	Item Description	**Units**	**Unit Cost, $**	**Quantity**	**Cost**
1	Excavation - Pipe and Manholes	CUYD	$ 10	222	$ 2,220
2	Trench Box	Week	$ 500	2	$ 1,000
3	Fill Grit Chamber Drop Box with Grout	CUYD	$ 180	1.7	$ 300
4	Plug and Cut Existing 20" CI/DI Pipe	LS	$ 250	2	$ 500
5	Remove/Dispose Existing 20" CI/DI Pipe	FT	$ 35	50	$ 1,750
6	Core Drill/Link Seal for New 20" DI Wall Pipe	LS	$ 1,000	1	$ 1,000
7	New 20" DI Pipe to Metering Manhole & Between Manholes	FT	$ 120	30	$ 3,600
8	Flex Couplings at Chamber and Manholes	LS	$ 1,200	5	$ 6,000
9	Package Manhole with Nested Parshall Flume	LS	$ 33,347	1	$ 33,350
10	Drop Manhole and Interior Grouting	LS	$ 2,500	1	$ 2,500
11	Backfill/Compaction	CUYD	$ 10	222	$ 2,220
12	Crushed Surfacing Top Course	CUYD	$ 40	11	$ 440
13	Asphalt Replacement	CUYD	$ 200	7	$ 1,480
14	Trench for Conduit to Existing Transmitter	LF	$ 10	30	$ 300
15	Portable Temp. Trash Pump/Hose for Flow Bypass	DAY	$ 500	10	$ 5,000
16	Flowmeter Transmitter and Recorder	LS	$ 2,299	1	$ 2,300
17	Transducer	LS	$ 512	1	$ 510
18	Start-Up Services for Transducer/Transmitter	LS	$ 1,000	1	$ 1,000
19	Mark-Up on Instrumentation Subcontractor	%	15%	3,810	$ 570
20	Electrical Sub. - Conduit/Wire to Transmitter/Mounting	LS	$ 1,165	1	$ 1,170
21	Electrical Sub. - Miscellaneous	%	10%	1,170	$ 120
22	Electrical Sub. - Overhead & Profit	%	25%	1,290	$ 320
23	Mark-Up on Electrical Subcontractor	%	15%	1,610	$ 240
24	Contractor O&P, Mob/Demob, Trench Safety	%	20%	67,890	$ 13,580
25	Contract Cost (2013$)				$ 81,470
26	Contract Cost (2016$)	%	3%	3	$ 89,030
27	State Sales Tax	%	8.70%	89,030	$ 7,750
28	Estimated Construction Cost				$ 96,780
29	Engineering-Design	%	10%	96,780	$ 9,680
30	Engineering-Construction	%	12%	96,780	$ 11,610
31	Contingency	%	20%	118,070	$ 23,610
32	Estimated Total Project Capital Cost (2016$)				$ 141,700

Table TM-EEE-1.5 Cost Estimate for Influent Flow Meter Alternate No. 3					
	Item Description	**Units**	**Unit Cost, $**	**Quantity**	**Cost**
1	Excavation - Vault	CUYD	$ 10	296	$ 2,960
2	Precast Concrete Vault, Water-Tight/Traffic Rated Hatch	LS	$ 10,000	1	$ 10,000
3	Cut Existing 20" CI/DI Pipe	LS	$ 250	2	$ 500
4	Remove/Dispose Existing 20" CI/DI Pipe	FT	$ 35	25	$ 880
5	20" x 12" MJ Reducers	LS	$ 3,200	2	$ 6,400
6	20" MJ Joint Restraint	LS	$ 630	2	$ 1,260
7	12" MJ Joint Restraint	LS	$ 250	2	$ 500
8	Seal 12" DI Pipe Penetrations	LS	$ 100	4	$ 400
9	12" GRV Tee	LS	$ 2,350	2	$ 4,700
10	12" GRV 90 Bends	LS	$ 1,500	2	$ 3,000
11	12" GRV Plug Valves	LS	$ 4,000	4	$ 16,000
12	12" GRV Dismantling Joints	LS	$ 500	2	$ 1,000
13	12" GRV Pipe Spools	LS	$ 65	4	$ 260
14	12" GRV Pipe Spools	LS	$ 65	2	$ 130
15	12" FL Pipe Spool	LS	$ 100	1	$ 100
16	Backfill/Compaction	CUYD	$ 10	296	$ 2,960
17	Crushed Surfacing Top Course	CUYD	$ 40	7	$ 300
18	Asphalt Replacement	CUYD	$ 200	7	$ 1,480
19	Trench for Conduit to Existing Transmitter	LF	$ 10	30	$ 300
20	Portable Temp. Trash Pump/Hose for Flow Bypass	DAY	$ 500	10	$ 5,000
21	Magnetic Flowmeter and Transmitter	LS	$ 9,432	1	$ 9,430
22	Start-Up Services for Meter/Transmitter	LS	$ 1,000	1	$ 1,000
23	Mark-Up on Instrumentation Subcontractor	%	15%	10,430	$ 1,560
24	Electrical Sub. - Conduit/Wire to Transmitter/Mounting	LS	$ 1,715	1	$ 1,720
25	Electrical Sub. - Miscellaneous	%	10%	1,720	$ 170
26	Electrical Sub. - Overhead & Profit	%	25%	1,890	$ 470
27	Mark-Up on Electrical Subcontractor	%	15%	2,360	$ 350
28	Contractor O&P, Mob/Demob, Trench Safety	%	20%	72,830	$ 14,570
29	Contract Cost (2013$)				$ 87,400
30	Contract Cost (2016$)	%	3%	3	$ 95,510
31	State Sales Tax	%	8.70%	95,510	$ 8,310
32	Estimated Construction Cost				$ 103,820
33	Engineering-Design	%	10%	103,820	$ 10,380
34	Engineering-Construction	%	12%	103,820	$ 12,460
35	Contingency	%	20%	126,660	$ 25,330
36	Estimated Total Project Capital Cost (2016$)				$ 152,000

Budinger & Associates
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Geotechnical Engineering
Environmental Engineering
Construction Material Testing
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Special Inspection

Dennis D. Fuller, PE
Century West Engineering, Inc.
1825 N. Hutchinson Rd.
Spokane Valley, WA 99212

November 8, 2013

Project Number S13134

PROJECT: Liberty Lake Sewer and Water District Water Reclamation Facility Tertiary Upgrade, Liberty Lake, WA
SUBJECT: Results of geotechnical exploration and analysis

Dear Mr. Fuller,

Budinger & Associates, Inc. is pleased to provide results of geotechnical exploration for the proposed Liberty Lake Sewer District improvements.

We appreciate the opportunity to provide this service. We have an excellent team of technicians available to assist with quality control during the construction phase of the work.

Respectfully Submitted:
BUDINGER & ASSOCIATES, INC.

David C. Lehn, LG
Senior Geologist

John E. Finnegan, PE, GE, LHG
Principal Geotechnical Engineer

JEF/dcl
Addressee – (1) dfuller@CenturyWest.com
Allison@esvelt.com

1101 North Fancher Rd.
Spokane Valley, WA 99212
Tel: 509.535.8841
Fax: 509.535.9589

www.budingerinc.com

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EMBEDDED TABLES

ATTACHED FIGURES

CONTEXT

This report presents the results of a geotechnical exploration and analysis for the proposed improvements to the Liberty Lake Sewer and Water District facility at Liberty Lake, Washington. The work was contracted with Century West Engineering Inc., represented by Dennis D. Fuller, PE, President.

Project Considerations

We understand that the improvements will include a new building with dimensions of 110 by 90 feet (9900 square feet) with approximately 6600 square feet of tanks to be 12 to 18 feet below the building floor. The portion of the structure below-grade will require excavation to a depth of approximately 21 feet. The proposed building elements will include reinforced concrete, structural masonry, and structural steel components. Maximum loads anticipated by the structural engineer, Joe Scholze, SE of LSB Engineers, include 4,500 per lineal feet for walls and 125 thousand pounds (kips) for columns.

Location

The project is in Section 10 of Township 25 North, Range 45 East (T25N,R45E) of the Willamette Meridian, Spokane County, Washington. The site is located approximately 1500 feet from the south bank of the Spokane River adjacent to the east side of North Harvard Road and on the south side of Indiana Avenue in Liberty Lake, Washington. The property size is 39 acres. The parcel number is 55103.9035. The address is 2218 North Harvard Road.

Scope

This geotechnical study involved interpretation of the subsurface soil and rock conditions to address the suitability of the site to support the proposed structures and provide geotechnical parameters needed for others to design and construct the proposed improvements. However, specific loads were not available at the time of field work. We endeavored to conduct these services in accordance with generally accepted geotechnical engineering practices as outlined in the proposal, S-13134 and Century West Task Order 2013-01, dated April 18, 2013.

The scope is summarized as follows:

1. Researched available geotechnical, topographic, and geologic information.
2. Drilled and sampled 2 borings using air rotary methods to maximum depths of 30 feet below ground surface. Sampled soils at intervals of 5 feet.
3. Logged subsurface conditions including encountered soil, penetration resistance, and soil moisture.
4. Conducted laboratory testing of index parameters of soils.
5. Prepared geotechnical report documenting data and analysis completed, as well as providing geotechnical recommendations addressing:
    a) Foundation design criteria for the building including allowable bearing pressures, anticipated settlement, lateral earth pressure, and minimum size of spread footings; and
    b) Earthwork criteria such as subgrade preparation, use of existing soils as fill, placement of fill, temporary slope angles, and pavement subgrade characteristics.

Construction inherently entails risk and this project is not an exception. The purpose of this study is to reduce risks related to subjects in our scope to levels generally accepted for similar projects designed with

the benefit of similar geotechnical study.

ENCOUNTERED CONDITIONS

Geologic Setting

Mapped geologic units in the area include *Glacial flood-channel deposits, predominantly gravel (Qfg)* (WSDNR, 2011). This unit was described as a mixture of grain sizes from boulders to sand, with occasional lenses of finer material, deposited between 2 million to 10,000 years ago during multiple glacial outburst flooding events from glacial Lake Missoula, Montana and other glacial lakes to the north. Glacial outburst floods traveled at great speeds with a large amount of water that carved river valleys in bedrock, in certain areas also depositing sands and gravels in the cut channels and pre-existing deep river channels. Below the subject site, 400 to 600 feet of gravel may be present based on aquifer thickness maps completed by Spokane County (2009).

Soils from the site were mapped as *Opportunity very gravelly ashy loam, 0 to 3 percent slopes* (USDA, 2011).

Seismic Considerations

In accordance with 2012 International Building Code (IBC) seismic parameters were calculated using the USGS Earthquake Ground Motion Parameters software, version 5.1.0.

The maximum earthquake spectral response accelerations are:

Short Period Response (S_S) – 0.343g
One Second Response (S_1) – 0.115g

The appropriate seismic site class is C due to the presence of very dense soils, per table 20.3-1 in ASCE 7-05 (ASCE, 2010).

The maximum considered earthquake design spectral response accelerations adjusted for site class effects are:

Short Period Response (S_{DS}) – 0.274g
One Second Response (S_{D1}) – 0.129g

Surface Conditions

The site is currently an existing primary and secondary sewage treatment plant with an office, maintenance shop, numerous tanks and chemical buildings. Most of the site is landscaped with grass, sidewalks and HMA paving. The ground surface is at approximately 2043 to 2054 feet (NGVD 29).

Subsurface Conditions

Conditions at the site were evaluated from two test borings and index laboratory tests. *Figures* and *Tables* are listed in the *Table of Contents*; they include a *Site Plan* and *Boring Logs*.

The subsurface conditions found included nearly 3 to 7 feet of gravel fill. Below the fill, we encountered gravel with sand, silt, and cobbles. Boulder-sized particles were also encountered.

Split-spoon penetration resistance tests revealed a dense to very dense condition. Measured N-values ranged 38 to over 100. Characteristics of the native soils include excellent strength and high infiltration capacity.

Surface and Groundwater Hydrology

The Spokane River's left (south) bank is approximately 1500 feet to the north. Groundwater was not encountered in the exploratory borings at the time of field exploration. Groundwater below the site occurs in the unconfined Spokane Valley Aquifer. The aquifer surface has been mapped in the area at approximately elevation 1980 feet (Campbell, 2005), approximately 60 feet below ground surface.

CONCLUSIONS

Based on the encountered conditions, we conclude that the site offers favorable geotechnical conditions for support of the project. Existing undocumented fill poses a potential hazard. Fortunately, excavation for the tanks will necessitate removing a large portion of the fill. The plan can be readily modified to remove remaining undocumented fill and avoid relying on it for support.

The native gravel offers excellent support characteristics for foundations and slabs. Excavation will likely encounter cobbles and boulders. Excavations will not likely stand steeper than 1 horizontal to 1 vertical, except in isolated zones.

Feasibility of some shoring methods may be limited due to the presence of boulders. Groundwater should not affect the project. Feasible shoring methods anticipated include driven soldier piles with steel sheet lagging and soil nailing using temporary berms or closely spaced pin piles to control stand-up time, which is the ability for the soil to stand vertically over short height, temporary. Driven sheet piling is not anticipated to be feasible due to the presence of boulders.

RECOMMENDATIONS

The following recommendations are based on the conclusions described above.

The recommendations presented in this report are intended to provide economically feasible criteria at normally accepted risk levels. More conservative design parameters can be used if lower risks are preferred. Specifically, the design should incorporate the following recommendation concerning earthwork, foundations, lateral earth pressures, floor slabs, tank floors, and drainage.

Earthwork

Excavation. The presence of boulders may make some portions of the excavations difficult.

Temporary slopes. The soils at the site are considered Type C materials under the current OSHA Classification System. OSHA specifies a maximum inclination of 1½ Horizontal to 1 Vertical (1½H:1V) in the temporary condition. Excavations steeper than 1H:1V are likely to ravel. Surcharge loadings from soil or equipment including cranes will require stability analysis.

Preparation of surface to receive fill. Surfaces to receive structural fill and backfill should be moisture conditioned, if necessary, and compacted in place to at least 92 percent of maximum dry unit weight (see Maximum Unit Weight).

Fill material. Native gravel appears suitable for reuse as structural fill. Backfill of the tank/basin may require screening to limit the maximum particle size to a size appropriate for the compaction equipment.

Fill placement. Place fill in lifts of thickness suited to the compaction equipment after moisture conditioning, where necessary, to near optimum moisture content and compact to at least 92 percent of maximum dry unit weight.

Exercise caution when using vibratory and heavy compaction equipment in close proximity to steep cuts or retaining structures. Without adequate bracing, energy from the vibrating rollers and plates can cause hydrostatic loads far in excess of those for which slopes and walls are designed.

Maximum unit weight. Determine maximum unit weight and optimum moisture contents for fill material in accordance with the Modified Proctor Method (ASTM D-1557). If more than 30 percent of the material is retained on a 3/4-inch sieve, however, we recommend using methods described in the *Rock Embankment Construction* of the *Standard Specifications for Road, Bridge, and Municipal Construction,* 2012, WSDOT/APWA (2-03.3(14)A).

Verification and application. These earthwork recommendations apply to structural fill, backfill against footings and walls, and backfill of utility trenches. Retain a qualified earthwork technician present during fill and backfill operations to observe and test each lift of fill. A representative of the Geotechnical Engineer is best suited to provide such testing.

Foundations

We understand that conventional shallow, spread footings will be used. We recommend establishing footings in the gravel layer, or similar structural fill at maximum pressures of 4000 pounds per square foot (psf) embedded a minimum of 24 inches below grade. However, depth will need to meet local frost depth requirements. The recommended minimum width for wall footings is 18 inches. For spread footings, the recommended minimum width is 24 inches.

Temporary Live Loads. To calculate seismic loading, the acceleration and site classification criteria described in *Seismic Considerations* should be followed.

Foundation construction. Backfill quality is critical to performance if footings are formed and cast in wide excavations. Compaction testing of backfill against footings is required, as described in *Earthwork*.

Settlement

Due to the dense condition of the native soil, total predicted settlement in the native soil is estimated to be less than 1 inch under the anticipated, relatively light, loads. Settlement will take place rapidly with the majority occurring during construction.

Lateral Earth Pressures

Retaining structures. Assuming level backfill, calculate the lateral earth pressures against the tank/basin using the following At-Rest pressures. Since some displacement is required to mobilize the full active strength (approximately 0.2 percent of the wall height), the *At-Rest* pressure factors must be used because the structure will be laterally constrained to limit yield under earth pressure. No reduction factors are included in these values.

Table 1: Retaining Walls

STRATUM	*EQUIVALENT FLUID PRESSURE AT-REST AND DRAINED*
Gravel	50 pcf

Lateral Resistance. Lateral forces can be transferred to the soil through the use of passive earth pressures, together with the earth/concrete friction factors presented in *Table 2*. These values anticipate properly compacted backfill and will be substantially reduced when densities are less than those recommended under Earthwork.

Table 2: Lateral Resistance

STRATUM	*EQUIVALENT FLUID PRESSURE*	
	EARTH/CONCRETE FRICTION FACTOR	*PASSIVE EARTH CONDITION*
Gravel	0.40	460 pcf

Floor Slabs

We recommend constructing slabs on properly compacted structural fill. A layer of crushed aggregate would be helpful for leveling, improving drainage, and increasing support. We recommend repairing irregular areas produced by normal construction activities (wheel ruts, frost heave, etc.) so the slab can be placed on a smooth compacted subgrade. Also, we recommend limiting traffic on exposed grades.

Backfill of adjacent footings and underlying utility excavations should be performed in accordance with the recommendations described under *Earthwork* to provide uniform slab support. We recommend designing footings to be integrated with slabs to provide leak resistance. Water-stop between foundation and wall elements should reduce leakage to the minimum specified in AWWA tank tightness testing.

If moisture sensitive floor coverings are installed in the building, use of a durable vapor barrier geomembrane should be considered such as Stegowrap.

Additional Services

Soil and Foundation Engineering comprises a 5-part endeavor involving cooperation with the owner, designer and constructor as follows:

1. Preliminary study to assist in planning and to economically adapt the project to its geologic environment.
2. Soil exploration and analysis to evaluate subsurface conditions and recommend design criteria.
3. Consultation with the designer to adapt the specific design to the site in accordance with the recommendations.
4. Monitor fill placement to verify proper compaction.
5. Construction observation to verify the conditions encountered and to make recommendations for modifications as necessary.

FIELD EXPLORATION

The fieldwork was conducted by Thomas Black, PE, on October 2, 2013, supervised by principal geotechnical engineer John Finnegan, PE. The field activities generally consisted of the following:

- Reconnaissance of the site and surrounding area;
- Drilling and logging subsurface conditions in 2 test borings using air rotary drilling;
- Obtaining split-spoon and bulk samples of the soils.

Results are presented in *Figures.*

Test Borings

Borings were drilled with a truck-mounted Mobile B-57 utilizing 4½-inch outside diameter air rotary overburden methods north of the existing ultraviolet disinfection station at two corners of the proposed new building site.

Air rotary drilling. The air rotary method involves circulating air through a specially designed pilot bit that engages with a casing bit during drilling, but disengages upon reversal of rotation to allow retrieval of the drill stem at desired sampling depths.

Soil Samples

Samples were obtained by driving samplers through the temporary drill casing. Cutting samples were collected from the drilling discharge hose to assist field identification of particle size. The maximum particle size that can be retained is limited to the opening of the samplers, which is approximately 1.3 inches for a standard 2-inch sampler and 2.3 inches for a 3-inch sampler. Such results tend to understate the coarse fraction of the actual formation, which should be expected to be coarser (larger).

Standard penetration tests - ASTM D 1586. To obtain samples of soil, Standard Penetration Tests (SPT) were conducted by driving a 2-inch outside diameter split-spoon sampler with a 140-pound hammer actuated by a Mobile automatic hammer to provide a test of penetration resistance. The resulting blow count for each foot of sampler advancement, representing uncorrected N-values, is presented in the *Boring Logs*. The energy ratio (ER) is much higher with the automatic hammer compared to the reference cathead/rope system. Consequently, to correct N-values an ER of 1.2 is assumed in order to reflect the greater energy imparted by the automatic hammer.

3-inch split spoon samples (3”SS) - ASTM D 3550. Most of the split spoon samples were obtained with

a 3.0-inch outside by 2.4-inch inside diameter split spoon barrel sample similar to the 2-inch SPT described above. Blow counts with the 3"SS do not represent N-values since the end area of the 3-inch sampler is approximately twice that of the standard sampler. Uncorrected N-values can be approximated by multiplying the observed blow counts (in blows per foot) by 0.5 for the 3-inch split-spoon. As with SPT sampling, N-values for the 3-inch split spoon are corrected with an ER of 1.2 to reflect the energy of the automatic hammer.

Soil Classification

WSDOT Soil and Rock Classification and Logging – GDM, Chapter 4. Field description of soils is done in accordance with the Washington State Department of Transportation, Geotechnical Design Manual (GDM), M 46-03, September 2005. The soil descriptions presented in the *Boring Logs* are intended to comply with the GDM. Soil descriptions are briefly covered in *Guide to Soil and Rock Descriptions.*

Unified soil classification system - ASTM D 2487. The soil descriptions presented in the *Grain Size Distribution Graph* and *Laboratory Summary* are intended to comply with the Unified Soil Classification System (USCS). In some cases the sample may not be classified, if the percentage of fines is greater than 5 percent and the plasticity index has not been measured.

Location

Horizontal & vertical control. Test boring locations were determined using tape measures and site plans provided by the client. Elevations were referenced relative to existing pavement.

LABORATORY ANALYSIS

Laboratory testing was performed on representative samples of the soils encountered to provide data used in our assessment of soil characteristics.

Tests were conducted, where practical, in accordance with nationally recognized standards (ASTM, AASHTO, etc.), which are intended to model in-situ soil conditions and behavior. The results are presented in *Tables* and *Figures*.

Index Properties

Moisture content - AASHTO T-265. Moisture contents were determined by direct weight proportion (weight of water/weight of dry soil) determined by drying soil samples in an oven until reaching constant weight.

Gradation - AASHTO T-27 & T-11. Gradation analysis was performed by the mechanical sieve method. The mechanical sieve method is utilized to determine particle size distribution based upon the dry weight of sample passing through sieves of varying mesh sizes. The results of gradation are provided in *Grain Size Distribution Results*.

LIMITATIONS

The conclusions and recommendations presented herein are based upon the results of field explorations and laboratory testing results. They are predicated upon our understanding of the project, its design, and its location as defined in by the client.

We endeavored to conduct this study in accordance with generally accepted geotechnical engineering practices in this area. This report presents our professional interpretation of investigation data developed, which we believe meets the standards of the geotechnical profession in this area; we make no other warranties, express or implied.

Attached is a document titled "*Important Information About Your Geotechnical Engineering Report*," which we recommend you review carefully to better understand the context within which these services were completed.

Unless test locations are specified by others or limited by accessibility, the scope of analysis is intended to develop data from a representative portion of the site. However, the areas tested are discreet. Interpolation between these discreet locations is made for illustrative purposes only, but should be expected to vary. If a greater level of detail is desired, the client should request an increased scope of exploration.

REFERENCES

American Society of Civil Engineers, 2006, ASCE Standard 7-05

International Code Council, 2012, International Building Code.

Campbell, A. M., 2005, Ground-Water Levels in the Spokane Valley – Rathdrum Prairie Aquifer, Spokane County, Washington Bonner and Kootenai Counties, Idaho, September 2004, US Geological Survey, Scientific Investigations Map 2905.

Joseph, 1990, Geologic Map of the Spokane 1:100,000 Quadrangle, Washington State Department of Natural Resources, Open File Report 90-17.

Spokane County, 2009, The Spokane Valley-Rathdrum Prairie Aquifer Atlas, http://www.spokanecounty.org/loaddoc.aspx?docid=4487 (accessed June 6, 2011)

United States Department of Agriculture (USDA), 2012, Natural Resources Conservation Service, Web Soil Survey, http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx .

USGS, 1973, Greenacres, Washington, 7.5 Minute Quadrangle, 1:24,000, PR 1986.

United States Department of the Interior, 2013, United States Geological Survey (USGS), Earthquakes Hazard Program: http://earthquake.usgs.gov/hazards/apps/

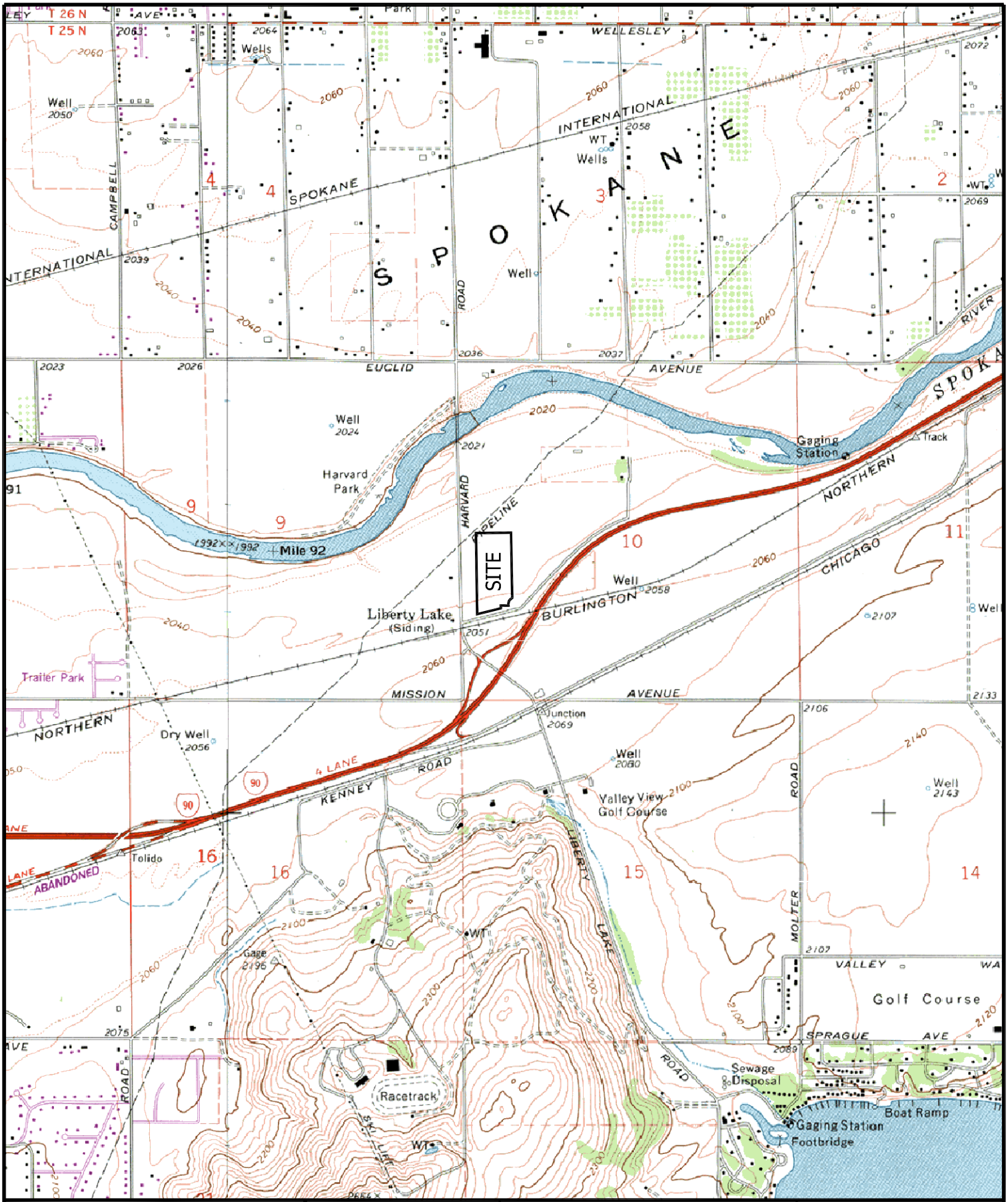
USGS, 2013, US Seismic Design Maps Web Application,

http://geohazards.usgs.gov/designmaps/us/application.php

Washington State Department of Natural Resources (WSDNR), 2013, Division of Geology and Earth Resources, Washington Interactive Geologic Map, http://wigm.dnr.wa.gov/

Washington State Department of Transportation (WSDOT), 2012, Geotechnical Design Manual (GDM).

Washington State Department of Transportation (WSDOT), 2012, Standard Specification for Road, Bridge, and Municipal Construction.



N

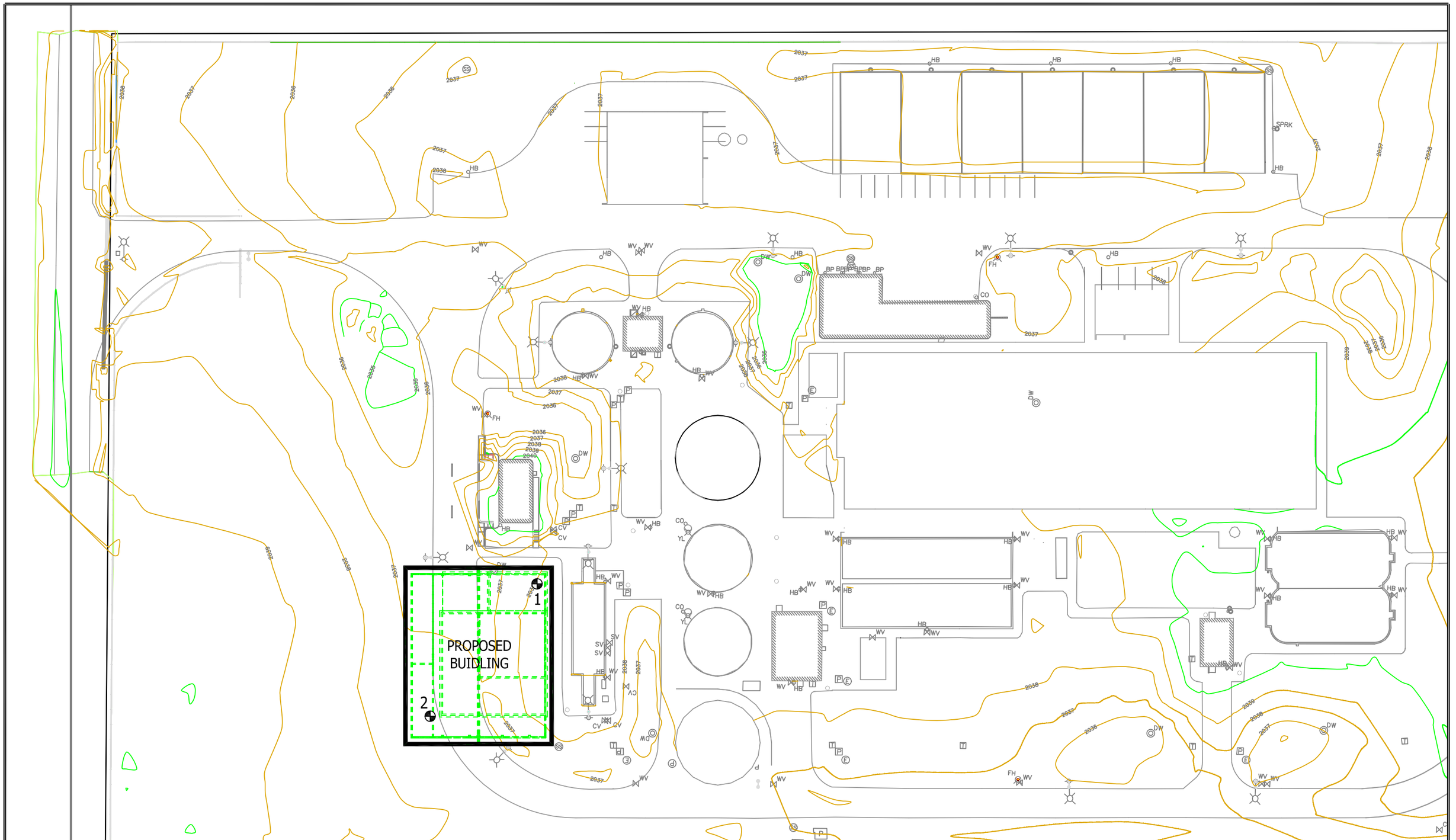
SCALE: 1"=2000'

0 1000 2000

SECTION 10
T 25 N R 43 E
USGS 1973

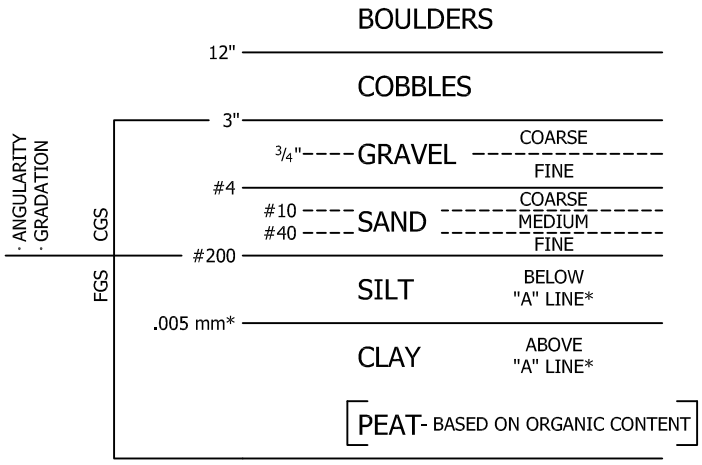
Budinger & Associates

VICINITY MAP	FIGURE 1
LIBERTY LAKE WWTP IMPROVEMENTS LIBERTY LAKE, WASHINGTON	PROJECT NUMBER S13134
	DATE: 10/2013


PROPOSED
BUIDLING
1
2
B-1 air rotary boring
N
SCALE: 1"=60'
0 30 60
BASE PLAN PROVIDED BY
CENTURY WEST
Budinger
& Associates
SITE PLAN
LIBERTY LAKE WWTP IMPROVEMENTS
LIBERTY LAKE, WASHINGTON
FIGURE 2
PROJECT NUMBER S13134
DATE: 10/2013

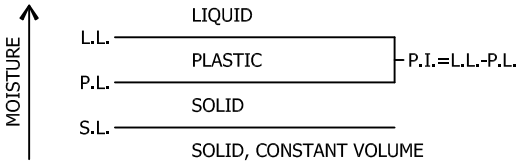
GUIDE TO SOIL & ROCK DESCRIPTIONS

SOIL CLASSIFICATION

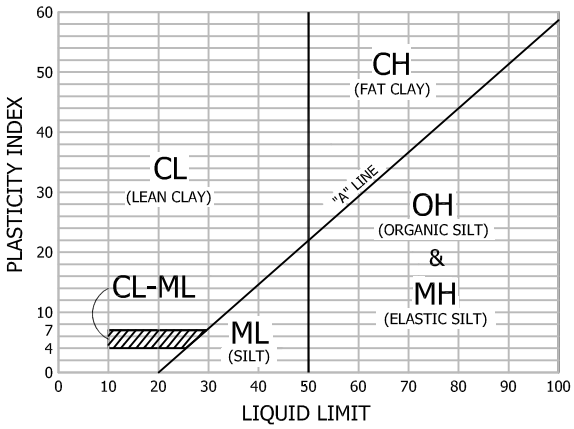


** SEE PLASTICITY CHART*
CGS - COARSE GRAINED SOIL - MORE THAN 50% RETAINED ON A #200 SIEVE
FGS - FINE GRAINED SOIL - 50% MORE PASSES, #200 SIEVE
FINES - PORTION FINER THAN #200 SIEVE

ATTERBERG LIMITS



PLASTICITY CHART



NOTE - CHART APPLIES TO FGS AND MINUS #40 SIEVE FRACTION OF CGS

GUIDE TO SOIL DESCRIPTION MODIFIERS, MOISTURE, AND CONDITION PRESENTED ON LOGS

MODIFIER	ESTIMATED PERCENTAGE OF MATERIAL
SUFFIX "LY" OR "Y"	30% OR MORE FOR COARSE PARTS IN FGS GREATER THAN 12% FOR FINES IN CGS
WITH	15% - 29% FOR COARSE PARTS IN FGS 5% - 12% FOR FINES IN CGS
SMALL AMOUNT	8% - 25%
TRACE/OCCASIONAL	1% - 12%

NOTE - BOUNDARIES APPLY ONLY TO CLASSIFICATIONS FROM LABORATORY TESTING. VISUAL ESTIMATES OF MATERIAL PERCENTAGES TYPICALLY VARY 0 TO 10% FROM THOSE DETERMINED BY LABORATORY TESTING.

MOISTURE

DRY
MOIST
SATURATED OR WET

SOIL CONDITION

CGS:
- VERY LOOSE
- LOOSE
- MEDIUM DENSE
- DENSE
- VERY DENSE

FGS:
- VERY SOFT
- SOFT
- MEDIUM STIFF
- STIFF
- VERY STIFF
- HARD

SAMPLES

- STANDARD 2" PENETRATION TEST SAMPLER WITH BLOWS PER FOOT
- 3" SPLIT SPOON SAMPLER WITH BLOWS PER FOOT
- DRILL CUTTING SAMPLE
- BULK SAMPLE
- THIN-WALLED TUBE SAMPLE
- DIAMOND CORE RUN WITH % RECOVERY & ROCK QUALITY DESIGNATION
- 4" SPLIT SPOON SAMPLER WITH BLOWS PER FOOT
- R — REFUSAL OF SAMPLE (50+ BLOWS PER 6")

ROCK WEATHERING	ROCK CONDITION
FRESH	EXTREMELY WEAK
SLIGHTLY WEATHERED	VERY WEAK
MODERATELY WEATHERED	MODERATELY WEAK
HIGHLY WEATHERED	MODERATELY STRONG
COMPLETELY WEATHERED	STRONG
RESIDUAL SOIL	VERY STRONG

Budinger & Associates

FIGURE 3

TEST BORING 1

Date of Boring: 10-2-13
Driller: Budinger & Assoc., Inc.
Type of Drill: Mobile B-57 with automatic SPT hammer
Location: SE corner of proposed building
Surface: grass/sod

Elevation: 103 ft
Logged by: T. Black
Size of hole: air rotary overburden system, 4.5 in O.D. casing

DEPTH	SAMPLES RQD, BLOW COUNTS N (% RECOVERY)	MOISTURE, COLOR, CONDITION	DESCRIPTION
0		wet, green with dark brown, loose	GRASS SOD (3 inches)
	47 (78%)	wet (likely because of sprinklers), dark brown, medium dense	GRAVEL with Sand and Silt, occasional Cobble and organics (roots), subangular to rounded, medium to coarse - stratum appears re-worked: possibly fill
5	38 (67%)	dry to moist, dark brown to brown, medium dense	GRAVEL with Sand, occasional Silt and Cobbles, subrounded to subangular, medium to coarse - stratum still appears reworked: possibly fill
		dry to moist, brown to gray, dense to very dense	GRAVEL with Sand, occasional Cobbles and boulders, subrounded to rounded, coarse
10	62 (50%)		(layer has intermittent cemented zones - cuttings are brown and more moist)
15	R (89%)		
20	R (50%)		
25			
		dry, gray, very dense	BOULDER/COBBLES
30	R (0%)	no free groundwater observed	End of Boring @ 30 ft
35			
40			

SOIL LOG

TEST RESULTS

ATTERBERG LIMITS
PL — LL
WATER CONTENT ○
STANDARD PEN TEST, N-VALUE (OBSERVED)
3" SPLIT SPOON PENETRATION, BLOWS/FT

10 20 30 40 50 60 70 80 90

+100

+100

+100

LOGS WITHOUT WELL WITH TESTS S13134 BORING LOGS.GPJ BUDINGER.GDT 10/4/13

Budinger & Associates
1101 North Fancher Road
Spokane Valley, WA 99212

BORING LOGS **FIGURE 4-1**

Project: Liberty Lake WWTP Upgrade
Location: Liberty Lake, WA
Number: S13134

TEST BORING 2

Date of Boring: 10-2-13
Driller: Budinger & Assoc., Inc.
Type of Drill: Mobile B-57 with automatic SPT hammer
Location: NW corner of proposed building
Surface: grass and weeds

Elevation: 100 ft
Logged by: T. Black
Size of hole: air rotary overburden system, 4.5 in O.D. casing

DEPTH	SAMPLES RQD, BLOW COUNTS N (% RECOVERY)	MOISTURE, COLOR, CONDITION	DESCRIPTION	SOIL LOG
0		dry, light brown to brown, medium dense	GRAVEL with Silt and Sand, occasional Cobbles and Organics (roots), subrounded, medium to coarse - layer appears to be re-worked: possibly fill	
	47 (56%)			
	R (56%)	dry, gray, dense	BOULDER/COBBLES	
	R (83%)			
5	80 (83%)	dry, brown to gray, dense	GRAVEL, occasional Cobbles and Sand, subrounded, coarse	
		moist, brown, medium dense	SILTY GRAVEL with Sand, subrounded, medium to coarse	
		dry to moist, brown to gray, dense	GRAVEL, occasional Cobbles and Sand, subrounded, coarse	
10	R (100%)		(layer has intermittent cemented zones - cuttings are brown and more moist)	
		dry, gray, dense	BOULDER	
		dry to moist, brown to gray, dense	GRAVEL, occasional Cobbles and Sand, subrounded, coarse	
15	84 (22%)		(layer has intermittent cemented zones - cuttings are brown and more moist)	
20				
		dry, brown to gray, dense	GRAVEL with Cobbles and Sand, occasional Boulders, subrounded, coarse	
25	R (67%)			
		no free groundwater observed	End of Boring @ 25 ft	
30				
35				
40				

TEST RESULTS

ATTERBERG LIMITS
PL — LL
WATER CONTENT ○
STANDARD PEN TEST, N-VALUE (OBSERVED)
3" SPLIT SPOON PENETRATION, BLOWS/FT

10 20 30 40 50 60 70 80 90

+100
+100
+100
+100

LOGS WITHOUT WELL WITH TESTS S13134 BORING LOGS.GPJ BUDINGER.GDT 10/4/13

Budinger & Associates
1101 North Fancher Road
Spokane Valley, WA 99212

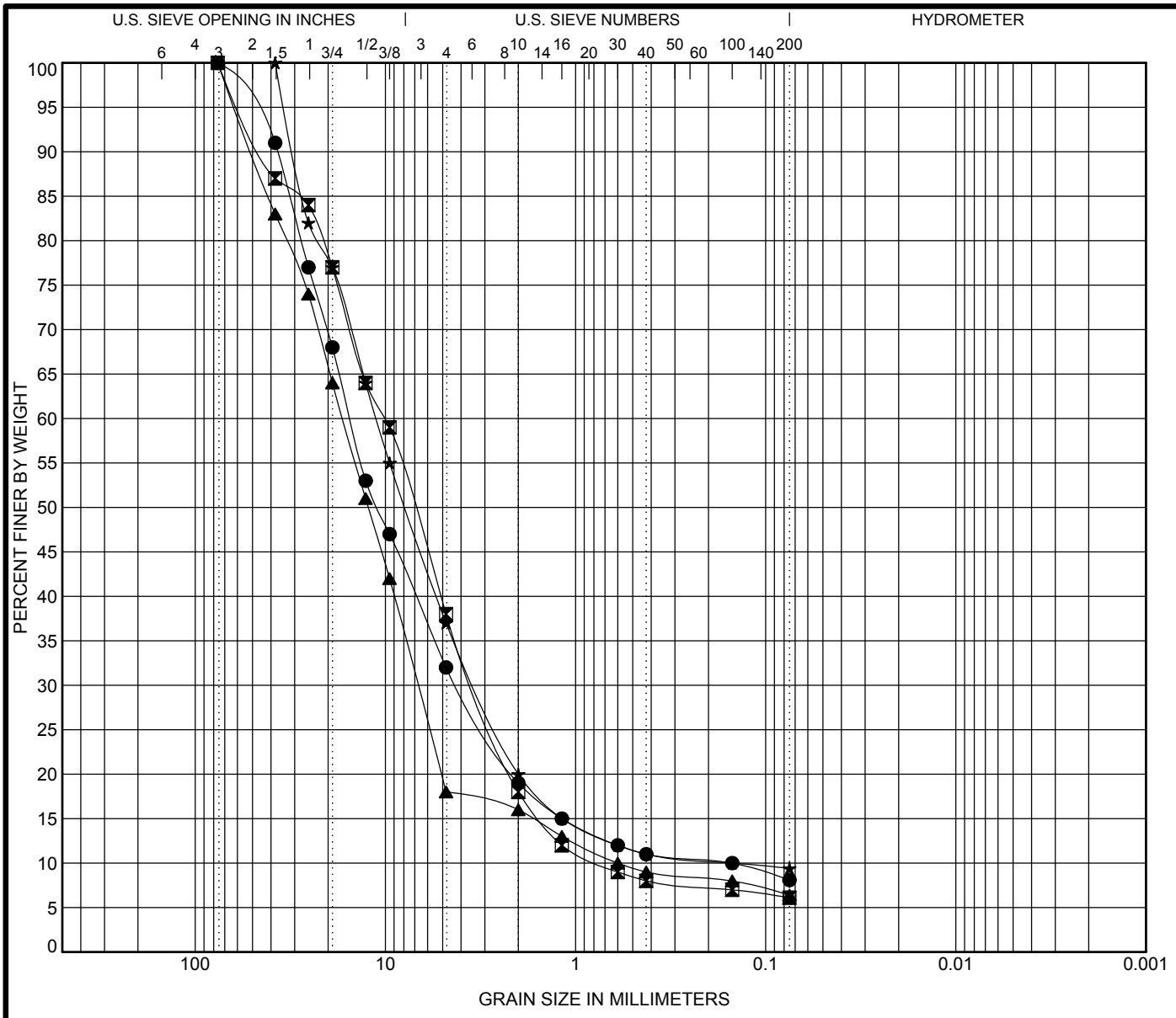
BORING LOGS **FIGURE 4-2**

Project: Liberty Lake WWTP Upgrade
Location: Liberty Lake, WA
Number: S13134

Figure 5 ***LABORATORY SUMMARY***

		Units	Test Methods				
LABORATORY NUMBER				13-5831	13-5834	13-5836	13-5837
BORING NUMBER				1	1	2	2
DEPTH	TOP	feet		2	14½	4	9
	BOTTOM	feet		3½	16	5½	10½
MOISTURE		%	ASTM D 2216	7.4	4.1	1.9	4.7
LIQUID LIMIT		%		34	31	27	28
PLASTIC LIMIT		%	ASTM 4318	24	21	22	22
PLASTICITY INDEX		%		10	10	5	6
UNIFIED CLASSIFICATION			ASTM D-2487	GP-GM	GW-GC	GP-GM	GP-GC
	3"		ASTM D-422	100	100	100	
S	1½"			91	87	83	100
I	1"			77	84	74	82
E	3/4"			68	77	64	77
V	1/2"	%		53	64	51	64
E	3/8"			47	59	42	55
	#4	P		32	38	18	37
S	#10	A		19	18	16	20
I	#16	S		15	12	13	15
Z	#30 SAND	S		12	9	10	12
E	#40	I		11	8	9	11
	#100	N		10	7	8	10
	#200	G		8.1	6.1	6.4	9.4

3"SS = 3-inch outside diameter split barrell sampler with 2.4-inch inside diameter
SPT = 2.0-inch outside diameter by 1.3-inch inside diameter standard penetration test sampler
NP = Non-Plastic
The maximum particle size that can be retained is limited to the opening of the samplers.
Reference the report for guidance on expected coarse fraction of the actual formation.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	1	2.0	POORLY GRADED GRAVEL with SILT and SAND(GP-GM)	34	24	10	7.66	102.18
⊠	1	14.5	WELL-GRADED GRAVEL with CLAY and SAND(GW-GC)	31	21	10	1.51	13.39
▲	2	4.0	POORLY GRADED GRAVEL with SILT(GP-GM)	27	22	5	4.53	27.98
★	2	9.0	POORLY GRADED GRAVEL with SILTY CLAY and SAND(GP-GC)	28	22	6	6.69	74.42

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	1	2.0	76.2	15.327	4.195	0.15	68.0	23.7	8.1	
⊠	1	14.5	76.2	10.068	3.382	0.752	61.9	31.7	6.1	
▲	2	4.0	76.2	16.785	6.753	0.6	81.6	11.6	6.4	
★	2	9.0	38	11.163	3.347	0.15	63.2	27.4	9.4	

Budinger & Associates
1101 North Fancher Road
Spokane Valley, WA 99212

GRAIN SIZE DISTRIBUTION RESULTS

Project: Liberty Lake WWTP Upgrade

Location: Liberty Lake, WA

Number: S13134

FIGURE 6

Important Information About Your
Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes. The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one -not even you* -should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on a Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes-even minor ones-and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Options

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ-sometimes significantly-from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not over-rely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from the judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled “limitations” many of these provisions indicate where geotechnical engineers’ responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth
8811 Colesville Road/Suite G106, Silver Spring, MD 20910 Telephone: 301/565-2733 Facsimile: 301/589-2017 e-mail: inlo@asle.org www.asle.org