PROPOSED ALTERNATIVE

This chapter provides engineering, cost, and environmental information for the proposed alternative (Alternative 1B - Pipeline Bottom-of-Basin Storage). The preliminary information for this alternative, presented in Chapter 5, is also included in this chapter, along with additional design details and environmental information in order to provide a complete description of the proposed alternative.

6.1 ALTERNATIVE OVERVIEW

6.1.1 Overflow Frequency and Volume

Table 6.1 shows CSO frequency and volume from the North Beach Basin both prior to project implementation and anticipated after implementation.

Table 6.1 CSO Frequency and Volume from the North Beach Basin

CSO Frequency and Volume	Prior To Project Implementation	Anticipated After Project Implementation[2]
Annual Frequency	10 Overflows/year	1 Overflow/year
Annual Volume	2.2 MG	0.5 MG
30-year Simulation Total Volume	34.9 MG[1]	15.5 MG

Notes:

1. Based on MIKE Urban Model and a North Beach PS capacity of 3 MGD.
2. Based on MIKE Urban Model, North Beach PS capacity of 3 MGD, and 0.23 MG of storage at bottom of basin.

6.1.2 General Layout

Alternative 1B includes a buried storage pipeline located in Triton Drive NW and NW Blue Ridge Drive public right-of-way. The pipeline would provide 0.23 MG of storage volume for combined sewage. Ancillary facilities would be located on the North Beach Pump Station site. Figure 6.1 illustrates this scenario. It includes the following elements:

- A new diversion structure to redirect peak flows from the sewer to storage.
- A 325-foot-long, and 12-foot in diameter buried storage pipe. The storage pipeline includes:
  - A 20-inch influent sewer-and-isolation gate.
  - A pump station to empty the pipeline contents over a 24-hour period following a wet-weather event.
  - A 6-inch effluent line to the local CSS.
  - A flushing system, including a flap gate and utility water equipment, to facilitate pipeline cleaning.

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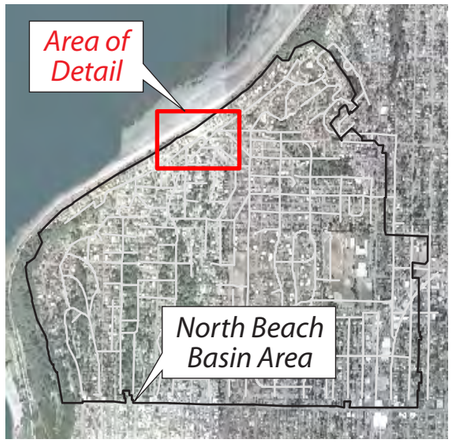

N

0 50 100 150'
Approximate Scale

Legend

- Combined Sewer System
- Storm Sewer System
- Sanitary Sewer System
- 10' Topographic Contour
- Feasible Area for Pipe Location

Figure 6.1
SITE LAYOUT PLAN

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Department of Natural Resources and Parks
Wastewater Treatment Division

Figure 6-1.ai

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  - Access features for routine and long-term operations and maintenance.
- An ancillary equipment facility for odor control, mechanical, and electrical equipment including:
  - Control panels and MCCs.
  - Standby power generator, including fuel storage tank.
  - Odor control system including mist eliminator, carbon scrubbers, and fans.
  - Ventilation system.
  - Utility water system including backflow preventer, air gap tank, pumps, and hydropneumatic tank.
- Site improvements including:
  - Improvements as required by SDOT along Triton Drive NW and NW Blue Ridge Drive.
  - North Beach Pump Station surface access, fencing, and landscaping modifications and restoration.

6.1.2.1 Diversion Structure

In this scenario, flow to the North Beach Pump Station will be routed through a new diversion structure. Figure 6.2 shows a conceptual plan and section view of this arrangement.

During wet-weather conditions, the water level in the North Beach Pump Station wet well and combined sewer system will rise. The rising water level in the diversion structure will overtop the weir (at Elevation 123.00 feet (Metro Datum)) and peak flows will be diverted to the storage pipeline. A new 20-inch pipeline will run from the diversion structure to the head of the storage pipeline. When the maximum water surface elevation in the storage pipe (Elevation 121.00 (Metro Datum)) is reached, the isolation gate will close and any additional peak flows will flow through one of the existing outfalls to Puget Sound.

The diversion structure will be below grade and include access hatches for visual inspection and maintenance. Utility water will be provided near the structure for washdown of the weir and flushing of the pipeline to storage. The structure will also house a level sensor for remote monitoring of water levels.

6.1.2.2 Pipeline Storage

The proposed CSO storage facility is a buried pipeline 325 feet long and 12-feet in diameter. Figure 6.3 shows a conceptual plan and Figure 6.4 shows section views of this storage pipeline. The pipeline is equipped with carbon scrubber odor control, electrical equipment, and a backup generator, housed in a separate structure on the North Beach Pump Station site. The pipeline is accessed from the top at portals for maintenance. Equipment at the portals includes level sensors, flushing gate, and utility water valving for cleaning, and submersible effluent pumps and valving to drain the pipeline.

In this design, the pipeline will begin to fill once CSOs overtop the weir at the diversion structure and are conveyed through the 20-inch influent pipe. Pipeline storage will be sloped to a sump at

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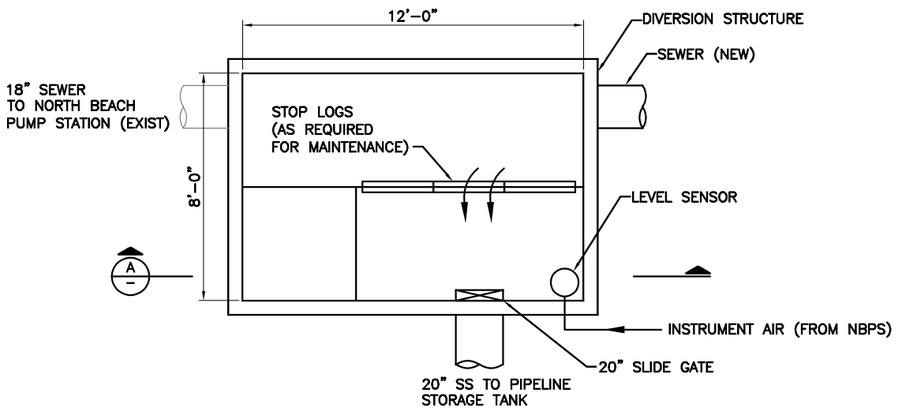
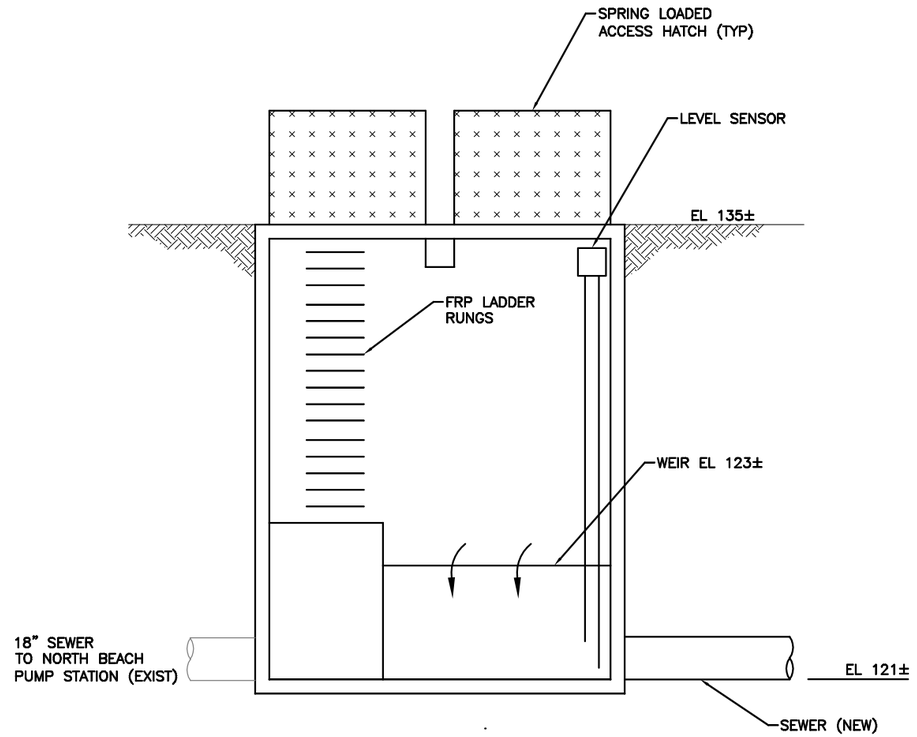
NOTES:

1. ELEVATIONS AND PIPE DIMENSIONS ARE APPROXIMATE AND SHOULD BE VERIFIED DURING FINAL DESIGN.



DIVERSION STRUCTURE PLAN
SCALE: 3/8" = 1'-0"



SECTION A
SCALE: 3/8" = 1'-0"

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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RECOMMENDED:	CONTRACT NO:
APPROVED:	

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NORTH BEACH BASIN

FIGURE 6.2
DIVERSION STRUCTURE
PLAN AND SECTION

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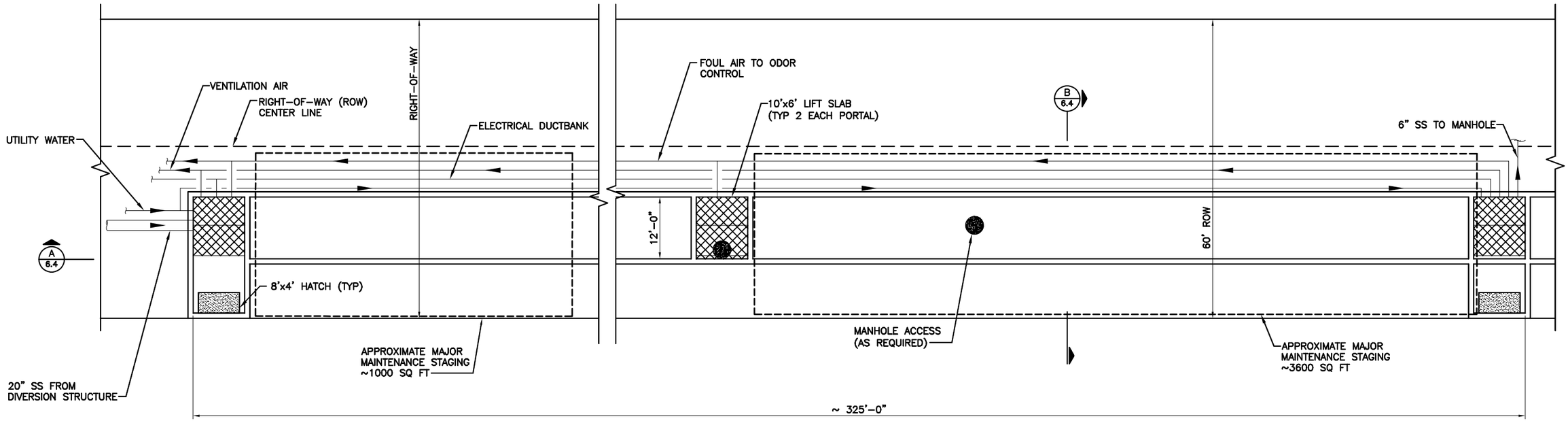
NOTES:

1. ELEVATIONS AND PIPE DIMENSIONS ARE APPROXIMATE AND SHOULD BE VERIFIED DURING FINAL DESIGN.



STORAGE PIPELINE PLAN
SCALE: 1" = 20'

ONE INCH
AT FULL SIZE. IF NOT ONE INCH SCALE ACCORDINGLY

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NORTH BEACH BASIN

FIGURE 6.3
STORAGE PIPELINE PLAN

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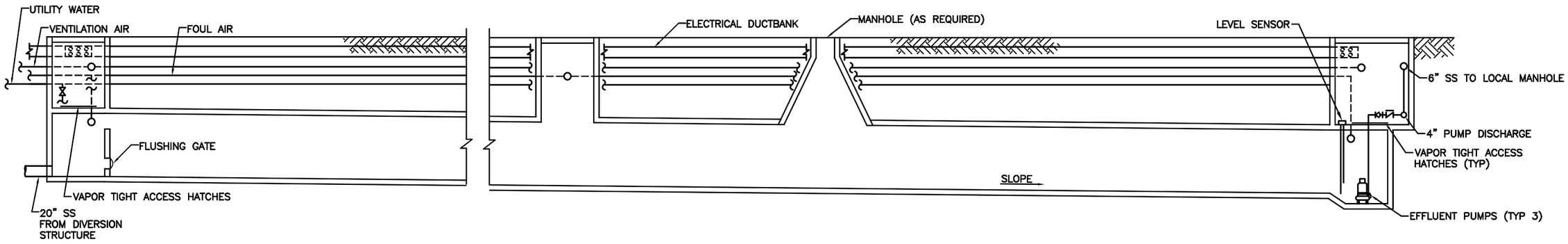
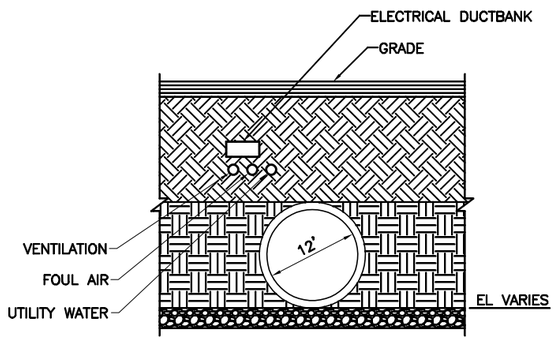
1. ELEVATIONS AND PIPE DIMENSIONS ARE APPROXIMATE AND SHOULD BE VERIFIED DURING FINAL DESIGN.



SECTION A 6.3
SCALE: 1" = 10'



SECTION B 6.3
SCALE: 1" = 10'

ONE INCH
AT FULL SIZE. IF NOT ONE INCH SCALE ACCORDINGLY

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NORTH BEACH BASIN

FIGURE 6.4
STORAGE PIPELINE SECTIONS

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the effluent end of the facility so that water will begin to collect around the effluent pumps. When the storage pipeline reaches the maximum water level, the influent gate will close.

When flows drop below the capacity of the North Beach Pump Station, the storage pipeline effluent pumps will be activated and the influent gate opened. Three submersible pumps located in the sump will lift stored flows back into the sewer system via a 6-inch force main to a local manhole. The minimum pumping rate will be 160 gpm to drain the pipeline in a maximum of 24 hours. If the combined sewer flow rate and pumped storage flow rate exceed the capacity of the North Beach Pump Station, flows will overtop the weir in the diversion structure and be recirculated to the storage pipeline.

After the storage pipeline empties, an automated flushing system will be used to remove solids. The flushing gate will be closed and utility water will fill a portion of the pipeline upstream of the gate. Once the water level reaches a certain level, the gate will open and discharge the flushing water. The flushing water will be sent through the pipeline, scouring the solids on the pipeline floor. After each flush, the water will be collected in the sump of the pipeline and pumped by the submersible pumps. The same force main used to pump stored flows will convey the flush water from the pipeline to the sewer system.

Access to the portals and storage pipeline will be through lift slabs and hatches. The upstream and downstream portals will have ladders or additional access equipment for routine maintenance. The portals will be isolated from the storage pipeline and ventilated as required to allow for routine operations and maintenance, such as level sensor calibration and pump exercising.

The access hatches would be embedded into large, concrete removable panels that could be lifted by boom truck or crane to allow for infrequent repairs or manual cleaning. Intermediate access points would also be provided for life safety equipment access to support long-term maintenance activities.

6.1.2.3 Ancillary Equipment Facility

The ancillary equipment facility for this approach, shown in Figure 6.5, contains the odor control system, mechanical equipment, and electrical equipment to support the storage pipeline. The exterior dimensions of the ancillary equipment facility are approximately 40 feet long by 20 feet wide. The facility is one-story maximum as allowed by Seattle Municipal Code. The facility is located to provide adequate access to facilities on the North Beach Pump Station site and minimize its visual presence.

The odor control system consists primarily of a carbon adsorption scrubber vessel, mist eliminator, and fan. Additional instruments and smaller components would also be required, but are not considered major equipment. The ventilation rate would be two air changes per hour (ac/hr) or maximum fill rate (5.5 mgd), whichever is greater, to control odors. There are also provisions, including a variable speed drive for the odor control fan and bypass ductwork, for six ac/hr to bypass the carbon scrubber and to facilitate manned entry into the storage facility. The odor control system is directly connected to the storage facility with buried corrosion-resistant ductwork or piping (PVC or fiberglass ductwork). Treated-air discharge ductwork would be routed to a location and height on the North Beach Pump Station site as determined during final design.

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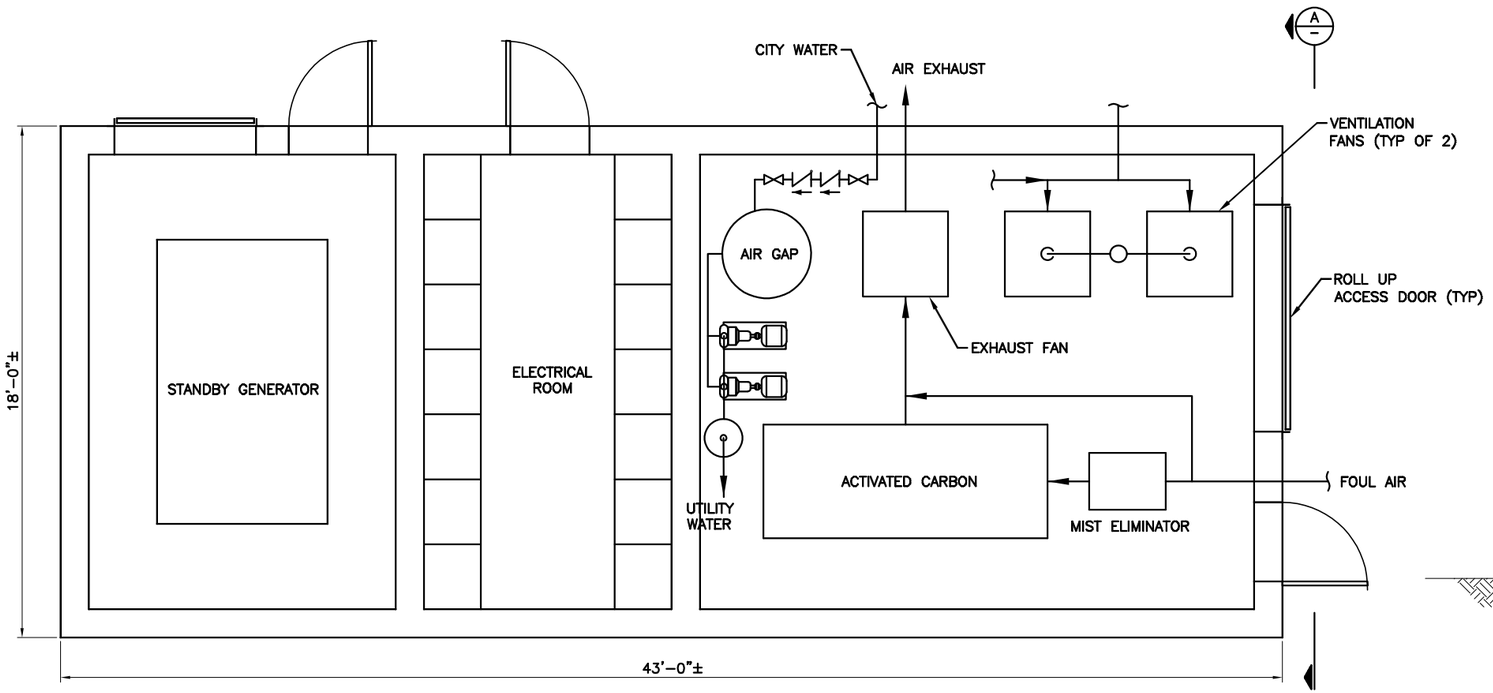
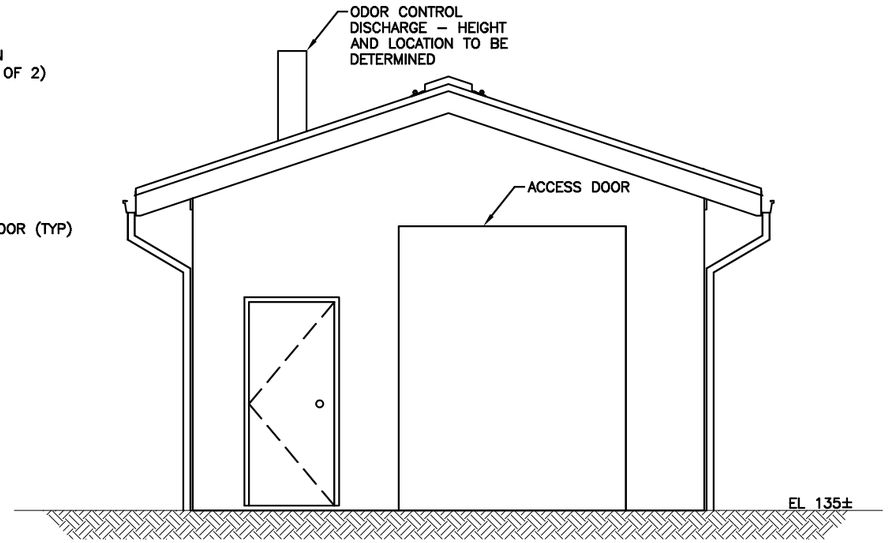
NOTES:

1. ELEVATIONS AND PIPE DIMENSIONS ARE APPROXIMATE AND SHOULD BE VERIFIED DURING FINAL DESIGN.



ANCILLARY EQUIPMENT FACILITY
SCALE: 3/8" = 1'-0"



SECTION A
SCALE: 1'-0"=3/8"

ONE INCH AT FULL SIZE. IF NOT ONE INCH SCALE ACCORDINGLY

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FIGURE 6.5
ANCILLARY EQUIPMENT FACILITY
PLAN AND SECTION

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The building also houses HVAC equipment for the ancillary equipment facility and the storage pipeline portals. The ventilation rate for the occupied spaces would be 12 air changes per hour (ac/hr) continuously.

To provide water for the flushing system and other facility needs, water drawn from a new service water line is be routed through an above-grade backflow preventer and air break tank as required by health codes. The air break tank is a 500-gallon reservoir inside the ancillary equipment facility. Utility water pumps would draw from the reservoir and pump the water into a hydropneumatic tank to pressurize the utility water system.

6.1.2.4 Site Improvements

6.1.2.4.1 Access to Proposed Facilities

Access to the storage pipeline is from the right-of-way on Triton Drive NW and NW Blue Ridge Drive. Access hatches for routine maintenance are located as far to the edge of the right-of-way as possible. Moving as far from the traveled roadway lanes as possible will facilitate safe access and minimize street closures. All access hatches would be rated for HS20 loading. Removable lifting slabs are configured in other areas of the right-of-way for less frequent maintenance activities. Depending on the final location of the lifting slabs, these maintenance activities would require partial or full closure of the roadway.

The road alignment and configuration should provide the space required and safe setbacks for maintenance access to the storage pipeline. The hatches and surrounding space would be marked for King County vehicles only.

The North Beach Pump Station site has an existing access road on the west side of the site. This alternative uses a portion of this area for the ancillary equipment facility, cutting off access to the north side of the pump station. A new access road would be constructed on the east side of the North Beach Pump Station to allow access to the diversion structure and north side of the ancillary equipment facility and North Beach Pump Station.

6.1.2.4.2 Revisions to the Existing Site

The entire North Beach Pump Station site would be fenced with restricted access both during construction and after project completion. The site is currently fenced on all sides; this existing fence would be replaced or restored after construction.

Stormwater control and treatment is required per the Seattle Municipal Code. Stormwater bioretention is to be placed around the site adjacent to paved surfaces and runoff will be directed to these locations for treatment prior to discharge to the existing storm drain system in the right-of-way. Irrigation controllers and irrigation lines to stormwater bioretention areas and perimeter planting areas would be established to facilitate plant establishment. Stormwater requirements are discussed in more detail below.

The existing rockery retaining wall along the eastern property boundary may be revised to facilitate site grading and construction. The retaining wall would likely be replaced. The replacement could be constructed of concrete or rock and would range in height between 3 and 5 feet similar to the existing.

6.1.2.4.3 Right-of-Way Improvements

The right-of-way in the project area will be repaved following construction to meet current SDOT pavement and street restoration requirements. Applicability of the following codes would be verified during final design:

- Development projects must provide full street improvements (Ordinance 122615 Sidewalks Improvement Initiative).
- Pavement removal and restoration in the right-of-way must conform to SDOT Director's Rule 5-2009.
- Any new landscaping must be in accordance with City of Seattle standards.
- Stormwater requirements must conform to Seattle Department of Planning and Development Director's Rule 17-2009 (SMC Chapters 22.800 – 22.808).

Protection of existing utilities is addressed in Section 6.2.

6.1.2.4.4 Stormwater Requirements

Due to improvements both within the right-of-way and on a parcel, if implemented this alternative will be classified as a "Joint Project" under Seattle Municipal Code, requiring that both parcel-based and roadway stormwater requirements be met (SMC 22.805.070). The area of impact for the proposed alternative includes more than 7,000 square feet of new or replaced impervious surface. Therefore, for site stormwater control, according to the November 2009 Directors' Rules for the Seattle Stormwater Code (SMC Chapters 22.800-22.808), runoff from the site will require water quality treatment. The design water quality treatment volume is be equal to 91 percent of the total volume of the simulation period using an approved continuous model (SMC 22.805.090.B1.a).

The site discharges to a storm drainage system that drains to Puget Sound, which is classified as a designated receiving water and will not require the project to implement flow control.

This location is not designated as "capacity-constrained," which would require peak flow control (SMC 22.805.080.B4). However, as a "large" project (replacing 5,000 square feet or more of impervious surface), this project would require an analysis of the downstream system within 1/4-mile of the site to ensure sufficient capacity of the drainage system (SMC 22.805.020.I). Should the downstream system be determined to have insufficient capacity for the peak flow with a 4-percent annual probability (a 25-year recurrence interval), peak flow control or improvements to the drainage system may be necessary.

This alternative will implement green stormwater infrastructure BMPs to the maximum extent feasible (SMC 22.805.020.F), including, but not limited to, the use of permeable surfacing and bioretention for water quality treatment. Under the City's current standards for design of low impact development (LID) concepts, the size of the treatment facility will be based on the percentage of existing impervious surface and on the technology used.

6.1.2.4.5 Landscaping

Existing shrubs and grass would be removed due to construction. There are no large trees in the construction area.

Areas disturbed by construction would be replanted with drought-tolerant or native planting, or both, as developed during final design. Landscaping will be in accordance with City of Seattle standards and the County will work with the community to develop the landscaping plan, as this area is a viewshed for the residences. Temporary irrigation systems would be employed during the plant establishment period (typically 1 to 2 years) to reduce plant mortality.

6.1.3 Process Flow

This section describes how the North Beach CSO control facilities will operate during normal flow and peak wet-weather events after the proposed changes.

6.1.3.1 Normal Flow Description

Figure 6.6 is a schematic of normal flow operation. Normal flow is defined as flow up to 3 mgd, which is the capacity of the North Beach Pump Station. Normal flows from the North Beach Basin will pass through the diversion structure to the North Beach Pump Station. All flow will be conveyed to the Carkeek Pump Station and, ultimately, the West Point Treatment Plant.

6.1.3.2 Peak Wet-Weather Flow Description

Figure 6.7 is a schematic of peak wet-weather flow operation. Peak wet-weather flow is defined as flow greater than 3 mgd, which exceeds the capacity of the North Beach Pump Station. Peak wet-weather flows from the North Beach Basin will enter the diversion structure, which will send 3 mgd through to the North Beach Pump Station for conveyance to the Carkeek Pump Station.

All flow greater than 3 mgd will overflow a weir in the diversion structure and flow by gravity to pipeline storage. If the capacity of the influent pipe (approximately 6.6 mgd) or pipeline storage (230,000 gallons) is exceeded during the peak wet-weather event, overflows will occur at the existing outfalls. When the capacity of pipeline storage is exceeded, an isolation gate at the inlet will be closed to prevent flooding through the pipeline storage access portals.

At the conclusion of the peak wet-weather event, when flows in the CSS subside to less than 3 mgd, effluent pumps will drain the pipeline. The pumps will be sized to drain the storage pipeline in less than 24 hours (firm capacity). Should wastewater flows in the CSS combined with storage effluent exceed the capacity of the North Beach Pump Station, the excess flow will overflow the weir at the diversion structure and recirculate through storage.

6.1.3.3 Process Flow Diagram

Figure 6.8 shows a process flow schematic of the North Beach CSO control system.

Instrumentation and controls strategies will be developed during final design of this project. The SCADA system will provide the operator with applicable control set points and will generate level alarms when the storage facility approaches and reaches its fill level and when flows overtop weirs. Appropriate control actions will be implemented for the following situations:

- Power failure and restore.
- Communications failure and restore.
- PLC self-diagnostics alarms and restore.

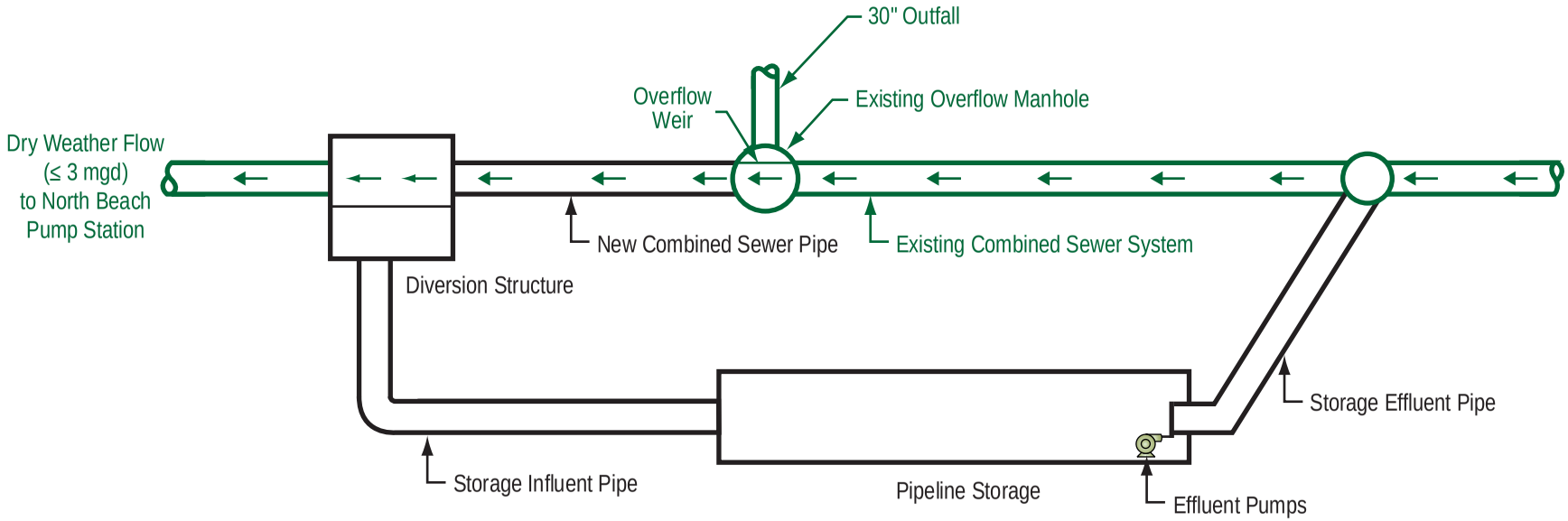

Figure 6.6
AVERAGE DRY-WEATHER FLOW SCHEMATIC

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Department of Natural Resources and Parks
Wastewater Treatment Division

Figure 6-6.ai

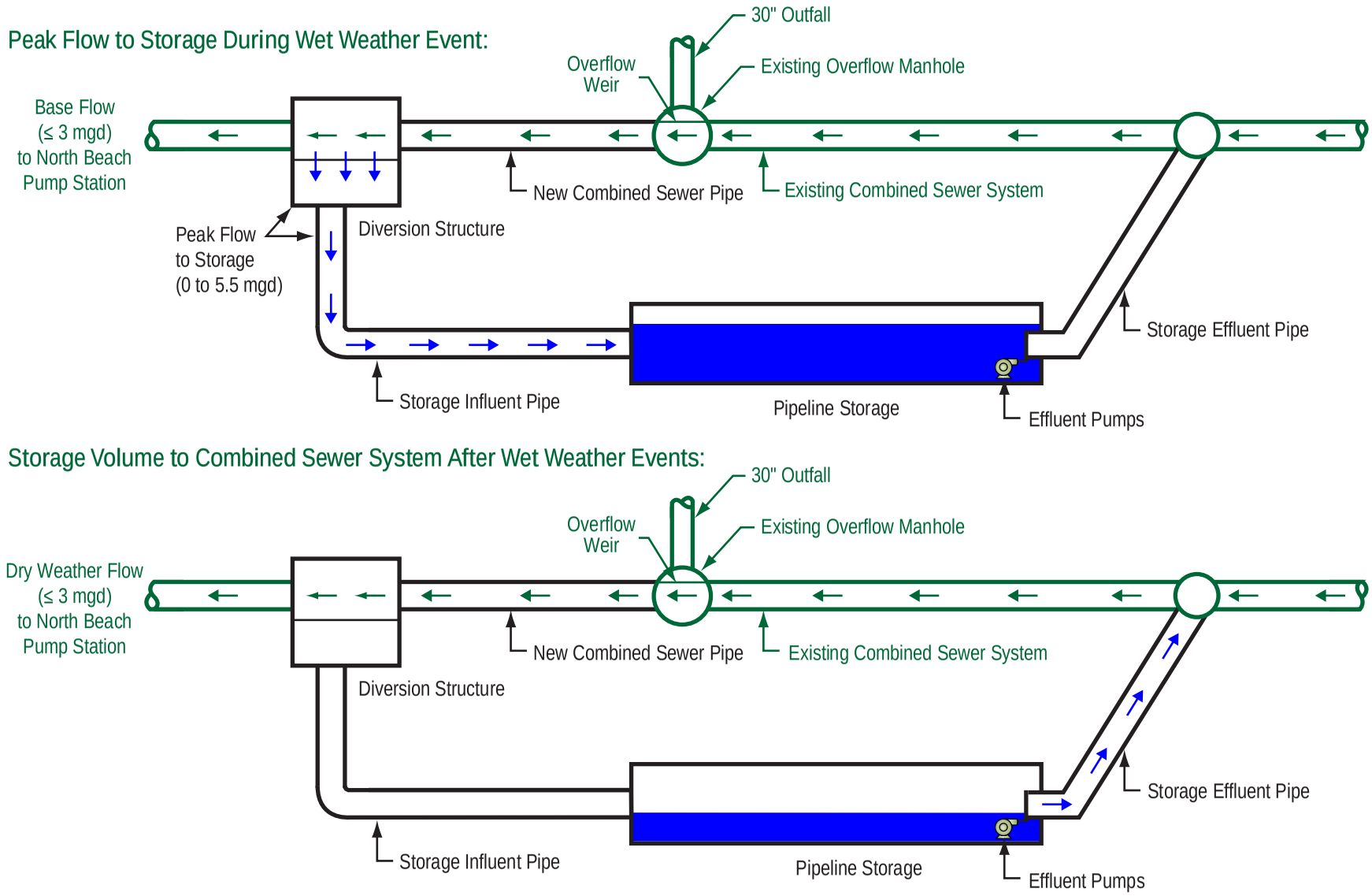

Figure 6.7
PEAK WET-WEATHER FLOW SCHEMATIC

King County
Department of Natural Resources and Parks
Wastewater Treatment Division

Figure 6-7.ai

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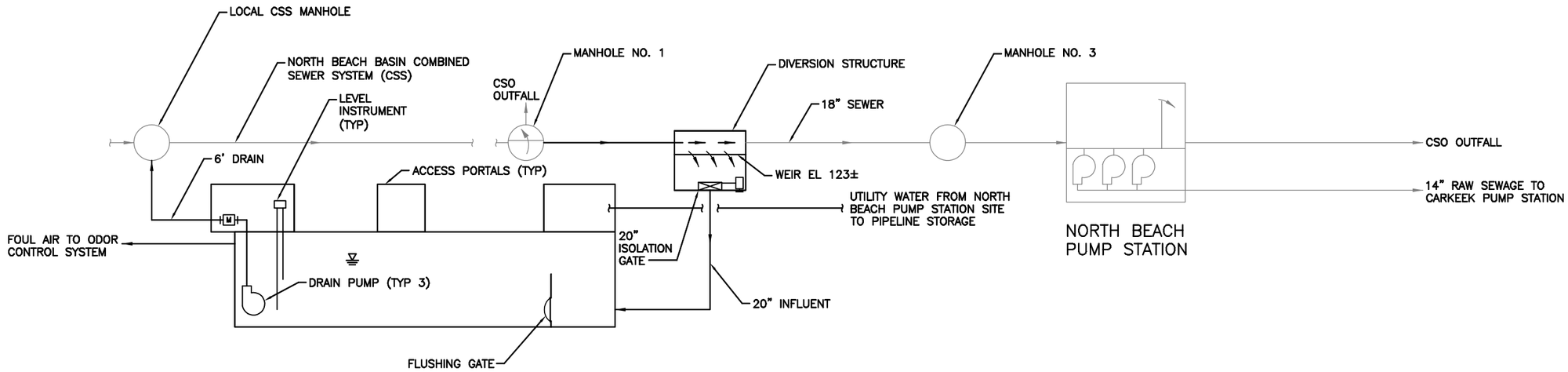

PROCESS FLOW DIAGRAM
SCALE: NTS

ONE INCH AT FULL SIZE. IF NOT ONE INCH SCALE ACCORDINGLY

No.	REVISION	BY	APP'D	DATE

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DRAWN: JLS	SCALE: NONE
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NORTH BEACH BASIN

FIGURE 6.8
PROCESS FLOW DIAGRAM

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- Level measure calibration, out of range (high and low), and restore.
- Set point entry range checking.

6.1.3.4 Hydraulic Profile

The hydraulic profile of the North Beach CSO control system is shown in Figure 6.9.

6.1.4 Facility Sizing

Major project dimensions and sizes are provided in Table 6.2. Additional details of the proposed facilities can be found in Figures 6.2 through 6.5.

Table 6.2 North Beach Basin CSO Facility Sizing

Facility Component	Design Criteria[1]
Diversion Structure	
Structure Dimensions	12 ft x 8 ft
Structure Depth	17 ft
Weir Length	8 ft
Pipeline Storage	
Diameter of Influent Pipe	20 in
Pipeline Volume	0.23 MG
Pipeline Length	325 ft
Pipeline Diameter	12 ft
Number of Cells	1
Floor Slope	1%
Minimum Freeboard	2 ft
Number of Drain Pumps	2 duty + 1 standby
Drain Pump Type	Submersible
Drain Pump Capacity	80 gpm each
Diameter of Effluent Pipe	6 in
Maximum Time to Drain Storage	24 hrs
Access	Every 200 ft (minimum); outside right-of-way
Equipment Materials	Corrosion resistant (304/316 SS or FRP)

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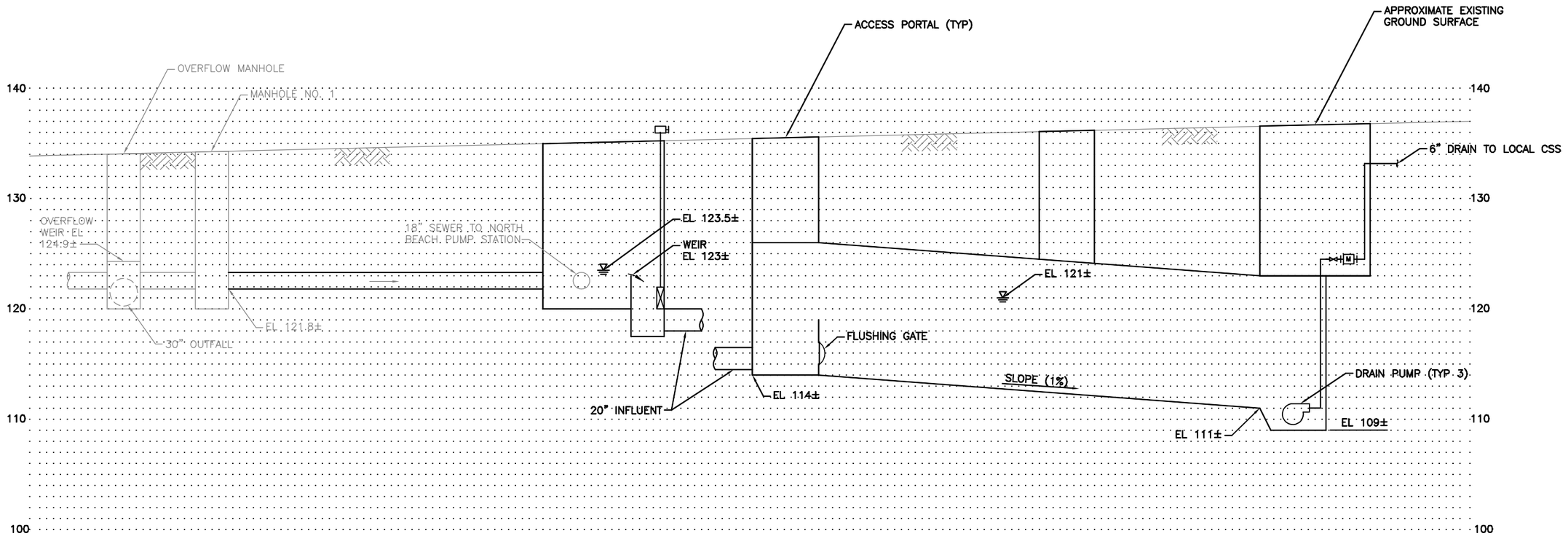
GENERAL NOTES:

1. ALL EVELVATIONS BASED ON METRO DATUM.
2. WATER SURFACE ELEVATIONS BASED ON MAXIMUM CSO FLOW (6.6 MGD) OR VOLUME (230,000 GALLONS).



EXISTING COMBINED SEWER SYSTEM | DIVERSION STRUCTURE | STORAGE PIPELINE

HYDRAULIC PROFILE
SCALE: H = NTS
V = 1" = 10'

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

No.	REVISION	BY	APP'D	DATE

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FIGURE 6.9
HYDRAULIC PROFILE

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Table 6.2 North Beach Basin CSO Facility Sizing (continued)	
Facility Component	**Design Criteria[1]**
Ancillary Equipment Facility	
Odor Control	Peak air displacement rate (5.5-mgd peak-flow to storage) or 2 ac/hr (whichever is greater)
Air Treatment	Activated carbon; 1 pass; 50 fpm; constant speed fan/blower
Occupied Space Ventilation	12 ac/hr
Standby Generator	Total estimated load; 80% of nameplate rating at full load; diesel w/ 24 hr capacity
Backflow Preventer	4 in
Air Gap Tank	500 gal
Number of Utility Water Pumps	2 duty
Utility Water Pump Type	End-suction centrifugal
Utility Water Pump Capacity	80 -100 gpm
Facility Footprint	40 ft x 20 ft
Notes: 1. Design criteria are preliminary and may be revised during final design.	

6.2 ENVIRONMENTAL IMPACTS

The project would reduce the volume and frequency of untreated overflows to Puget Sound, enhancing water quality and wildlife habitat. Elements evaluated during initial environmental analyses included: groundwater and surface water, earth resources, land use, recreational resources, utilities, transportation, odor and air quality, noise, vibration, cultural resources, endangered/ threatened species and habitats, and prime or unique farmland. The County is preparing a SEPA Environmental Checklist in accordance with WAC 197-11 and plans to issue a threshold determination in February 2011. A copy of the SEPA Environmental Checklist and threshold determination will be provided in Appendix D when available.

6.2.1 Existing Ecosystems

The primary project area consists of a parcel on Triton Drive NW and right-of-way along Triton Drive NW and NW Blue Ridge Drive. The parcel, owned by King County, includes the North Beach Pump Station and ancillary support facilities.

Documentation provided in Appendix D describes existing environmental conditions in the project area.

6.2.1.1 Wetlands

According to the City of Seattle Critical Areas Map (Figure 3.7) there are no wetlands on or immediately adjacent to the project sites.

6.2.1.2 Streams and Ditches

The City of Seattle Critical Areas Map (Figure 3.7) indicates a piped stream crossing though the project area near the western edge of the North Beach Pump Station parcel. This is the pipe that the existing overflow manhole discharges into. It is anticipated that there would be no need to relocate or modify this piped stream due to construction of the proposed facilities.

There is a ditch along the southeast side of the NW Blue Ridge Drive right-of-way. The ditch carries stormwater from residential development and other surface water runoff to existing storm drainage features.

Street frontage improvements required for this project could permanently impact the surface water ditch. The ditch would be reconfigured or replaced to convey stormwater runoff.

6.2.1.3 Fish Resources

There are no fish bearing streams in the vicinity of the project. This project would limit combined sewer overflows to Puget Sound, which should enhance water quality and wildlife habitat. Therefore, no negative impact on fish resources is expected.

6.2.2 Groundwater and Surface Water

A preliminary geologic/geotechnical evaluation (Shannon & Wilson, Inc., August 2010) of the North Beach alternatives is provided in Appendix A. As described in Chapter 3, the evaluation included an assessment of the geologic conditions in the project area and information on the geotechnical limitations. A detailed geotechnical evaluation will be conducted during final design.

The depth to groundwater is unknown but it is probably perched close to the ground surface since the surface water in this basin is focused toward the project area.

Since the proposed storage pipeline will be approximately 25 feet below ground surface, it is assumed that groundwater will be encountered during excavation for the pipeline. Dewatering flow will most likely be discharged through the existing sewer or storm drain systems. An NPDES or Industrial Waste Discharge Permit would be obtained, as required.

Puget Sound lies to the north of the project area. However, no impact on the Sound is expected. The project will have a long-term beneficial impact on water resources since it will achieve the CSO control objective of allowing no more than one untreated event per year on average.

6.2.3 Earth Resources

6.2.3.1 Soils

Impacts on soils during construction of the CSO facilities will include erosion from excavation activities. A majority of the soils excavated for the storage pipeline would be hauled off-site to approved locations.

6.2.3.2 Geologic Hazards

The City of Seattle Critical Areas Map (Figure 3.7) shows no geologic hazards on or near the site.

6.2.3.3 Soil and Groundwater Contamination

According to the City of Seattle Critical Areas Map (Figure 3.7) there are no known contaminated areas in the vicinity of the project.

6.2.4 Land Use

The right-of-way within the proposed construction area will be temporarily impacted during construction activities. No permanent impacts on land use are anticipated.

6.2.5 Recreational Resources

The project site is immediately south of Blue Ridge Park. Currently, the site is used by the Blue Ridge neighborhood as a private park.

Construction of the facilities would impact access to the park by recreational users. Parking immediately adjacent to the park will not be available. Pedestrian access would likely be routed along the north edge of the NW Blue Ridge Drive right-of-way.

There would be no long-term impact on recreational resources.

6.2.6 Utilities

Existing utilities at the North Beach Pump Station site and in the Triton Drive NW and NW Blue Ridge Drive right-of-way may need to be relocated as part of facility construction and improvements to the property. Existing sewer, drainage, power, gas, and telecommunications services would be maintained through temporary and/or permanent relocation of utilities as required by the final design.

6.2.7 Transportation

There will be temporary impacts on traffic and access during construction within Triton Drive NW and NW Blue Ridge Drive. Potential delays and detours during construction could have temporary, indirect impacts. Longer traffic queuing times are not anticipated.

Temporary road closures would occur on Triton Drive NW and NW Blue Ridge Drive within the construction area for construction of the influent pipe, storage pipeline, effluent pipe and utilities

required for the storage pipeline. There are nearby alternate routes available to Triton Drive NW from the west and NW Blue Ridge Drive from the east. The length of closure is anticipated to be 12 to 18 months. The closure would also require temporary relocation of the Metro bus stop adjacent to the North Beach Pump Station site and re-routing of the bus. In addition to road closures and detours during construction, there will be increased construction traffic to and from the project site. The peak number of daily construction trips would occur during excavation and backfilling of the storage pipeline and asphalt paving and are estimated at approximately 30 trips per day. During other phases of construction, the number of daily construction trips is likely to be less than 30 trips per day. It is likely that the general construction traffic would have little impact on the level of service in the area.

During construction, the contractor would be required to submit a traffic control plan detailing the haul route for construction traffic. Additional traffic control measures, such as warning signs and flaggers, may be a requirement of the haul route approval.

Measures to reduce or control transportation impacts by the completed project would not be required.

6.2.8 Odor and Air Quality

Air quality impacts from earth-moving activities during construction are typical for large construction projects. BMPs would be implemented for dust control, including street sweeping, watering exposed soil surfaces, and covering soil stockpiles to help minimize the amount of fugitive dust and particulate pollution to the surrounding areas. Other similar BMPs might be employed by the contractor to minimize dust. Construction activities often concentrate heavy equipment powered by gas or diesel engines in a particular location. Air pollution from engines could increase during certain activities, such as queuing trucks for loading and offloading of materials, or during heavy excavation. Provisions to limit idling of mechanical equipment typically are included in King County projects and would be employed during construction to minimize the amount of air pollution generated from gas- and diesel-engine-driven machinery, as well as to limit greenhouse gas effects.

Long-term impacts (continuous emissions) from odors associated with operation of the facilities would be minimized and mitigated through several design features. Odor generation in the new diversion structure would be minimized by limiting turbulence and keeping the hatches to the structure closed. Odors generated at the storage pipeline would be minimized through the automated flushing system installed to clean settled solids from the pipeline after each storage event. Periodic manual wash-down of the accessible portions of the pipeline walls could be used to minimize odorous gas formation in the pipeline further; however, the current design prioritizes the automated flushing system. Any odors generated within the pipeline from stored wastewater or solids not removed from the wash-down system would be mitigated through operation of the planned odor control facility.

Instrumentation to measure inlet and outlet gas concentrations at the odor control facility would help determine the functional performance and life remaining on the carbon filter media to more accurately schedule carbon replacement. Active monitoring ensures that foul odors are controlled to the extent possible by the installed system.

6.2.9 Noise

Noise impacts during construction would be mitigated by contract documents requiring compliance with noise regulations and the local jurisdictional codes. Variances may be obtained if the schedule requires working additional hours beyond current ordinance allowances.

Equipment operation after the facility is in operation would produce little if any noticeable noise. Pumps in the storage pipeline are submersible and would not produce noticeable noise. All functional noise controls, such as insulation under access hatches, would be implemented so that noise levels at the property line would not exceed limits established for the site's current zoning.

In this alternative odor control equipment, pump motor starters and a standby generator are housed in a facility on the North Beach Pump Station site. Additional noise mitigation measures such as louver baffles, acoustical shrouds, and exhaust stack silencers would be included as necessary to provide minimum noise conditions at the site's property line. Additional measures such as cabinet acoustical insulation or noise-suppressing insulation inside the structure may be required if noise levels at the site became unacceptable to the adjacent residents.

6.2.10 Vibration

Vibration during construction of the facilities would be monitored at nearby residences. Standards of care would be applied and specified in the contract documents.

During normal operation of the storage pipeline and completed facility equipment, vibrations would be localized to the degree that only those persons standing near the equipment enclosure or on hatches directly adjacent to equipment would notice vibrations. Pumps currently sized for this facility are not large enough to create vibration issues, particularly given the mass of the new storage facility. Odor control equipment and standby generator would be fitted with anti-vibration components in the equipment anchoring systems specified for the project.

6.2.11 Cultural Resources

A review of known and potential cultural, archaeological, and historic resources within the North Beach Basin has been conducted. There are no known archaeological sites or historic structures on or near the proposed project site. Based on site characteristics and location, the project area has a low probability of containing archaeological resources.

6.2.12 Endangered/Threatened Species or Habitats

There are no threatened or endangered species known to be on or immediately adjacent to the project site. Project construction would be approximately 200 to 300 feet south of Puget Sound. Long-term effects of the project would be beneficial to listed species in Puget Sound, as water quality would be improved with a reduction in combined sewer overflow events.

6.2.13 Prime or Unique Farmland

There is no farmland within the project area, so there would be no impacts on prime or unique farmland.

6.3 DESIGN LIFE

The design life of the storage facility is based on a 50-year life cycle, and the primary equipment design life is based on a 20-year life cycle. Routine maintenance of the facility and replacement of equipment would occur as needed to obtain the design life.

6.4 RESIDUALS MANAGEMENT

The proposed storage pipeline is designed with a flushing gate so that solids will be cleaned out of the pipe following a CSO event and do not accumulate in the storage pipe. Utility water would also be provided at the diversion structure to flush the influent pipeline to storage. Therefore, sludge management should not be a concern here. The storage pipeline will be designed to allow for access and cleaning by O&M staff, should additional cleaning be needed.

6.5 ABILITY TO EXPAND

It is not anticipated the North Beach Basin will experience any significant demographic or land use changes in the future. The area is considered built-out and population levels are anticipated to remain relatively constant. The need for this project is not due to anticipated population growth or increase in sewered areas (connecting on-site systems to sewer system); therefore, it is not anticipated that future demographics, land use, or population growth will increase the storage volume required to meet current Ecology requirements.

In the event that the facility is undersized, the primary option to provide additional CSO reduction is inflow and infiltration reduction measures, including a focus on the City of Seattle's Residential RainWise Program.

Due to the age of the collection system in the North Beach Basin, it is likely that many locations experience inflow and infiltration; the majority of the inflow and infiltration is likely occurring on private property.

The City's Residential RainWise Program aims at reducing the amount of stormwater runoff (inflow) from private properties into the sewer collection system. By removing residential stormwater connections from the combined system, the volume and flow rate of wet-weather peak flows are reduced. This reduction increases the capacity of the existing facilities within the basin.

For the City-owned collection sewers, additional investigation would be required to identify and locate points of infiltration in the system. It is difficult to predict the level of reduction that will be achieved with infiltration reduction projects, and the projects are unreliable in achieving the reductions of flow required for CSO control. Other combined sewer agencies across the nation, including many in the Northwest, consider infiltration reduction a good asset management practice but do not rely upon it to achieve compliance with CSO reduction requirements. Infiltration reduction is usually a secondary benefit of rehabilitating the pipe.

6.6 O&M AND STAFFING NEEDS

The recommended alternative would need regular maintenance to ensure that the design life of the facility is met and proper operation occurs. Table 6.3 shows the types of O&M activities that could occur, the frequency of each activity, and staffing requirements to perform those activities.

Key issues for O&M include the following:

- Monitor the system remotely during a wet-weather event and for gas build-up during dry weather.
- Design the system for ease-of-operations and maintenance, including post-wet weather event cleaning.
- Design so that maintenance staff will not need to routinely enter the storage pipeline.
- Provide provisions for entry to storage pipeline and maintenance, if needed.
- Visually integrate the ancillary facility with the surrounding neighborhood.

6.7 DESIGN GUIDELINES

This section summarizes the guiding principles that will be used for final design of the proposed alternative.

6.7.1 Site Design

The finished design of the site must provide for adequate traffic movement and safety while providing adequate access, working space, and parking for maintenance of the facilities. Minimizing impact on existing land uses is an important design parameter in the final design of the alternative.

6.7.2 Traffic

It is important to minimize lane and road closures and impacts on traffic during construction.

Once the facility is completed, King County O&M staff will periodically be required to visit the site. Disruption to traffic should be minimized without compromising King County's ability to effectively operate and maintain the facility.

6.7.3 Structural/Geotechnical

Shoring for earthwork should be of a type appropriate for the available space and other site conditions. Shoring for earthwork must adequately support the sides of the excavation and protect adjacent areas and structures.

Anticipated groundwater levels would require dewatering during construction of the pipeline, piping and diversion structure. The structural design of the storage pipeline would also need to counteract buoyancy due to groundwater while avoiding or minimizing the need for piles or other foundation supports.

Table 6.3 Operations and Maintenance Activities

Component	Activity	Frequency	Staff Needed	Special Equipment Needed
Diversion Structure				
Access Hatches	Inspect hatches for wear and tear from surface by opening access hatches and visually assess conditions; replace worn or damaged components.	Annually	2	Repair components from manufacturer/ supplier
Gates	Grease riser stems, adjust seats, etc. depending on type of gate.	Annually or per Manufacturer recommendations	2	None
Gates	Replace gates.	As needed	6	Confined space entry equipment
Operators/Actuators	Grease riser stems, packing, seats, etc., depending on type of operator/actuator.	Annually or per manufacturer recommendations	2	None
Level Gauges	Inspect and take readings.	Weekly	1	None
Level Gauges	Calibrate.	Annually	1	None
Level Gauges	Repair/Replace gauges.	As needed	2	None
Pipeline Storage				
Access Hatches	Inspect hatches for wear and tear from surface by opening access hatches and visually assess conditions; replace worn or damaged components.	Annually	2	Repair components from manufacturer/ supplier
Flushing Gate	Inspect flushing gate for wear and tear from surface by opening access hatches to view and visually assess conditions.	Monthly	2	None
Flushing Filling System	Inspect for damage to filling system; replace worn or damaged components.	Monthly	2	Repair components from manufacturer/ supplier
Storage Pipeline	Supplemental manual cleaning.	Every 3 to 5 years	10	Boom truck, Vactor™ truck, confined space entry equipment
Storage Pipeline	Flushing after CSO event.	~10 times per year	2	None

Table 6.3 Operations and Maintenance Activities

Component	Activity	Frequency	Staff Needed	Special Equipment Needed
Storage Pipeline	Surface inspection – open hatches and inspect visible areas with surface-supplied lighting to monitor for debris accumulation.	After each event for first year. Thereafter, annually at a minimum.	2	Surface direction lighting
Storage Pipeline	Manned structural inspection – perform manned entry into pipeline area to inspect concrete structure.	10-year cycle/post-seismic event	5	Confined space entry equipment, fire department standby
Storage Pipeline	Survey of existing structure for settlement.	10-year cycle/post-seismic event	4	Survey crew and equipment
Pumps	Routine maintenance – bearings, sensors – can be done at surface.	Semi-annually	3	None
Pumps	Pump Start/Stop cycling; operate pumps manually to ensure start/stop.	Monthly	2	None
Pumps	Clearing rags, blockages; can be done at surface.	As needed	3	None
Pumps	Slide rail – inspect for wear and tear.	Every 10 years/when manned structural inspection is performed	5	Confined space entry equipment, fire department standby
Valves	Grease riser stems, packing, seats, etc., depending on type of valves.	Annually or per manufacturer recommendations	3	None
Valves	Replace valves.	As needed	3	None
Gates	Grease riser stems, adjust seats, etc., depending on type of gate.	Annually or per manufacturer recommendations	3/5	None/confined space entry equipment
Gates	Replace gates.	As needed	6	Confined space entry equipment
Operators/Actuators	Grease riser stems, packing, seats, etc., depending on type of operator/actuator.	Semi-annually or per manufacturer recommendations	3	None

Table 6.3 Operations and Maintenance Activities

Component	Activity	Frequency	Staff Needed	Special Equipment Needed
Flow Meter	Inspect and take readings.	Weekly	1	None
Flow Meter	Calibrate.	Annually	1	None
Flow Meter	Repair/Replace gauges.	As needed	2	None
Level Gauges	Inspect and take readings.	Monthly	1	None
Level Gauges	Calibrate.	Annually	1	None
Level Gauges	Repair/Replace gauges.	As needed	2	None
Electrical Room				
Panels	Routine inspection and maintenance.	Semi-annually or per manufacturer	1	None
VFDs	Routine inspection and maintenance.	Semi-annually or per manufacturer	1	None
PLC	Routine inspection and maintenance.	Semi-annually or per manufacturer	1	None
MCC	Routine inspection and maintenance.	Semi-annually or per manufacturer	1	None
Motor Starters	Routine inspection and maintenance.	Semi-annually or per manufacturer	1	None
Standby Generator	Routine inspection and maintenance.	Semi-annually or per manufacturer	2	None
Standby Generator	Routine testing	Monthly	2	None
Mechanical Room				
Air Gap Tank	Visually inspect for leaks, corrosion and fouled contacts on instruments/floats.	Monthly	1	None
Air Gap Tank Filling System	Visually inspect for leaks, manually operate valves or system by hand-adjusting floats/level controllers.	Annually	1	None
HVAC	Belts and Bearings – Inspect and replace as needed.	Semi-annually or per manufacturer	1	None
Carbon Filter Media	Sample carbon for saturation; collect analytical sample for analysis by vendor/laboratory.	Semi-annually	1	None

Table 6.3 Operations and Maintenance Activities

Component	Activity	Frequency	Staff Needed	Special Equipment Needed
Carbon Filter Media	Inspect filter bed for crusting/fouling – use rake/hand tools to break up fouled surface (horizontal bed only).	Semi-annually or as indicated by pressure gauges across filter bed	1	None
Carbon Filter Media	Replace carbon media.	On 5-year intervals or as indicated by carbon testing results	3	Vactor™ truck, boom truck or lifting equipment if facility not equipped
Fan – Odor Control Fan	Belts and Bearings - Inspect and replace as needed.	Semi-annually or per manufacturer	1	None
Fan – HVAC	Belts and Bearings - Inspect and replace as needed.	Semi-annually or per manufacturer	1	None
Grease/Mist Eliminator	Remove fouled media filters and replace with clean filters; clean fouled filters off-site and store.	Semi-annually or as indicated by pressure gauges across filter bed	2	Flatbed truck to haul filters, lifting equipment if facility is not equipped
Pressure Gauges	Inspect all gauges and record readings.	Monthly based on visits to facility	1	None
Pressure Gauges	Repair/Replace gauges.	As needed	1	None
Fiberglass Ductwork	Visually inspect all ductwork for cracking or leaks.	Annually and after seismic events	1	None
Dampers	Visually inspect all dampers and actuators for damage or wear and tear.	Annually	1	None
Silencer	Visually inspect silencer for damage or wear and tear.	Annually	1	None

6.7.4 Stormwater Management

Stormwater design will follow the City of Seattle Stormwater Code for water quality treatment for runoff. The design water quality treatment volume will be equal to 91 percent of the total volume of the simulation period using an approved continuous model (SMC 22.805.090.B1.a). The stormwater design also will incorporate LID concepts to the extent feasible including, but not limited to, the use of permeable surfacing and bioretention.

6.7.5 Architecture/Landscaping

The ancillary equipment facility will be architecturally designed to be visually integrated with the surrounding neighborhood. Architectural consideration will be given to retaining walls, exhaust stacks, intake and exhaust plenum vaults, and other exposed above-grade features to ensure compatibility with the existing site's aesthetic characteristics.

Landscape design will be compatible with the surrounding neighborhood and park, will utilize native or drought-tolerant plants, and will minimize irrigation and maintenance requirements.

6.7.6 O&M and Facility Inspections

An important objective in the design of the project is for simple, reliable and safe operations and maintenance. This includes avoiding the need to routinely enter the storage pipeline to perform O&M activities by including a post-event flushing system and other design features.

The storage pipeline would be maintainable from access portals or the ground surface whenever possible, including the post-event solids removal activities. Access portals would be located so that O&M crews can access the equipment and storage pipeline, if needed.

Provisions for personnel and equipment to enter the portals and pipeline storage would be provided. For example, removable concrete panels would be incorporated into the design to allow large equipment to be placed inside or removed. Smaller access hatches would also be provided to allow access for routine operations and maintenance. Furthermore, the overall facility would be remotely monitored during operation to verify that mechanical systems are working properly.

Pumps would be used to drain the storage facility rather than draining it by gravity. When downstream capacity is available, the storage facility would drain at the maximum flow rate possible without overloading the downstream conveyance system. The pumps would be rail-guided submersible pumps to minimize the need for entry for maintenance.

The odor control system can assist in ventilation for maintenance activities as well as odor control. in this design the ventilation rate is 2 ac/hr to control odors, with provisions for 6 ac/hr with a bypass around the carbon scrubber prior to entry into the storage facility. Auxiliary portable ventilation equipment could be employed for infrequent entrance into the pipeline.

6.7.7 Reliability

The location of the site allows for filling of storage by gravity. Existing outfalls provide a relief point in the event that flow rates or volumes exceed the capacity of the storage pipeline and influent piping.

The odor control equipment, drain pumps, and other items requiring power are not considered critical to storing flows to prevent CSOs, since the storage pipeline would fill by gravity. Loss of power would prevent the storage facility from being drained by the pumps after an event; however, this would not prevent the sewer collection system from continuing to operate. Furthermore, it is anticipated that the CSO facility will only be used a few times a year and that the likelihood of back-to-back uses of the facility is very low. However, the design does include on-site standby power. Final design will investigate use of the existing standby generator in the North Beach Pump Station in lieu of a separate generator for the CSO facilities as the additional loads are anticipated to be minimal.

6.7.8 Effects of Sea Level Rise

In March of 2006, the King County Executive issued an executive order on Global Warming Preparedness directing all agencies to prepare for the affects of climate change including adaptation, mitigation and sequestration. The Wastewater Treatment Division is evaluating the effects of rising sea levels associated with climate change. Sea level rise (SLR) scenarios were developed by combining prediction of future SLR and storm surge from statistical analysis. The three main sources for the scenarios came from the University of Washington's Climate Impacts Group, Department of Ecology Report *Sea Level Rise in the Coastal Waters of Washington State* (2008) and *Response of Extreme Storm Tide Levels to Long-Term Sea Level Change* (C.E. Zervas, 2005).

To give a broad array of possibilities 1, 2, 10, and 100 year storm events were considered for each of the SLR scenarios. Table 6.4 shows the values used for possible future sea-level conditions with storm events.

Table 6.4 Puget Sound Sea-Level Rise Scenarios with Storm Surge

Sea-Level Rise Scenarios (Metro datum in ft.)	**Storm Surge**				
	No Storm	1 yr (1.48')	2 yr (2.27')	10 yr (2.79')	100 yr (3.19')
Current Conditions (Mean High High-Water)	105.36	106.84	107.63	108.15	108.55
Medium SLR 2050 (6")	105.86	107.34	108.13	108.65	109.05
Medium SLR 2100 (13")	106.44	107.92	108.71	109.23	109.63
Very High SLR 2050 (22")	107.19	108.67	109.46	109.98	110.38
Very High SLR 2100 (50")	109.53	111.01	111.8	112.32	112.72

No facilities associated with the CSO project are vulnerable to sea level rise scenarios. The lowest point vulnerable to SLR is the bottom of the storage pipeline at (Elevation 109.0 Metro) which will be designed for high groundwater conditions.

The outfall flow rate could be diminished under future SLR scenarios. This is being evaluated for the entire combined sewer system and adaptation plans will be evaluated under a separate project.

6.8 FEASIBILITY OF IMPLEMENTATION

Based on an evaluation of land use/permitting, environmental impacts, engineering, operations and maintenance, and community impacts, implementation of the proposed alternative appears to be feasible, with no identification of fatal flaws.