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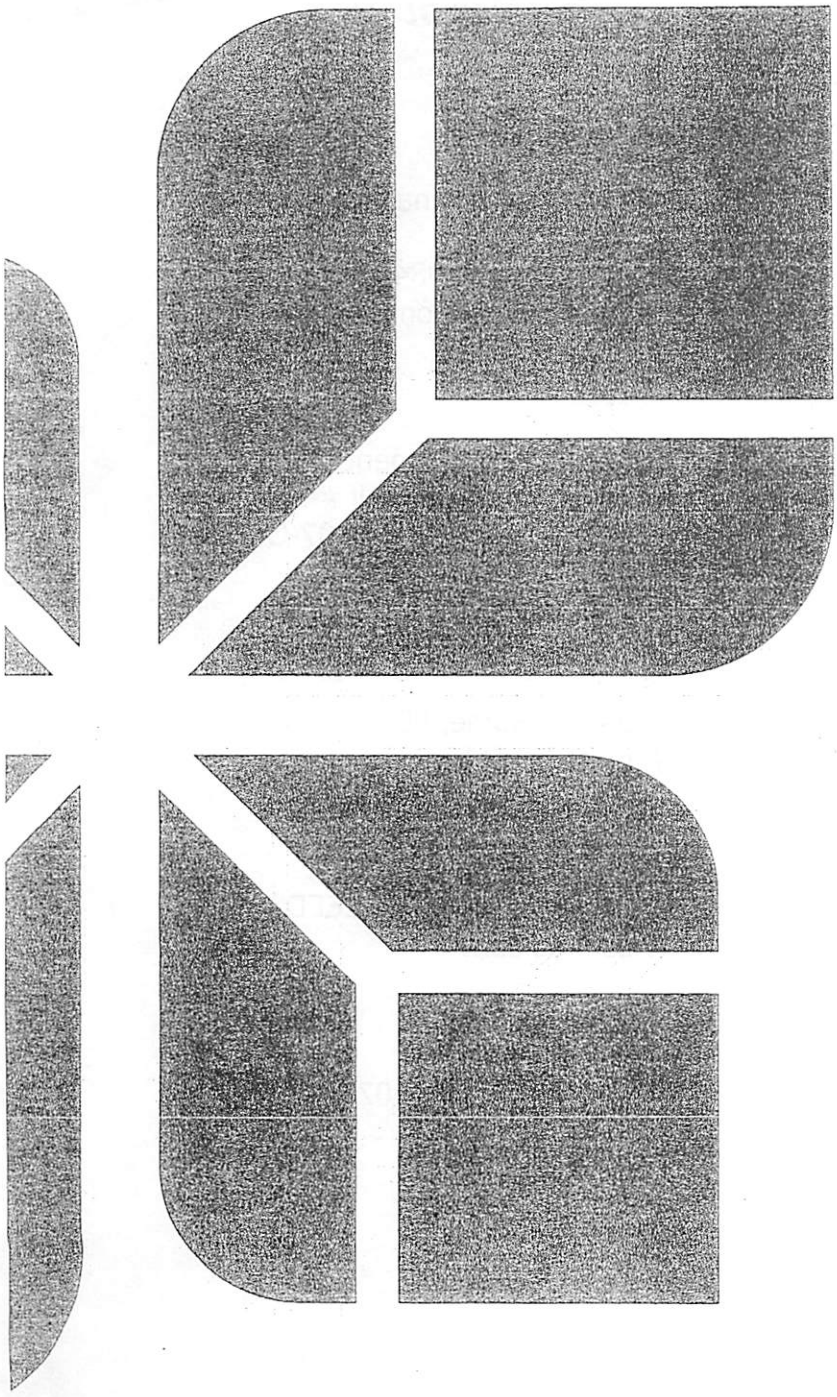

Design Narrative

PREPARED FOR:

Alutiiq International Solutions, LLC
PO Box 750
Fort Lewis, WA 98433
Contact: Jim Thompson

PROJECT:

Stormwater Treatment Facility
Fort Lewis, WA Outfall #4
Contract No. W912DW-07-C-0025
PN 65933

PREPARED BY:

Glenn C. Hume, PE
Project Engineer

REVIEWED BY:

Doreen S. Gavin, PE, LEED® AP
Vice President

April 2009
AHBL Project No. 207246.10

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I hereby state that this Design Narrative for the Stormwater Treatment Facility Fort Lewis, WA Outfall #4 has been prepared by me or under my supervision, and meets the standard of care and expertise that is usual and customary in this community for professional engineers. I understand that the Army Corps of Engineers does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.

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1.0 PROJECT OVERVIEW

As part of the re-development of the North Fort Lewis area, the U.S. Army Engineer District has proposed constructing new stormwater management facilities at the location of the existing Outfall #4. The project includes re-routing the stormwater runoff to a new pump station that will discharge the runoff to proposed ponds constructed in a soil borrow area located east of an existing landfill area. The project includes two ponds in series (Deep Pond, Shallow Pond) and an area for stormwater infiltration within an area referred to as an Infiltration Facility. Berms will be constructed to create the impoundment for the stormwater. The site is fenced except to the north of the Deep Pond. There is an existing chapel located north of the Deep Pond. When the chapel is to be opened to the public, a fence along the north side of the Deep Pond will be required for that project to be constructed.

The primary objective of the facilities is to provide water quality control for the runoff from Outfall #4. Treatment is provided by a combination of the existing oil/water separator and the proposed wetpool storage volume provided within the Deep Pond. The pond provides full water quality control for the tributary basin area in compliance with the *Washington State Department of Ecology Stormwater Management Manual for Western Washington, February 2005.*

An additional benefit of the proposed facilities is to reduce the rate and volume of runoff that is directly discharged to the downstream channel and Puget Sound. This is accomplished by providing detention volume within the Deep and Shallow Ponds and infiltration capacity within the infiltration facility area.

The project storage volume is constrained by the space available adjacent to the existing landfill and the infiltration rate is restricted based on the requirements that the project cannot create a significant rise in the groundwater elevations within the adjacent un-lined landfill. The Deep and Shallow Ponds are lined to retard infiltration allowing the infiltration rate to be controlled by providing an orifice discharge to the infiltration facility area.

The information contained within this report conforms to basis for design. The Hydrologic and Geotechnical Hydrogeologic Assessments Reports are available as separate documents.

2.0 DEBRIS INTERCEPTOR DESIGN

The debris interceptor and bypass vault are precast panel vaults located upstream from the existing oil/water separator that will receive and remove large debris from stormwater runoff from Basin 4. Basin 4 currently outlets via two 54-inch storm drain lines that parallel each other. The debris interceptor will be located on the northern 54-inch storm line, and the bypass vault will be constructed to intercept flow from the southern 54-inch storm line.

The debris interceptor has three chambers separated by two baffle walls. The first has two inlets: one directly in line with the vault from the northern 54-inch storm line and the second from the side from the bypass vault located on the southern 54-inch storm line. The first chamber will house the trash grate that traps/collects debris and allows water to flow to the next chamber. In the event that the first chamber exceeds capacity, runoff will flow back into the by-bass vault and outlet via the southern 54-inch storm line. The bypass vault contains a baffle wall that will catch floating debris prior to discharging. The second section of the vault will catch floating debris that has managed to bypass the trash grate. The third section will be clear water that outlets to the oil/water separator and then to the pump station downstream. All chambers of the debris interceptor and bypass vault have access hatches for maintenance. For maintenance, the debris interceptor can be accessed by an 18-foot gravel access road that connects from "I" Street to 7th Street.

A 24-inch industrial outlet currently outletting into the existing canal will be overbuilt with a Type 2-48" catch basin which will intercept and divert flow to the north. The outlet of this CB will be continuously submerged and connects to a second Type 2-48" catch basin with an unsubmerged outlet to the north. Flow is then directed to the existing 54" storm drain to the north which will be overbuilt with a 96" storm drain CB, allowing flow from the industrial area to be treated by the existing oil water separator. This system serves for debris interception. Both catch basins have deep sumps to allow debris to settle to the bottom.

3.0 PUMP STATION DESIGN

The stormwater runoff treatment event to pump to the storm ponds is at least 8,658 gallons per minute (gpm). The existing oil/water separator has a design capacity of 8,000 gallons per minute. Treated flow from the oil/water separator is combined downstream with the flow from secondary bypass upstream of the oil/water separator. The stormwater flow to be pumped will be collected from that downstream point where the treated flow and the bypass flow combine. The flow is collected in a precast panel vault with an approximately 31,150-gallon storage volume before a bypass situation occurs. A 9,000 gallon per minute (20.05 CFS) total pump rate is used, shared equally by three 3,000 gallon per minute submersible pumps. Storage volume is provided within the vault to allow one 3,000 gallon per minute pump to operate for at least a 10-minute cycle time, assuming no additional flow enters the vault during pump operation.

The pumps selected for the installation are manufactured by HOMA, Model AK1056-330. HOMA pumps are made in Germany and meet "Buy American" requirements. Total dynamic head loss (TDH) for the system is 33 feet. Pumping at 3,000 gallons per minute with 33 feet TDH, each 40 horsepower pump operates at a 61% efficiency level. The 3-pump configuration provides a balance of operational flexibility and efficiency. During maximum design flow of 8,658 gallons per minute from the oil/water separator, all 3 pumps will be operating at 9,000 gallons per minute. During times of lower flows, either one or two of the pumps will be operating. Selection of this configuration allows for variation of total pumping rates rather than if a single pump were utilized. The 3-pump configuration will allow pump rate to be more reflective of the inflow rate, thus optimizing the energy consumption. Head loss calculations are attached as Appendix B, and Pump Data Sheets are attached as Appendix C.

To facilitate pump removal from the surface, the pumps will be installed with a rail system. Access hatches provided by LW Products will grant access from above to the end user. Product Data Sheets for the access hatches are included as Appendix D.

Level sensing is provided by a submersible level transducer with analog output. Level controls are set to allow single, dual, or all three pumps to operate with successive water level increases to meet demand. An alternator is provided to have a different pump as the lead pump with each cycle. Control panel components for the pump system are provided in accordance with the Site Definition Checklist provided as Appendix E.

Discharge from each of the three pumps is conveyed by 10-inch High Density Polyethylene (HDPE) SDR 11. Flow is conveyed into a second precast panel manifold vault where it is combined into a single 24-inch HDPE SDR 11 force main for conveyance to the Deep Pond approximately. Velocities within the force main will exceed 2 feet per second (fps), reducing the risk for sedimentation. Force main velocity for single, dual, and triple pump operation are presented in the table below.

Number of Pumps	Flow Rate (gpm)	Velocity (fps)
1	3,000	2.1
2	6,000	4.3
3	9,000	6.4

4.0 STORMWATER PONDS

There are two stormwater ponds and an infiltration facility aligned in series that will receive stormwater runoff from Basin 4. The runoff will be pumped to the ponds at a rate of 3,000 gpm, 6,000 gpm, or 9,000 gpm by means of the stormwater pump station. All ponds are designed to meet the minimum treatment requirements of the *Washington State Department of Ecology Stormwater Management Manual for Western Washington, February 2005.*

The Deep Pond is the first stormwater pond downstream of the pump station. This pond is lined with a liner material on the pond bottom, side slopes, and berm slopes, which will allow infiltration at a predesigned rate. Beneath the pond liner at the bottom of the pond will be a filter layer consisting of 6 inches of crushed reclaimed material. The side slopes beneath the pond liner of the pond will also be built from the crushed reclaimed material. This layer will prevent migration of fines from the pond liner. The pond will allow for 6 feet of dead storage for sediment storage and 6 feet of live storage. The maximum design water stage will be 12 feet with overflow occurring above this elevation. The berm separating the Deep Pond and the Shallow Pond will be 15.5 feet high. The berm has an emergency overflow spillway in the event that the storm system would fail and would allow runoff to flow to the Shallow Pond. Two flow control manholes will control the stormwater release rate from the Deep Pond to the Shallow Pond (located in the first berm). One flow control structure will remain active at all times and will discharge 1 cfs of flow to the Shallow Pond. The second flow control structure will be inactive (0 cfs release) and operated by means of a manually operated valve that will be regulated by landfill personnel. When the manual valve is opened, the second flow control structure will allow 5 cfs of flow for a combined total flow of 6 cfs.

The Shallow Pond is downstream of the Deep Pond. This pond is lined with a liner material on the pond bottom, side slopes, and berm slopes, which will allow infiltration at a predesigned rate. Beneath the pond liner at the bottom of the pond will be a filter layer consisting of 6 inches of crushed reclaimed material. The side slopes beneath the pond liner of the pond will also be built from the crushed reclaimed material. This layer will prevent migration of fines from the pond liner. This pond will also be lined with 6 inches of top soil. The pond will allow for 1 foot of dead storage for sediment storage and 4 feet of live storage. The maximum design water stage will be 5 feet with overflow occurring above this elevation. The berm separating the Shallow Pond and the infiltration facility will be 7.5 feet high. The berm has an emergency overflow spillway in the event that the storm system would fail and would allow runoff to flow to the Infiltration Facility. Two flow control manholes will control the stormwater release rate from the Shallow Pond (located in the second berm). One flow control structure will remain active at all times and will discharge 1 cfs of flow to the infiltration facility. This flow control structure will have an electronic ultrasonic level sensor with analog output. The sensor will send an electronic signal to the pump station to shut off the pumps when the water level in the Shallow Pond reaches 3 inches below the overflow level. The second flow control structure will be inactive (0 cfs release) and operated by means of a manually operated valve that will be regulated by landfill personnel. When the manual valve is opened, the second flow control structure will allow 5 cfs of flow for a combined total flow of 6 cfs.

The Infiltration Facility is downstream of the Shallow Pond and will receive 1 cfs of flow during normal operation, and receive 6 cfs if the second flow control structure is manually opened by landfill personnel. This infiltration facility consists of natural vegetation with high permeable soils. Infiltration Facility simulations were conducted and have established that a flow rate of 1 cfs will work in worst case conditions while still maintaining sufficient separation from a high groundwater reading of 205.41 feet. During normal conditions, extra flow can be accommodated

by opening the manual valve in the second flow control structure. The extra flow release will be determined by time of year and groundwater levels. The release rate will be controlled by landfill personnel.

The infiltration rates for the pond liner material are based on actual test results for the liner material and simulation of the leakage rates from the constructed ponds (see Sections 5.2 and 6.1 of the Geotechnical Report). The long-term capacity of the infiltration facility is not expected to change over time since mounding beneath the discharge location is the limiting factor on capacity. The vertical infiltration rate is very high and does not limit the capacity of the facility.

5.0 DAM SAFETY ANALYSIS

The proposed Outfall #4 stormwater ponds will detain a volume of water greater than 10 acre-feet and are therefore subject to Dam Safety Analysis. The study includes determination of the boundary and characteristics of the basin area tributary to Outfall #4 based on record documents, topographic surveys, and field reviews. Hydrologic analysis was performed using the Western Washington Hydrology Model, Version 3 (WWHM). This analysis has been performed by assuming the ponds are combined into one large facility and using the dimensions of the Deep Pond berm because of its greater dimensions. Normal pool conditions are used in this Dam Safety Analysis because the ponds are filled by pumps limited to the design pump rate of 20.05 cfs. Pump controls will be provided that shut down the pumps when overflow conditions are experienced in the Shallow Pond. Therefore, there is a low probability that the pond stage will exceed the normal pool conditions regardless of precipitation event. See Appendix A for the Dam Safety Analysis Report. See Section 5.3 of the Geotechnical and Hydrological Assessment for Slope Stability of Pond Berms in Appendix A of the Hydrologic Report.

6.0 DEBRIS REMOVAL

Contractor has performed an interior investigation of the twin 54-inch storm drain pipes from Manholes 20622 and 20623 to the inlets at the existing oil/water separator. The northerly 54-inch pipe is approximately 14 feet deep, with the southerly pipe being approximately 10 feet deep. See Figure 6.1.

The deep pipe was observed to have minor root intrusion at several joints, with one joint, approximately 120 feet west of Storm Manhole 20622, having significant root intrusion blocking about three-quarters of the pipe area. The shallow pipe did not have the root intrusion observed at the deep pipes.

The proposed debris interceptor shall be sited to allow removal of the joint with the significant blockage. Roots within the inspected area will be removed by the Contractor.

7.0 OPERATIONS

The proposed ponds are designed to release a continuous flow of 1 cfs to the infiltration area. Each berm has a second flow control structure with a manual valve that remains closed, but can be opened manually by Echo Park personnel to allow additional flow release. During normal conditions, a flow of 5 cfs can be accommodated by opening the manual valve in the second flow control structure for a total of 6 cfs. The extra flow release will be determined by time of year and groundwater levels. Echo Park personnel will provide manual release without significant impact by monitoring existing groundwater monitoring wells.

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