Washington State Department of Enterprise Services

Technical Information Report (TIR)

for

Washington State Patrol
Fire Training Academy Burn Building Replacement

Prepared for
Rice Fergus Miller

July 2021

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The engineering material and data contained in this report were prepared under the supervision and direction of the undersigned, whose seal as a registered professional engineer is affixed below.

7/12/2021

Prepared by

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SECTION 1. PROJECT OVERVIEW

Introduction

This report addresses the stormwater management design for the Washington State Patrol (WSP) Fire Training Academy (FTA) Burn Building Replacement project. The proposed project will construct two new burn building structures and adjacent roadways, parking, and pedestrian walkways. Additional site improvements include retaining walls and underground utilities. The existing detention pond serving the entire campus will be expanded to provide flow control for the new and replaced impervious surfacing.

This project is part of the Phase 1 Master Plan Proposal that was approved during a Special Use Permit (SUP) process. Based on conditions of approval for the Master Plan SUP, the proposed stormwater flow control system must treat this redevelopment project and the existing campus infrastructure as a new development project.

Project Location

The FTA is located near North Bend, within Section 21, Township 23 North, Range 9 East, in unincorporated King County (see Figure 2, Vicinity Map). The FTA property is approximately 48 acres.

Existing Conditions

The proposed project is located near the middle south edge of the FTA campus. The project area is bounded to the west by an existing gravel road and west property line, to the north by AARF buildings, and to the south and east by Backdraft Boulevard, Pole Shed Place, and the existing Burn Tower and SCBA Building. Most of the site is grass vegetation, with some shrubs and trees. The site slopes to the east along an approximately 20-percent-sloped hillside. Based on the geotechnical report (see Appendix D), the project area soils consist of loose and compacted fill material underlain with poorly graded sand.

Stormwater from the vegetated hillside is directed to an existing 12-inch culvert that crosses under Backdraft Boulevard near the northeast corner of the project area. The culvert connects to an existing 24-inch conveyance pipe system that runs along Backdraft Boulevard before discharging into an existing diversion weir structure that directs runoff to three existing sedimentation ponds.

The following paragraphs explain the complex FTA campus stormwater system in more detail to demonstrate the relationship between the redevelopment project and the campus drainage system.

Overall FTA Campus Stormwater Management Design

The campus is separated into seven subbasins, where stormwater is collected and conveyed by storm pipes, catch basins, and drainage ditches to various stormwater facilities, which include an existing detention pond, three sediment ponds, and an infiltration pond (see Appendix C,

Figures 5 and 5A). The following paragraphs describe the stormwater conveyance system and stormwater facilities located on the FTA campus.

Under existing conditions, stormwater from Subbasins 3 and 4 is conveyed directly to the existing detention pond in Subbasin 5. The existing detention pond has a live storage volume of approximately 282,000 cubic feet and a dead storage volume of approximately 137,500 cubic feet for water quality treatment.

Stormwater from the ARFF training area (Subbasin 6) and the Burn Pad training area (Subbasin 2B) are directed to the oil/water separator and then to the sediment ponds. Subbasins 1A and 1B and the Burn Pad training area (Subbasin 2A) are conveyed to the diversion weir structure, which diverts runoff to the existing sedimentation ponds (Subbasin 2C). The diversion weir is designed to divert the incoming runoff from these subbasin areas to the sediment ponds; if the sediment ponds are at capacity or a large storm event occurs, stormwater overflows the weir and is diverted to the existing detention pond. Water from the sediment ponds is either reused as training water for the fire training activities or overflows to the downstream detention pond. Sediment Ponds #1 and #2 are hydraulically connected by storm pipe. Sediment Ponds #2 and #3 are also connected by a storm pipe, but a gate valve is installed to shut off the water releasing into Sediment Pond #3 in the event of an emergency (such as an oil spill). If the valve is open, all three ponds are at an equal elevation.

Stormwater from the remaining ARFF training area (Subbasins 7 and 8) is directed to Infiltration Ponds #1 and #2. Subbasin 8 flows to ARFF Infiltration Pond #1, which is not within the campus boundary. Subbasin 7 areas not contained in Infiltration Pond #1 are intended to overflow to Subbasin 1A and eventually release into the sediment ponds.

This redevelopment project is located within a portion of Subbasin 1B. Runoff from this area is directed to the existing sedimentation ponds before releasing into the existing detention pond during large storm events or during overflow conditions in the sedimentation pond system.

Developed Conditions

Site development within the project area includes the construction of two new burn building structures (Apartment and Single Family). New asphalt and concrete pavement, and gravel surfacing for parking, vehicular, and pedestrian access, will be installed adjacent to these buildings. Stormwater runoff from the new buildings and site pavement will be collected and conveyed by a series of catch basins and storm pipe to a pretreatment water quality structure located at or near the inlet of the existing culvert crossing Backdraft Boulevard. The existing live storage cells of the detention pond will be expanded to accommodate the project site improvements. Two separate but connected detention cells (Cells 4 and 5) will be constructed to handle the campus stormwater that discharges to and overflows from the existing sediment ponds. Additional site improvements include retaining walls for the existing detention pond, access roads, and underground utilities for water, sewer, and storm.

The project is subject to a Full Drainage Review based on the 2016 *King County Surface Water Design Manual* (KCSWDM).

The 2012 Western Washington Hydrologic Model (WWHM) was used to resize the existing detention pond and secondary detention pond cells.

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 1 PROJECT OWNER AND PROJECT ENGINEER

Project Owner: Washington State Patrol
Phone: 425-453-3000
Address: 50810 SE Grouse Ridge Rd, North Bend, WA 98045

Project Engineer: Mark Davis
Company: Reid Middleton, Inc
Phone: (425) 741-3800

Part 2 PROJECT LOCATION AND DESCRIPTION

Project Name: FTA Burn Bldg Replacement
DPER Permit #:
Location Township: 23N
Range: 9E
Section: 28
Site Address: 50810 SE Grouse Ridge Rd, North Bend, WA 98045

Part 3 TYPE OF PERMIT APPLICATION

- ☐ Landuse (e.g.,Subdivision / Short Subd. / UPD)
- ☐ Building (e.g.,M/F / Commercial / SFR)
- ☒ Clearing and Grading
- ☐ Right-of-Way Use
- ☐ Other

Part 4 OTHER REVIEWS AND PERMITS

- ☐ DFW HPA
- ☐ COE 404
- ☐ DOE Dam Safety
- ☐ FEMA Floodplain
- ☐ COE Wetlands
- ☐ Other
- ☐ Shoreline Management
- ☒ Structural Rockery/Vault/
- ☐ ESA Section 7

Part 5 PLAN AND REPORT INFORMATION

Technical Information Report

Type of Drainage Review (check one):
- ☒ Full
- ☐ Targeted
- ☐ Simplified
- ☐ Large Project
- ☐ Directed

Date (include revision dates): 5/11/2020
Date of Final:

Site Improvement Plan (Engr. Plans)

Plan Type (check one):
- ☒ Full
- ☐ Modified
- ☐ Simplified

Date (include revision dates): 5/11/2020
Date of Final:

Part 6 SWDM ADJUSTMENT APPROVALS

Type (circle one): Standard / Experimental / Blanket

Description: (include conditions in TIR Section 2)

N/A

Approved Adjustment No. Date of Approval:

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 7 MONITORING REQUIREMENTS

Monitoring Required: Yes / No

Start Date: _____

Completion Date: _____

Describe: _____

Re: KCSWDM Adjustment No. _____

Part 8 SITE COMMUNITY AND DRAINAGE BASIN

Community Plan : Snoqalmie

Special District Overlays: N/A

Drainage Basin: Snoqualmie River

Stormwater Requirements: N/A

Part 9 ONSITE AND ADJACENT SENSITIVE AREAS

- ☐ River/Stream _____
- ☐ Lake _____
- ☐ Wetlands _____
- ☐ Closed Depression _____
- ☐ Floodplain _____
- ☐ Other _____
- ☐ Steep Slope _____
- ☐ Erosion Hazard _____
- ☐ Landslide Hazard _____
- ☐ Coal Mine Hazard _____
- ☐ Seismic Hazard _____
- ☐ Habitat Protection _____
- ☒ None

Part 10 SOILS

Soil Type	Slopes	Erosion Potential
Compacted Fill Material		Low
Glacial Till		Low
Outwash Soils		Low

- ☐ High Groundwater Table (within 5 feet)
- ☐ Other _____
- ☐ Sole Source Aquifer
- ☐ Seeps/Springs

☐ Additional Sheets Attached

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 11 DRAINAGE DESIGN LIMITATIONS

REFERENCE	LIMITATION / SITE CONSTRAINT
☐ Core 2 – Offsite Analysis	
☐ Sensitive/Critical Areas	
☐ SEPA	
☐ LID Infeasibility	
☐ Other	
☐	

☐ Additional Sheets Attached

Part 12 TIR SUMMARY SHEET (provide one TIR Summary Sheet per Threshold Discharge Area)

Threshold Discharge Area: (name or description): Existing Subbasin 1B. Existing pavement and grass areas

Core Requirements (all 8 apply):

Discharge at Natural Location	Number of Natural Discharge Locations: 1
Offsite Analysis	Level: [1] / 2 / 3 dated:
Flow Control (include facility summary sheet)	Level: 1 / [2] / 3 or Exemption Number Flow Control BMPs Limited Infiltration
Conveyance System	Spill containment located at:
Erosion and Sediment Control / Construction Stormwater Pollution Prevention	CSWPP/CESCL/ESC Site Supervisor: TBD Contact Phone: TBD After Hours Phone:
Maintenance and Operation	Responsibility (circle one): [Private] / Public If Private, Maintenance Log Required: Yes / [No]
Financial Guarantees and Liability	Provided: Yes / [No]
Water Quality (include facility summary sheet)	Type (circle one): [Basic] / Sens. Lake / Enhanced Basic / Bog or Exemption No. Landscape Management Plan: Yes / [No]

Special Requirements (as applicable):

Area Specific Drainage Requirements	Type: CDA / SDO / MDP / BP / LMP / Shared Fac. / [None] Name:
Floodplain/Floodway Delineation	Type (circle one): Major / Minor / Exemption / [None] 100-year Base Flood Elevation (or range): Datum:
Flood Protection Facilities	Describe:

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 12 TIR SUMMARY SHEET (provide one TIR Summary Sheet per Threshold Discharge Area)

Source Control (commercial / industrial land use)	Describe land use: Fire Training Education Describe any structural controls:
Oil Control	High-use Site: Yes / No Treatment BMP: _____ Maintenance Agreement: Yes / No with whom? _____

Other Drainage Structures

Describe: Existing Sediment Ponds. Existing DAF unit for water quality treatment

Part 13 EROSION AND SEDIMENT CONTROL REQUIREMENTS

MINIMUM ESC REQUIREMENTS DURING CONSTRUCTION	MINIMUM ESC REQUIREMENTS AFTER CONSTRUCTION
☒ Clearing Limits	☒ Stabilize exposed surfaces
☒ Cover Measures	☒ Remove and restore Temporary ESC Facilities
☒ Perimeter Protection	☒ Clean and remove all silt and debris, ensure operation of Permanent Facilities, restore operation of Flow Control BMP Facilities as necessary
☒ Traffic Area Stabilization	☐ Flag limits of SAO and open space preservation areas
☒ Sediment Retention	☐ Other _____
☒ Surface Water Collection	
☐ Dewatering Control	
☒ Dust Control	
☐ Flow Control	
☒ Protection of Flow Control BMP Facilities (existing and proposed)	
☒ Maintain BMPs / Manage Project	

Part 14 STORMWATER FACILITY DESCRIPTIONS (Note: Include Facility Summary and Sketch)

Flow Control	Type/Description	Water Quality	Type/Description
☒ Detention	Expansion/new pond	☐ Vegetated Flowpath	
☐ Infiltration		☒ Wetpool	Ex. Wet Pond
☐ Regional Facility		☐ Filtration	
☐ Shared Facility		☐ Oil Control	
☐ Flow Control BMPs	Limited Infil	☐ Spill Control	
☐ Other		☐ Flow Control BMPs	
		☐ Other	

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

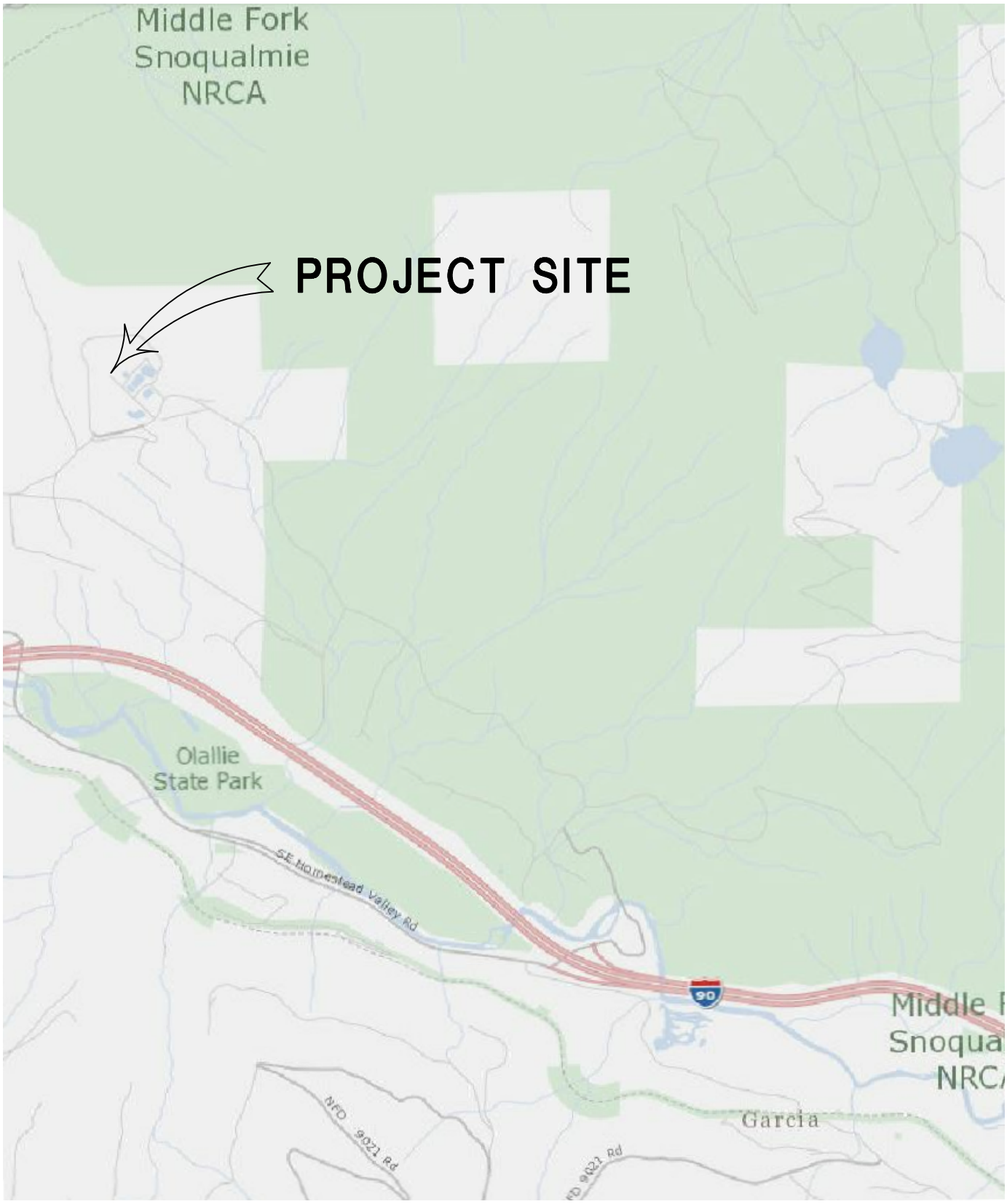
Part 15 EASEMENTS/TRACTS		Part 16 STRUCTURAL ANALYSIS
☐ Drainage Easement		☐ Cast in Place Vault
☒ Covenant		☒ Retaining Wall
☐ Native Growth Protection Covenant		☐ Rockery > 4' High
☐ Tract		☐ Structural on Steep Slope
☐ Other _____		☐ Other _____

Part 17 SIGNATURE OF PROFESSIONAL ENGINEER

I, or a civil engineer under my supervision, have visited the site. Actual site conditions as observed were incorporated into this worksheet and the attached Technical Information Report. To the best of my knowledge the information provided here is accurate.

5/11/2020

Signed/Date


Middle Fork
Snoqualmie
NRCA
PROJECT SITE
Olallie
State Park
SE Homestead Valley Rd
90
Middle F
Snoqua
NRC
Garcia
NFD 9021 Rd

SECTION 2. CONDITIONS AND REQUIREMENTS SUMMARY

The following summarizes King County's core and special requirements from the 2016 KCSWDM.

Core Requirement 1: Discharge at the Natural Location

Stormwater is collected and conveyed through the existing 12-inch storm pipe that crosses under Backdraft Boulevard. Stormwater that eventually reaches the existing detention pond will continue to discharge to the existing outfall pipe that eventually discharges to an existing stream channel further downstream of the site.

Core Requirement 2: Off-site Analysis

Stormwater from the project site discharges to the FTA storm system, which discharges to the existing sedimentation ponds and eventually into the existing detention pond system. Runoff from the detention pond releases into a conveyance outlet pipe prior to discharging to an existing stream channel. A Level 1 downstream drainage analysis is presented in Section 3 of this report.

Core Requirement 3: Flow Control

Based on the SUP and King County direction (Ronaldo Hoelscher), flow control facilities on the site will be resized to handle the entire campus development, including this redevelopment project. To treat the campus development area, the existing detention pond will be expanded, and two additional detention pond cells will be constructed.

Core Requirement 4: Conveyance System

All new stormwater conveyance systems have been designed to convey the 25-year developed storm events per Section 1.2.4 of the KCSWDM.

Core Requirement 5: Erosion/Sedimentation Control Plan

An Erosion/Sedimentation Control Plan (ESCP) has been developed for this project. The ESCP is summarized in Section 8 of this report.

Core Requirement 6: Maintenance and Operation

Maintenance guidelines for the proposed storm drainage system can be found in Section 10 of this report.

Core Requirement 7: Financial Guarantees and Liability

The Bond Quantity worksheet is provided in Appendix F of this report.

Core Requirement 8: Water Quality

Basic water quality is required to treat the new targeted pavement surfacing subject to vehicle traffic. Enhanced basic water quality treatment is exempt because threshold criteria have been

met. The existing wet pond section of the detention pond was sized to include future build-out of the FTA campus using the 2009 KCSWDM methodology but is not large enough to meet the 2016 KCSWDM methodology. The existing wet pond will be expanded to handle treatment for this development project. The sediment pond system provides water quality treatment for the fire training areas of the campus. A Hydrodynamic structure will be installed at the site discharge pipe to provide pretreatment to the downstream wet ponds.

Core Requirement 9: Flow Control BMPs

The redevelopment project must adhere to the Large Rural Lot BMP requirements, since the campus is larger than 5 acres and located outside the UGA.

The following is a feasibility analysis of the required BMPs for this project.

1. *Full Dispersion:* Full dispersion is not feasible because a native vegetated flow path segment of at least 100 feet is not available within the project extents.
2. *Full Infiltration:* Full infiltration is not feasible because the existing outwash soils are shallow and underlain with a till soil layer that will prevent further infiltration into the soil section.
3. *Limited Infiltration:* Per C2.3 of the KCSWDM, limited infiltration is applicable for only non-pollution-generating impervious surfaces. Most of the project impervious surfacing is pollution-generating, thus limited infiltration is only feasible for new pervious surfacing. The outwash soils in areas may not be suitable to reduce the risk of groundwater contamination. A gravel-filled trench will be constructed along the toe of the road access embankment slope.

Special Requirement 1: Other Adopted Area-Specific Requirements

Other adopted area-specific requirements are not applicable to this project.

Special Requirement 2: Delineation of 100-Year Floodplain

The FTA campus is not within a 100-year floodplain.

Special Requirement 3: Flood Protection Facilities

The project does not contain and is not adjacent to a flood protection facility.

Special Requirement 4: Source Control

The BMP worksheet describes ongoing and future source control measures that comply with the *King County Storm Water Pollution Control Manual*. The following BMPs are specific to the FTA project:

Structural Source Control Measures:

A-27: The construction site for the FTA project will have a Temporary Erosion and Sedimentation Control Plan and details that comply with the KCSWDM. This plan will include catch basin filters and covering of exposed soils.

Nonstructural Source Control Measures:

A-15: Pressure-washing of the building, rooftop, and large objects will comply with the appropriate BMPs.

A-29: During project construction, site toxic substances will not be dumped on the ground. Ground or drop cloths will be used, and the water used to clean water-based paints from tools will be disposed of in the sanitary sewer.

Special Requirement 5: Oil Control

The existing Subbasin 2 has an existing oil/water separator that collects stormwater runoff from the existing burn building areas (see Appendix C, Figure 5A, Drainage Network Diagram).

The proposed development does not meet the definition of a high-use site requiring oil control because it does not meet the following thresholds:

1. The average daily traffic (ADT) is less than 100 vehicles for 1,000 square feet of building area. Vehicle traffic is limited on the campus to personnel vehicles, fire trucks, and maintenance pick-up trucks and carts. Most of the campus structures are for training operations. Most people and vehicles are concentrated in the administrative and classroom building areas.
2. Petroleum is not stored or transferred at the campus.
3. The FTA campus does not store a fleet of 25 or more diesel vehicles that are over 10 tons in weight.

According to the KCSWDM (Section 1.3.5, page 1-82), all day parking areas, such as those surrounding the administrative and classroom building areas, are not intended to exceed the high-use site threshold.

SECTION 3. OFF-SITE ANALYSIS

Stormwater runoff from the project site discharges from the detention pond through an existing 720-linear-foot, 12-inch storm pipe to an existing stream channel. The detention overflow discharges to the same stream channel, just southeast of Boundary Road. The stream channel extends to the southeast for approximately 1,200 feet before merging with another stream channel from the northwest. The stream channel is approximately 2 feet wide and 5 to 6 feet deep, with vegetated 2:1 side slopes. The channel bottom is composed of organics and exposed soil. The channel gradient averages approximately 3 percent before steepening to about 6 percent as it approaches the merge with the existing stream channel. There is sloughing along the channel bank where the two stream channels merge.

The merged stream channel continues south and southeast for approximately 900 feet before merging with another existing stream channel from the north. The stream channel is about 2 to 3 feet wide at the bottom and 8 to 10 feet deep, with vegetated side slopes. The channel bottom is composed of mostly gravel and the channel gradient is approximately 6 percent. There were no signs of erosion along this stretch of the stream channel.

The following steps describe the stormwater flow from Location A to Location E. Figure 3 shows the downstream conveyance map and Figure 4 shows the downstream inventory table. The site visit was performed on February 6, 2015.

LOCATION A – 24-inch Culvert Outlet

1. Stormwater from the on-site detention pond discharges through an existing 24-inch storm pipe into the existing armored stream channel.

LOCATION B – Stream Channel

2. Approximately 100 feet downstream of the outlet pipe, the stream channel continues southeast. No signs of erosion were observed.

LOCATION C – Stream Channel

3. Approximately 500 feet downstream of the outlet pipe, the stream channel continues to the southeast. No signs of erosion were observed.

LOCATION D – Stream Channel

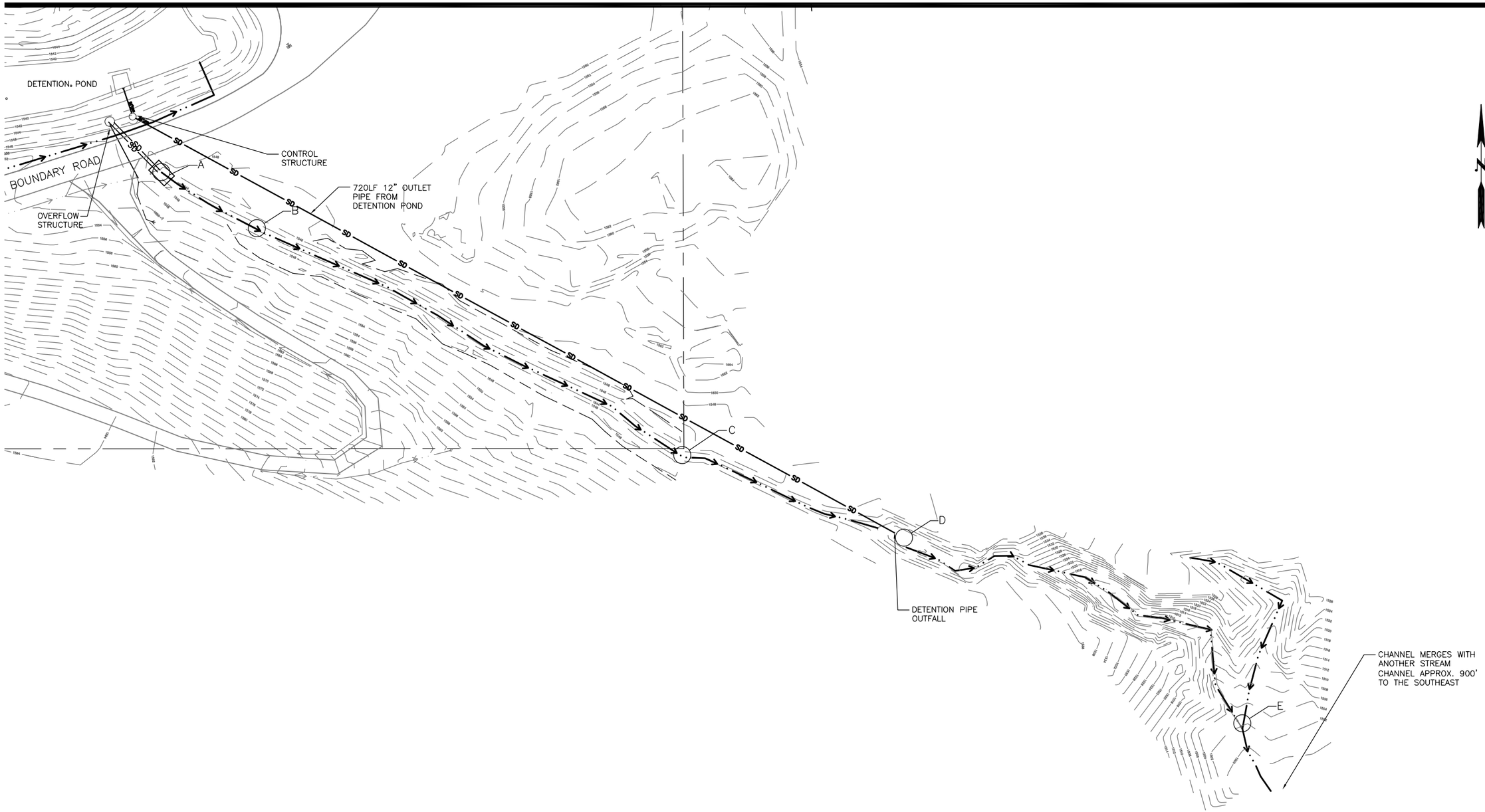
4. Approximately 700 feet downstream of the outlet pipe, the stream channel becomes wider with shorter side slopes for approximately 100 feet. No signs of erosion were observed.

LOCATION E – Merging Stream Channels

5. Approximately 1,200 feet downstream of the outlet pipe, two stream channels merge and continue to the southeast. There are signs of slope sloughing approximately 100 feet upstream and downstream of the stream convergence.

Drainage complaints within a mile of the campus have been reviewed to assess flooding concerns on and off site of the FTA campus. There were no complaints found associated with flooding problems in the general vicinity of the campus. The drainage complaint research generated only information on fee inquiries, maintenance enforcement, and water quality audits (see Appendix E for a drainage complaint printout). No action is required, since there are no complaints of flooding within or near the FTA campus.

There are no drainage complaints in the area and no significant erosion was observed within the stream channel; therefore, a Level 2 or 3 off-site analysis is not warranted.



Reid Middleton

DOWNSTREAM CONVEYANCE MAP

Washington State Patrol Fire Training Academey

Figure 3

OFF-SITE ANALYSIS DRAINAGE SYSTEM TABLE
SURFACE WATER DESIGN MANUAL, CORE REQUIREMENT #2

Basin: **Subbasin Name:** **Subbasin Number:**

Symbol	Drainage Component Type, Name, and Size	Drainage Component Description	Slope	Distance from site discharge	Existing Problems	Potential Problems	Observations of field inspector, resource reviewer, or resident
see map	Type: sheet flow, swale, stream, channel, pipe, pond; Size: diameter, surface area	drainage basin, vegetation, cover, depth, type of sensitive area, volume	%	¼ ml = 1,320 ft.	constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion		tributary area, likelihood of problem, overflow pathways, potential impacts
A	Emergency Outfall	Vegetated channel outfall	1.0	0	None		Detention Pond
B	Stream Channel	2:1 slopes, vegetated, 2ft wide bottom, organic soil	3	100	None		
		bottom, 5-6ft deep					
C	Stream Channel	Same as 'B' above	3	500	None		
D	Stream Channel	2-4ft wide bottom, 2-4ft deep	4.5	700	None		
E	Stream Channel	2-3ft wide, 5-6 ft deep,	6	1,200	Minor bank		
		gravel bottom			sloughing		
	Stream Channel	Similar to 'E' above	6	2,100	None		

FIGURE 4

SECTION 4. FLOW CONTROL BMPS AND WATER QUALITY ANALYSIS AND DESIGN

Part A: Existing Hydrology

As described in the *Overall FTA Campus Stormwater Management Design* section of the TIR, stormwater from the project site is conveyed to an existing sediment pond system that discharges to an existing detention pond during overflow conditions. Stormwater is collected in catch basins and open ditches and conveyed to the sediment and detention pond systems through storm drain pipe or ditches.

Part B: Developed Site Hydrology

As part of the SUP and under King County direction (Ronaldo Hoelscher), the detention system needs to account for the new and existing impervious surfacing within the campus. The detention pond expansion and its sizing are to be considered as one large detention pond system to account for this redevelopment project (Phases 1 and 2) and the remaining campus infrastructure area that did not have an existing detention system.

The proposed development will replace existing gravel, pavement surfacing, and vegetation with a combination of new gravel surfacing, asphalt, and concrete pavement. The existing detention pond will be expanded to provide flow control for the tributary Target Surfaces associated with the redevelopment project (Phase 1, Master Plan – SUP) and existing impervious surfaces. Limited infiltration BMPs will be used on a portion of the pervious surfacing associated with the road embankment slope. Separate detention pond cells (two) will be constructed to handle overflow from the existing sediment ponds that receive runoff from upstream tributary areas (Subbasins 2B, 2C, 6, and 7). The new detention pond cells will be hydraulically connected to the existing detention pond by a stormwater pipe and will be located southeast of Boundary Road in an open field area.

The following list of design actions demonstrates the project's compliance with KCSWDM Core Requirement #3, Flow Control; Core Requirement #8, Water Quality; and other requirements.

1. **Detention Pond Mitigation:** Because evidence of County approval for the previous stormwater design is not available and it does not meet the current KCSWDM guidelines, the entire system is being reevaluated. Table 1 summarizes the parameter revisions used in the detention pond sizing analysis, assuming Phase 1 and 2 redevelopment and existing tributary conditions.

Table 1 – WWHM Detention Parameters

Basin	Existing Condition	Proposed Conditions
1A, 1B, & 2A	7.2 ac – Till Forest	*3.59 ac – Impervious 3.61 ac – Pervious
3	2.49 ac – Till Forest	2.40 ac – Ex. Impervious 0.09 ac – Pervious
4	5.71 ac – Till Forest	2.54 ac – Ex. Impervious 0.44 ac – Future Phase 2 2.73 ac – Pervious
5	3.11 ac – Till Forest	0.84 ac – Ex. Impervious 2.27 ac – Pervious

*Includes existing impervious surfaces not being replaced.
Will be conveyed to sediment pond system.

Basin	Existing Condition	Proposed Conditions
6	0.6 ac – Till Forest	0.6 ac – Ex. Impervious
7	3.04 ac – Till Forest	**3.04 ac – Ex. Impervious
2B, 2C	9.38 ac – Till Forest 1.96 ac – Sed. Ponds	*6.08 ac – Impervious 3.3 ac – Pervious 1.96 ac – Sed. Ponds

*Includes existing impervious not being replaced.
**1.75 ac of area is treated by an existing infiltration pond within Subbasin 7.

2. **Detention Pond Expansion:** The current detention pond on site provides approximately 281,964 CF of storage volume. This is currently not sufficient to handle any redevelopment project or stormwater from basins draining to the existing sediment ponds (Basins 2B, 2C, 6, and 7). The existing sediment ponds cannot be used as part of the detention system. A calculation was completed to show the required volume needed for this current project and a future redevelopment project within the basin (Phase 1 – Proposed Project, Phase 2 – Future). This volume is accommodated and shown in the existing pond expansion grading (Cells 1, 2, and 3). Approximately 355,100 CF is provided with the proposed expansion. A new calculation was completed that included the entire campus (existing impervious) plus the Phases 1 and 2 redevelopment projects. This resulted in approximately 591,110 CF required volume. Two additional detention pond cells will be constructed to handle stormwater overflows from the existing sediment ponds, which receive stormwater from Subbasins 2B, 2C, 6, and 7, to account for the additional volume required (591,110 – 355,100 = 236,010). Table 2 summarizes the detention volumes for Phases 1 and 2, and full buildout (not including Phases 3 through 6 redevelopment).

Table 2 – Detention Pond Summary

	Existing Pond Design	Phases 1 & 2 Required Volume	Total Buildout Required Volume	New Pond Cell Required Volume	Detention Volume Provided
Detention Volume (CF)	281,964	355,100	591,110	236,010	355,100* 267,645**

*73,136 Additional storage volume in existing pond that includes:
9,636 CF – Cell 1
21,330 CF – Cell 2
42,170 CF – Area above Cells 1-3 @ Elev. 1539.5

**Additional volume in new cell ponds that include:
203,850 CF – Cell 5
63,795 CF – Cell 4

3. **Sediment and Detention Pond Backflow**: The existing sediment ponds are not intended to provide detention volume for the upstream tributary areas. Overflow from the sediment ponds is directed to the existing detention pond system. To prevent ponding water in the detention pond from backwatering into the sediment ponds, a backflow valve (e.g., Tide Gate valve) will be installed in the outlet pipe that discharges from the sediment pond.

4. **Weir Structure Improvements:** The existing storm vault downstream of the redevelopment project, which diverts upstream stormwater to the sediment ponds and detention pond with a weir structure, will be repaired. The existing slide gates in the weir vault are deteriorating and causing vault flooding. The existing slide gates will be removed, and a new concrete weir will be installed at the overflow pipe outlet to direct incoming stormwater to the sediment pond system.

5. **Water Quality Requirements:** Basic water quality treatment will be used for impervious surfacing subject to vehicle traffic. According to the KCSWDM, commercial projects are subject to enhanced water quality treatment requirements unless several threshold criteria are met as described in KCSWDM Section 1.2.8.1 (exceptions on page 1-74). The following items demonstrate compliance with the criteria:

   a. A facility from the Enhanced Basic WQ menu is not feasible.
      i. A large sand filter and stormwater wetland options require more land area than is available within the FTA property.
      ii. A treatment train option involving an acceptable proprietary media device and the detention wet pond is not feasible. The existing flat topography and existing underground piping infrastructure make it infeasible to use the only acceptable proprietary media device (StormFilter cartridge unit) in a treatment train option either upstream or downstream of the wet pond. The StormFilter has a 1.8-foot minimum internal elevation drop that would force downstream

storm piping to conflict with existing water, storm, and electrical piping or outfall pipe.

b. The existing and proposed structures will not use leachable metals.
c. A covenant will be recorded. A copy of the covenant is provided in Appendix G.
d. Land use for vehicle repair and maintenance is less than 50 percent of the total site area. Maintenance and repair of vehicles is done primarily inside the existing Maintenance Building.

The existing detention pond has an existing wet pond sized according to KCSWDM 2009 methodology to handle most of the campus stormwater. The wet pond will be expanded to meet the current drainage manual and provide treatment for the Phase 1 and Phase 2 basins and areas that discharge directly to the detention/wet pond. The FTA campus also contains an existing oil/water separator, sediment ponds, and a proposed water treatment system for subbasin areas (Basins 2B, 2C, 6, and 7). While the Phase 1 basin area is conveyed to the sediment pond system, the wet pond will be sized to account for this area.

Part C: Performance Standards

A summary of flow control and conveyance performance standards for the project is presented in Table 3. Calculation documents are provided in Appendix A.

Table 3 – Summary of Performance Standards

Category	Performance Standards	Source
Flow Control	Conservation Flow Control	Manual Section 1.2.3.1
Convey System Capacity	Developed 25-year Storm	Manual Section 1.2.4.1
Water Quality Treatment	Basic Treatment	Manual Section 1.2.8.1 Manual Section 6.2.1
Source Control	Stormwater Pollution Control Manual	Manual Section 1.3.4
Oil Control	N/A	Manual Section 1.3.5

Part D: Flow Control Systems

The Western Washington Hydrologic Model (WWHM) program was used to design the detention facility expansion. Procedures and design criteria specified in the KCSWDM were followed for all hydrologic modeling.

The WWHM detention calculations are provided in Appendix A.

Part E: Water Quality Systems

A hydrodynamic separation system (e.g., Aqua-Swirl™) is used for pretreatment. The unit meets the WSDOE criteria for emerging technologies. The Aqua-Swirl system has General Use Designation for Pretreatment and Conditional Use Designation for Basic Treatment. The facility has an internal bypass system to convey larger storm events through the structure. The existing

wet pond cell in the existing detention pond will be expanded approximately 21,800 CF to handle the increase in impervious area from the Phase 1 and Phase 2 redevelopment projects.

Table 4 – Wet Pool Facility Summary

Type	Required Volume (CF)	Provided Volume (CF)
Wet Pond Cell	145,450	159,500

SECTION 5. CONVEYANCE SYSTEM ANALYSIS AND DESIGN

The project will provide new catch basin and storm pipe systems designed to convey stormwater runoff from the project site area. The system is designed to convey the 25-year runoff peak flows from the developed conditions. The system is capable of accommodating the 100-year runoff rate for the developed conditions without creating a flooding hazard.

The rational method was used to size the conveyance systems for both the 25-year and 100-year storm events. Pipe sizing calculations are provided in Appendix B.

SECTION 6. SPECIAL REPORTS AND STUDIES

Table 5 summarizes special reports and studies conducted for the project.

Table 5 – Summary of Special Reports and Studies

Study/Report	Date Conducted	Appendix
Floodplain delineation (1.3.2)	N/A	N/A
Flood protection conformance (1.3.3)	N/A	N/A
Critical areas analysis and delineation	N/A	N/A
Geotechnical/Soils	5/27/2014	Appendix D
Groundwater	N/A	N/A
Slope protection/Stability	N/A	N/A
Erosion and deposition	N/A	N/A
Geology	N/A	N/A
Hydrology	N/A	N/A
Fluvial geomorphology	N/A	N/A
Anadromous fisheries impacts	N/A	N/A
Water quality	N/A	N/A
Structural design	N/A	N/A
Structural fill	N/A	N/A

SECTION 7. OTHER PERMITS

Table 6 summarizes other permits required for the project.

Table 6 – Summary of Other Permits Required

Permit	Required?	Regulating Agency
On-site Sewage Disposal	No	Seattle/King County Department of Health
On-site Well	No	Seattle/King County Department of Health
Developer/Local Agency Agreement	No	Washington State Department of Transportation
Hydraulic Project Approval	No	Washington State Department of Fish and Wildlife
NPDES Stormwater	Yes	Washington State Department of Ecology
Forest Practices Class IV General	No	Washington State Department of Natural Resources
Sections 10, 401, 404	No	United States Army Corps of Engineers

SECTION 8. EROSION/SEDIMENTATION ANALYSIS AND DESIGN

The following explains the proposed ESC measures and their compliance with the Erosion and Sediment Control Standards of the KCSWDM.

Part A: Erosion Control Construction Sequence

1. Clearing Limits: The project site will be delineated with orange fencing and temporary chain link fencing. No clearing will be necessary because the majority of the site and adjacent area is paved.

2. Cover Measures: Any stockpile areas will be covered with plastic sheeting.

3. Perimeter Protection: Filter berms and silt fencing will be installed prior to any upslope grading. Upstream areas tributary to the site will be diverted around the construction site.

4. Traffic Area Stabilization: Stabilized construction entrances shall be installed along Backdraft Boulevard and Bulldog Boulevard to reduce sediment transport.

5. Sediment Retention: The existing sedimentation ponds and detention wet pond cell shall be used as a temporary sediment pond. Upon completion of the project, sediment accumulation in these ponds shall be removed.

6. Surface Water Collection: Due to the flat grades within the site, water will tend to stay within the project area and drain as sheet flow to the various catchment structures. Perimeter ditches along adjacent roadways collect and convey runoff to the existing sedimentation ponds.

7. Dewatering Control: The existing sedimentation ponds will be used as a temporary sediment pond as described above.

8. Dust Control: Water will be used to prevent wind transport of dust from exposed soil surfaces onto adjacent surfaces.

9. Flow Control: The existing detention pond provides the flow control to mitigate increases in runoff peaks during construction.

Part B: SWPPS Plan Design

The following identifies each anticipated pollution-generating activity and the pollution prevention BMPs to address it. The proposed BMPs are provided in the King County *Stormwater Pollution Prevention Manual* (2009).

1. Clean Storm Drainage System: Catch basins tend to be the key components for drainage systems and continually capture dirt, leaves, litter, and other materials that create mucky

buildup at the sump bottom. This buildup prevents solids from being trapped in the sump. A routine cleaning/removal of sediment shall be implemented to prevent sediment transport. Likewise, the proposed detention facility shall be inspected routinely and any sediment shall be removed.

2. Illicit Connections to Storm Drainage System: Severe pollution problems can occur if non-stormwater is discharged into the drainage system. Some non-stormwater items include sanitary sewer pipes, wastewater discharges, and internal building drains; these items shall not be connected to the drainage system. Any illicit connections found during an inspection shall be plugged or disconnected.

3. Stencil Storm Drains: To prevent the improper disposal of pollutants, storm drains will be stenciled with a message such as "Dump No Waste – Drains to Streams."

4. Building Repair, Remodeling, and Construction: Use drop cloths underneath outdoor painting and scraping and dispose of collected material daily. Use a catch basin insert to protect against any pollutants that may escape from the work area.

Required BMPs for All Commercial Properties

MINIMUM REQUIREMENTS

The following BMPs are required if you own or occupy commercial, industrial, agricultural, public, or multifamily residential property in unincorporated King County.

1 Clean Your Storm Drainage System

Maintain your storm drainage system by removing sediment and other debris to prevent the transport of pollutants into receiving waters. The storm drainage system includes all drains, catch basins, pipes, ditches, gutters, and flow control and water quality facilities.

☞ See BMP Info Sheet 7 in Chapter 5 for details on drainage system maintenance.

2 Eliminate Illicit Connections to the Storm Drainage System

A common situation that can cause severe stormwater pollution problems is discharge of non-stormwater to the storm drainage system. Examples are discharges from internal floor drains, appliances, industrial processes, sinks, and toilets. These are sometimes illegally or inadvertently connected or drained to the nearby storm drainage system. These discharges must go to the sanitary sewer system, a holding tank, an on-site process water treatment system, or a septic system. You must correct these illicit discharges. If you have any questions as to whether your discharge is allowable, contact the King County Water and Land Resources Division at 206-296-1900.

☞ See BMP Info Sheet 1 in Chapter 5 for information on how to check for illicit connections. You can also ask for help from your local sewer utility. If you find out that your internal drains are

improperly connected to the storm drainage system, they will need to be either removed, permanently plugged, or connected to the sanitary sewer, septic system, on-site treatment system, or a holding tank.

Stencil Your Storm Drains

Stencil or apply storm drain markers adjacent to storm drains to help prevent the improper disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste - Drains to Stream" applied next to the catch basin to warn against the intentional dumping or discharge of pollutants. If the metal catch basin grate has been cast with this message, marking the drains is still recommended, but may not be required unless evidence is found that pollutants are being dumped or washed to the storm drains.

For more information or assistance in implementing these best management practices, contact the King County Department of Natural Resources and Parks Water and Land Resources Division at 206-296-1900.

Reader Note: The above requirements are the minimum required BMPs. If these BMPs fail to prevent discharges to the storm drainage system, you will be asked to take additional measures to correct the continued pollution discharges.

Pressure Washing of Buildings, Rooftops, and Other Large Objects

This activity applies if you are engaged in pressure washing large, immobile objects such as building facades, rooftops, and awnings on a site-to-site basis. Pressure washing can degrade water quality as the runoff and loosened solids typically travel directly into the storm drainage system. Wash water from pressure washing operations can be contaminated with suspended solids, metals, and possibly other pollutants present on the objects being washed. Pressure washing of boats in boat yards, marinas, and dry dock areas is covered by a National Pollutant Discharge Elimination System (NPDES) permit, administered by the Washington State Department of Ecology, so the BMPs listed below may not apply to pressure washing in these locations.

MINIMUM REQUIREMENTS

The following BMPs, or equivalent measures, methods, or practices are required if you are engaged in pressure washing of large objects:

1. In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.

☞ See BMP Info Sheet 2 in Chapter 5 for information on disposal options.

2. If soaps or detergents are NOT used, and the surrounding area is paved, wash water runoff does not have to be collected but must be screened. Pressure washers must use filter fabric catch basin inserts or some other type of screening device on the ground and/or in the catch basin to trap the particles in wash water runoff.

3 If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash water runoff must infiltrate into the grass and not drain to the pavement or storm drainage system.

4 Another option is to hire a mobile washer who collects and recycles water or complies with the above.

If the painted surface being pressure washed is painted with lead or other heavy metal-bearing paint (such as chromium or cadmium), consider using a commercial pressure washing service that can collect, test, and properly dispose of the wastewater.

Additional BMPs

The following BMPs are optional, unless the above minimum required BMPs do not provide adequate source control:

A catch basin insert, configured for debris removal, may remove some of the pollutants in runoff from this activity. Catch basin inserts require frequent maintenance to be effective. Carefully consider this when evaluating your options.

☞ See BMP Info Sheet 10 in Chapter 5 for more information.

For more information or assistance in implementing these best management practices, contact the King County Department of Natural Resources and Parks Water and Land Resources Division at 206-296-1900.

Reader Note: The above requirements are the minimum required BMPs. If these BMPs fail to prevent discharges to the storm drainage system, you will be asked to take additional measures to correct the continued pollution discharges.

Clearing and Grading of Land for Small Construction Projects

This activity applies if you clear, grade or prepare land for projects. Stormwater runoff from cleared and graded sites can be loaded with suspended sediments and attached pollutants such as oils and greases, toxic hydrocarbon and herbicide compounds, metals, and nutrients. Control of this runoff at the source can prevent large pollutant loadings from entering and degrading receiving waters. Prior to clearing, grading, and preparation activities for construction sites greater than 2,000 square feet, the King County Department of Development and Environmental Services (DDES) must be contacted. You may need to follow the procedures for construction site erosion and sediment control outlined in the King County Surface Water Design Manual, Appendix D.

King County DDES coordinates the clearing, grading, and erosion control requirements on individual sites. The King County Surface Water Design Manual has requirements for erosion and sediment control measures. Appendix D (Erosion and Sediment Control Standards) outlines requirements that all sites must implement. The King County Surface Water Design Manual Appendix C (Small Project Drainage Requirements) addresses small project developments. Even if your site does not require a permit, erosion control measures are still required to prevent turbid water from entering drainage systems or surface waters. King County uses the authority of K.C.C. 9.12 and this manual to develop erosion control requirements for those activities not covered by the King County Surface Water Design Manual.

For more information or assistance in implementing these best management practices, contact the King County Department of Natural Resources and Parks Stormwater Services Section at 206-296-1900.

Reader Note: The above requirements are the minimum required BMPs. If these BMPs fail to prevent discharges to the storm drainage system you will be asked to take additional measures to correct the continued pollution discharges.

Demolition of Buildings

This activity applies to the removal of existing buildings by controlled explosions, wrecking balls, or manual methods, and subsequent clearing of the rubble. Demolition of buildings can introduce a variety of pollutants into stormwater runoff, primarily suspended solids, but also toxic organic compounds and metals. Broken concrete can elevate the pH of stormwater. This activity can also produce air borne pollutants that must be controlled to avoid surface water contamination.

MINIMUM REQUIREMENTS

The following BMPs, or equivalent measures, methods, or practices are required if you are engaged in building demolition:

1. Spray water throughout the site to help control fine materials and dust. The amount of water must be actively controlled and monitored to eliminate contaminated runoff from leaving the site. Other approved dust suppressants are available. Avoid excessive and repeated applications of dust suppressant chemicals.

2. Place filter fabric, inlet control measures or a similarly effective device in or around all nearby drains to prevent particles and solids from entering the storm drainage system. Filtering devices shall be placed at the beginning of the workday and the accumulated materials collected and disposed of properly before removing the devices at the end of the workday. Filter fabric and other filter devices are commercially available.

3. Sweep surrounding street gutters, sidewalks, driveways, and other paved surfaces as needed to collect loose debris and garbage. Properly dispose of collected debris and garbage. Do not hose down the area to a storm drain.

ADDITIONAL BMPs

The following BMPs are optional unless the above minimum required BMPs do not provide adequate source control:

A catch basin insert configured for sediment and debris removal may remove some of the pollutants in runoff from this activity. Catch basin inserts require frequent maintenance to be effective. Carefully consider this when evaluating your options.

☞ See BMP Info Sheet 10 in Chapter 5 for information.

For more information or assistance in implementing these best management practices, contact the King County Department of Natural Resources and Parks Water and Land Resources Division at 206-296-1900.

Reader Note: The above requirements are the minimum required BMPs. If these BMPs fail to prevent discharges to the storm drainage system, you will be asked to take additional measures to correct the continued pollution discharges.

Building Repair, Remodeling, and Construction

This activity applies if you are engaged in common on-site labor activities associated with construction of buildings and other structures, remodeling of existing buildings and houses, painting of building exteriors, and general exterior building repair work. Stormwater runoff from building repair, remodeling, and construction work can be contaminated with toxic hydrocarbons in solvents, other toxic organic compounds, suspended solids, metals, abnormal pH, and oils and greases. Concrete pouring is covered under Activity Sheet A-20,"Concrete and Asphalt Application at Temporary Sites."

MINIMUM REQUIREMENTS

The following BMPs, or equivalent measures, methods, or practices are required if you are engaged in building repair, remodeling, and construction:

1. Do not dump any substance, wash water or liquid waste on the pavement, the ground, or toward a storm drain or drainage ditch.

2. Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work and properly dispose of collected material daily.

3. Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning. Dispose of all wash water from tool cleaning to the sanitary sewer system. Never dispose of wash water to on-site yard drains or street drains.

4. Never dispose of any wash water to a storm drain. Clean paint brushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.

☞ See BMP Info sheet 2 in Chapter 5 for information on disposal options.

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Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the workday, and accumulated dirty runoff and solids must be collected and disposed of in an appropriate manner before removing the containment device(s) at the end of the workday. For example, a combination of a wet vacuum and brooms and dustpans could be used to collect accumulations of dirty runoff. Drain covers, filter fabric, and other containment devices are commercially available if effective runoff control cannot otherwise be provided.

If you need to dewater an excavation site, you must filter the water before discharging to a catch basin or discharging off-site. You should direct the water through sediment filters or traps or use an equivalent method. The pH of water from dewatering activities must be monitored. If the pH is not neutral (7), discharge must not occur to a drainage system until the water is neutralized through an approved method. Dewatering must also be assessed for other pollutants that may not be removed by simple filtering of stormwater. If other pollutants are present, discharging the water to surface or stormwater systems may not be allowed. See Appendix D of the King County Surface Water Design Manual, "Erosion and Sediment Control Standards."

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Routine Maintenance:

- Store and maintain appropriate spill cleanup materials in a location known to all. Ensure that employees are familiar with proper spill cleanup procedures.
- Sweep paved areas as needed and collect loose particles for proper disposal. Wipe up spills with rags and other absorbent material immediately. Do not hose down the area to a storm drain.
- Store toxic material under cover during precipitation events and when not in use (such as overnight). A cover would include tarps or other temporary cover materials.

☞ See Activity Sheet 3, "Storage of Liquid Materials Portable Containers."

ADDITIONAL BMPs

The following BMPs are optional unless the above minimum required BMPs do not provide adequate source control:

Recycle or reuse left over materials.

A catch basin insert configured for debris and sediment removal may remove some of the pollutants in runoff from this activity. Catch basin inserts require frequent maintenance to be effective. Carefully consider this when evaluating your options.

☞ See BMP Info Sheet 10 in Chapter 5 for more information.

For more information or assistance in implementing these best management practices, contact the King County Department of Natural Resources and Parks Water and Land Resources Division at 206-296-1900.

Reader Note: The above requirements are the minimum required BMPs. If these BMPs fail to prevent discharges to the storm drainage system, you will be asked to take additional measures to correct the continued pollution discharges.

Vehicle and Equipment Parking and Storage

This activity applies to all types of parking lots (commercial, public, and private), retail store parking lots, fleet vehicle lots and yards (including rent-a-car lots and car dealerships), industrial areas, equipment sale and rental lots, and parking lot driveways. Stormwater runoff from these sites can be contaminated with toxic hydrocarbons and other organic compounds, oils and greases, metals, nutrients, and suspended solids.

MINIMUM REQUIRED ROUTINE MAINTENANCE

The following BMPs, or equivalent measures, methods, or practices are required if you have parking lots and driveways:

1. Sweep parking lots, storage areas, and driveways as needed to collect dirt, waste, and debris. Do not hose down the area to the storm drainage system.

2. If washing/pressure washing of the parking lot occurs, the wash water must be collected and discharged to a sanitary sewer or other treatment system. There are services that will clean parking lots and collect water for off-site disposal. Never drain washwater to the storm drainage system.

☞ See BMP Info Sheet 2 in Chapter 5 for information on disposal options.

3. Gravel and dirt lots may require additional BMPs to prevent sediment laden water from leaving your site. Vehicles can track dirt out of parking and storage areas onto public roadways. Basic sediment controls as outlined in Appendix D ("Erosion and Sediment Control Standards") of the King County Surface Water Design Manual must be installed if other BMPs do not adequately control sediment laden water from entering off site storm water conveyance systems or surface water. Wheel wash facilities may need to be considered if track out of mud becomes a problem. See Activity Sheet A-41, "Wheel Wash and Tire Bath Operations."

ADDITIONAL BMPs

The following BMPs are optional, unless the above minimum required BMPs do not provide adequate source control.

1. Encourage employees to carpool or use public transit through incentives.

2. Encourage customers to use public transit by rewarding valid transit pass holders with discounts.

3. A catch basin insert configured for sediment and also oil removal may remove some of the pollutants in runoff from this activity. Catch basin inserts may require frequent maintenance to be effective. Carefully consider this when evaluating your options.

4. Clean up oil and antifreeze spills with absorbent materials.

☞ See BMP Info Sheet 10 in Chapter 5 for more information.

For more information or assistance in implementing these best management practices, contact the King County Department of Natural Resources and Parks Water and Land Resources Division at 206-296-1900.

Reader Note: The above requirements are the minimum required BMPs. If these BMPs fail to prevent discharges to the storm drainage system, you will be asked to take additional measures to correct the continued pollution discharges.

SECTION 9. BOND QUANTITIES

A completed site improvement bond quantity worksheet is shown in Appendix F.

SECTION 10. OPERATION AND MAINTENANCE MANUAL

The applicable maintenance requirements, taken from the 2016 KCSWDM, are referenced in this section.

NO. 1 – DETENTION PONDS

Maintenance Component	Defect or Problem	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
Site	Trash and debris	Any trash and debris which exceed 1 cubic foot per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size office garbage can). In general, there should be no visual evidence of dumping.	Trash and debris cleared from site.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Grass/groundcover	Grass or groundcover exceeds 18 inches in height.	Grass or groundcover mowed to a height no greater than 6 inches.
Top or Side Slopes of Dam, Berm or Embankment	Rodent holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents removed or destroyed and dam or berm repaired.
	Tree growth	Tree growth threatens integrity of slopes, does not allow maintenance access, or interferes with maintenance activity. If trees are not a threat or not interfering with access or maintenance, they do not need to be removed.	Trees do not hinder facility performance or maintenance activities.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted slope.	Slopes stabilized using appropriate erosion control measures. If erosion is occurring on compacted slope, a licensed civil engineer should be consulted to resolve source of erosion.
	Settlement	Any part of a dam, berm or embankment that has settled 4 inches lower than the design elevation.	Top or side slope restored to design dimensions. If settlement is significant, a licensed civil engineer should be consulted to determine the cause of the settlement.
Storage Area	Sediment accumulation	Accumulated sediment that exceeds 10% of the designed pond depth.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
	Liner damaged (If Applicable)	Liner is visible or pond does not hold water as designed.	Liner repaired or replaced.
Inlet/Outlet Pipe.	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.
Emergency Overflow/Spillway	Tree growth	Tree growth impedes flow or threatens stability of spillway.	Trees removed.
	Rock missing	Only one layer of rock exists above native soil in area five square feet or larger or any exposure of native soil on the spillway.	Spillway restored to design standards.

NO. 4 – CONTROL STRUCTURE/FLOW RESTRICTOR

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Structure	Trash and debris	Trash or debris of more than ½ cubic foot which is located immediately in front of the structure opening or is blocking capacity of the structure by more than 10%.	No Trash or debris blocking or potentially blocking entrance to structure.
		Trash or debris in the structure that exceeds $^1/_3$ the depth from the bottom of basin to invert the lowest pipe into or out of the basin.	No trash or debris in the structure.
		Deposits of garbage exceeding 1 cubic foot in volume.	No condition present which would attract or support the breeding of insects or rodents.
	Sediment	Sediment exceeds 60% of the depth from the bottom of the structure to the invert of the lowest pipe into or out of the structure or the bottom of the FROP-T section or is within 6 inches of the invert of the lowest pipe into or out of the structure or the bottom of the FROP-T section.	Sump of structure contains no sediment.
	Damage to frame and/or top slab	Corner of frame extends more than ¾ inch past curb face into the street (If applicable).	Frame is even with curb.
		Top slab has holes larger than 2 square inches or cracks wider than ¼ inch.	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than ¾ inch of the frame from the top slab.	Frame is sitting flush on top slab.
	Cracks in walls or bottom	Cracks wider than ½ inch and longer than 3 feet, any evidence of soil particles entering structure through cracks, or maintenance person judges that structure is unsound.	Structure is sealed and structurally sound.
		Cracks wider than ½ inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering structure through cracks.	No cracks more than $^1/_4$ inch wide at the joint of inlet/outlet pipe.
	Settlement/ misalignment	Structure has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards.
	Damaged pipe joints	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering the structure at the joint of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of inlet/outlet pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Ladder rungs missing or unsafe	Ladder is unsafe due to missing rungs, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
FROP-T Section	Damage	T section is not securely attached to structure wall and outlet pipe structure should support at least 1,000 lbs of up or down pressure.	T section securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
		Connections to outlet pipe are not watertight or show signs of deteriorated grout.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes—other than designed holes—in the structure.	Structure has no holes other than designed holes.
Cleanout Gate	Damaged or missing	Cleanout gate is missing.	Replace cleanout gate.

NO. 4 – CONTROL STRUCTURE/FLOW RESTRICTOR

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
		Cleanout gate is not watertight.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
Orifice Plate	Damaged or missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
	Deformed or damaged lip	Lip of overflow pipe is bent or deformed.	Overflow pipe does not allow overflow at an elevation lower than design
Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.
Metal Grates (If Applicable)	Unsafe grate opening	Grate with opening wider than $^{7}/_{8}$ inch.	Grate opening meets design standards.
	Trash and debris	Trash and debris that is blocking more than 20% of grate surface.	Grate free of trash and debris. footnote to guidelines for disposal
	Damaged or missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.
Manhole Cover/Lid	Cover/lid not in place	Cover/lid is missing or only partially in place. **Any open structure requires urgent maintenance**.	Cover/lid protects opening to structure.
	Locking mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to Remove	One maintenance person cannot remove cover/lid after applying 80 lbs. of lift.	Cover/lid can be removed and reinstalled by one maintenance person.

NO. 5 – CATCH BASINS AND MANHOLES

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Structure	Sediment	Sediment exceeds 60% of the depth from the bottom of the catch basin to the invert of the lowest pipe into or out of the catch basin or is within 6 inches of the invert of the lowest pipe into or out of the catch basin.	Sump of catch basin contains no sediment.
	Trash and debris	Trash or debris of more than ½ cubic foot which is located immediately in front of the catch basin opening or is blocking capacity of the catch basin by more than 10%.	No Trash or debris blocking or potentially blocking entrance to catch basin.
		Trash or debris in the catch basin that exceeds $^1/_3$ the depth from the bottom of basin to invert the lowest pipe into or out of the basin.	No trash or debris in the catch basin.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within catch basin.
		Deposits of garbage exceeding 1 cubic foot in volume.	No condition present which would attract or support the breeding of insects or rodents.
	Damage to frame and/or top slab	Corner of frame extends more than ¾ inch past curb face into the street (If applicable).	Frame is even with curb.
		Top slab has holes larger than 2 square inches or cracks wider than ¼ inch.	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than ¾ inch of the frame from the top slab.	Frame is sitting flush on top slab.
	Cracks in walls or bottom	Cracks wider than ½ inch and longer than 3 feet, any evidence of soil particles entering catch basin through cracks, or maintenance person judges that catch basin is unsound.	Catch basin is sealed and structurally sound.
		Cracks wider than ½ inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	No cracks more than $^1/_4$ inch wide at the joint of inlet/outlet pipe.
	Settlement/ misalignment	Catch basin has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards.
	Damaged pipe joints	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering the catch basin at the joint of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of inlet/outlet pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.

NO. 5 – CATCH BASINS AND MANHOLES

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Metal Grates (Catch Basins)	Unsafe grate opening	Grate with opening wider than $^{7}/_{8}$ inch.	Grate opening meets design standards.
	Trash and debris	Trash and debris that is blocking more than 20% of grate surface.	Grate free of trash and debris. footnote to guidelines for disposal
	Damaged or missing	Grate missing or broken member(s) of the grate. **Any open structure requires urgent maintenance**.	Grate is in place and meets design standards.
Manhole Cover/Lid	Cover/lid not in place	Cover/lid is missing or only partially in place. **Any open structure requires urgent maintenance**.	Cover/lid protects opening to structure.
	Locking mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to Remove	One maintenance person cannot remove cover/lid after applying 80 lbs. of lift.	Cover/lid can be removed and reinstalled by one maintenance person.

NO. 6 – CONVEYANCE PIPES AND DITCHES

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Pipes	Sediment & debris accumulation	Accumulated sediment or debris that exceeds 20% of the diameter of the pipe.	Water flows freely through pipes.
	Vegetation/roots	Vegetation/roots that reduce free movement of water through pipes.	Water flows freely through pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Damage to protective coating or corrosion	Protective coating is damaged; rust or corrosion is weakening the structural integrity of any part of pipe.	Pipe repaired or replaced.
	Damaged	Any dent that decreases the cross section area of pipe by more than 20% or is determined to have weakened structural integrity of the pipe.	Pipe repaired or replaced.
Ditches	Trash and debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet of ditch and slopes.	Trash and debris cleared from ditches.
	Sediment accumulation	Accumulated sediment that exceeds 20% of the design depth.	Ditch cleaned/flushed of all sediment and debris so that it matches design.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Vegetation	Vegetation that reduces free movement of water through ditches.	Water flows freely through ditches.
	Erosion damage to slopes	Any erosion observed on a ditch slope.	Slopes are not eroding.
	Rock lining out of place or missing (If Applicable)	One layer or less of rock exists above native soil area 5 square feet or more, any exposed native soil.	Replace rocks to design standards.

NO. 9 – FENCING

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Erosion or holes under fence	Erosion or holes more than 4 inches high and 12-18 inches wide permitting access through an opening under a fence.	No access under the fence.
Wood Posts, Boards and Cross Members	Missing or damaged parts	Missing or broken boards, post out of plumb by more than 6 inches or cross members broken	No gaps on fence due to missing or broken boards, post plumb to within 1½ inches, cross members sound.
	Weakened by rotting or insects	Any part showing structural deterioration due to rotting or insect damage	All parts of fence are structurally sound.
	Damaged or failed post foundation	Concrete or metal attachments deteriorated or unable to support posts.	Post foundation capable of supporting posts even in strong wind.
Metal Posts, Rails and Fabric	Damaged parts	Post out of plumb more than 6 inches.	Post plumb to within 1½ inches.
		Top rails bent more than 6 inches.	Top rail free of bends greater than 1 inch.
		Any part of fence (including post, top rails, and fabric) more than 1 foot out of design alignment.	Fence is aligned and meets design standards.
		Missing or loose tension wire.	Tension wire in place and holding fabric.
	Deteriorated paint or protective coating	Part or parts that have a rusting or scaling condition that has affected structural adequacy.	Structurally adequate posts or parts with a uniform protective coating.
	Openings in fabric	Openings in fabric are such that an 8-inch diameter ball could fit through.	Fabric mesh openings within 50% of grid size.

NO. 11 – GROUNDS (LANDSCAPING)

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Trash or litter	Any trash and debris which exceed 1 cubic foot per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size office garbage can). In general, there should be no visual evidence of dumping.	Trash and debris cleared from site.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Grass/groundcover	Grass or groundcover exceeds 18 inches in height.	Grass or groundcover mowed to a height no greater than 6 inches.
Trees and Shrubs	Hazard	Any tree or limb of a tree identified as having a potential to fall and cause property damage or threaten human life. **A hazard tree identified by a qualified arborist must be removed as soon as possible.**	No hazard trees in facility.
	Damaged	Limbs or parts of trees or shrubs that are split or broken which affect more than 25% of the total foliage of the tree or shrub.	Trees and shrubs with less than 5% of total foliage with split or broken limbs.
		Trees or shrubs that have been blown down or knocked over.	No blown down vegetation or knocked over vegetation. Trees or shrubs free of injury.
		Trees or shrubs which are not adequately supported or are leaning over, causing exposure of the roots.	Tree or shrub in place and adequately supported; dead or diseased trees removed.

NO. 12 – ACCESS ROADS

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Trash and debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet (i.e., trash and debris would fill up one standards size garbage can).	Roadway drivable by maintenance vehicles.
		Debris which could damage vehicle tires or prohibit use of road.	Roadway drivable by maintenance vehicles.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Blocked roadway	Any obstruction which reduces clearance above road surface to less than 14 feet.	Roadway overhead clear to 14 feet high.
		Any obstruction restricting the access to a 10- to 12 foot width for a distance of more than 12 feet or any point restricting access to less than a 10 foot width.	At least 12-foot of width on access road.
Road Surface	Erosion, settlement, potholes, soft spots, ruts	Any surface defect which hinders or prevents maintenance access.	Road drivable by maintenance vehicles.
	Vegetation on road surface	Trees or other vegetation prevent access to facility by maintenance vehicles.	Maintenance vehicles can access facility.
Shoulders and Ditches	Erosion	Erosion within 1 foot of the roadway more than 8 inches wide and 6 inches deep.	Shoulder free of erosion and matching the surrounding road.
	Weeds and brush	Weeds and brush exceed 18 inches in height or hinder maintenance access.	Weeds and brush cut to 2 inches in height or cleared in such a way as to allow maintenance access.
Modular Grid Pavement	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Damaged or missing	Access surface compacted because of broken on missing modular block.	Access road surface restored so road infiltrates.

SECTION 11. REFERENCES

King County Surface Water Management Division, 2016. *King County Surface Water Design Manual.*

King County Water and Land Resources Division, Stormwater Services Section, 2009. *King County Stormwater Pollution Prevention Manual.*

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APPENDIX A

WWHM DETENTION AND WATER QUALITY CALCULATIONS

The following is an overview of the modeling output. The information provided is a combination of WWHM output and explanatory text to allow the reviewer to navigate through the detailed information.

As detailed in the report, the existing Fire Training Academy (FTA) is separated into several sub-basins. To simplify the calculations and the software modeling, the tributary sub-basins have been grouped together into a single drainage basin.

Basins 1A, 1B, 2A, 3, 4, and 5 currently discharge directly to the existing detention pond. See FTA Burn Bldg Calculation for required detention volume for these basins.

Below is a summary of the Developed Basin (Phase 1 & 2) information:

	Impervious (ac)	**Pervious (ac)**
Basin 1A,1B,2A	3.59	3.61 (C, Flat)
Basin 3	2.40	0.09 (C, Flat)
Basin 4	*2.98	2.73 (C, Flat)
Basin 5	0.84	2.27 (C, Flat)
Total	**9.81**	**8.70 C, Flat**

*Phase 2 Buildout

Basins 2B, 2C, 6, and 7 currently discharge to the existing sediment ponds with any overflows released to the downstream existing detention pond.

Below is a summary of the Developed Basin (Phases 3-6) information:

	Impervious (ac)	**Pervious (ac)**
Basin 2B, 2C	6.08, 1.96 (Ponds)	1.45 (C, Flat), 1.85 (C, Steep)
Basin 6	0.6	0.0
Basin 7	3.04	0.0
Total	9.72, 1.96 Pond	3.3

See FTA Total Basin Calculation the includes entire tributary area to detention pond.

FTA Burn Bldg Calculation (Phases 1 & 2)

WWHM2012
PROJECT REPORT

Project Name: FTA Burn Bldg
Site Name: FTA
Site Address: 50810 Grouse Ridge
City : North Bend
Report Date: 9/20/2019
Gage : Landsburg
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.71
Version Date: 2016/02/25
Version : 4.2.12

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Ex. Basin
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Flat	16.91
C, Forest, Steep	1.6
Pervious Total	18.51

Impervious Land Use	acre
Impervious Total	0
Basin Total	18.51

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Dev. Basin

Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Lawn, Flat	8.21
Pervious Total	**8.21**

Impervious Land Use	acre
ROADS FLAT	10.3
Impervious Total	**10.3**
Basin Total	**18.51**

Element Flows To:

Surface	Interflow	Groundwater
Detention Pond	Detention Pond	

Name : Detention Pond
Bottom Length: 330.13 ft.
Bottom Width: 110.04 ft.
Depth: 8.5 ft.
Volume at riser head: 8.1505 acre-feet.
Side slope 1: 3 To 1
Side slope 2: 3 To 1
Side slope 3: 3 To 1
Side slope 4: 3 To 1
Discharge Structure
Riser Height: 7.5 ft.
Riser Diameter: 18 in.
Notch Type: Rectangular
Notch Width: 0.480 ft.
Notch Height: 2.820 ft.
Orifice 1 Diameter: 6.221 in. **Elevation:** 0 ft.

Element Flows To:

Outlet 1	Outlet 2

Pond Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.834	0.000	0.000	0.000
0.0944	0.839	0.079	0.322	0.000
0.1889	0.845	0.158	0.456	0.000
0.2833	0.851	0.238	0.559	0.000
0.3778	0.857	0.319	0.645	0.000
0.4722	0.862	0.400	0.721	0.000

0.5667	0.868	0.482	0.790	0.000
0.6611	0.874	0.564	0.853	0.000
0.7556	0.880	0.647	0.912	0.000
0.8500	0.886	0.730	0.968	0.000
0.9444	0.892	0.814	1.020	0.000
1.0389	0.897	0.899	1.070	0.000
1.1333	0.903	0.984	1.118	0.000
1.2278	0.909	1.070	1.163	0.000
1.3222	0.915	1.156	1.207	0.000
1.4167	0.921	1.243	1.250	0.000
1.5111	0.927	1.330	1.291	0.000
1.6056	0.933	1.418	1.330	0.000
1.7000	0.939	1.506	1.369	0.000
1.7944	0.945	1.595	1.406	0.000
1.8889	0.951	1.685	1.443	0.000
1.9833	0.957	1.775	1.479	0.000
2.0778	0.963	1.866	1.513	0.000
2.1722	0.969	1.957	1.547	0.000
2.2667	0.975	2.049	1.581	0.000
2.3611	0.981	2.141	1.613	0.000
2.4556	0.987	2.234	1.645	0.000
2.5500	0.994	2.328	1.677	0.000
2.6444	1.000	2.422	1.707	0.000
2.7389	1.006	2.517	1.738	0.000
2.8333	1.012	2.612	1.767	0.000
2.9278	1.018	2.708	1.797	0.000
3.0222	1.024	2.804	1.825	0.000
3.1167	1.031	2.902	1.854	0.000
3.2111	1.037	2.999	1.881	0.000
3.3056	1.043	3.097	1.909	0.000
3.4000	1.049	3.196	1.936	0.000
3.4944	1.055	3.296	1.963	0.000
3.5889	1.062	3.396	1.989	0.000
3.6833	1.068	3.496	2.015	0.000
3.7778	1.074	3.598	2.041	0.000
3.8722	1.081	3.699	2.066	0.000
3.9667	1.087	3.802	2.091	0.000
4.0611	1.093	3.905	2.116	0.000
4.1556	1.100	4.008	2.140	0.000
4.2500	1.106	4.113	2.165	0.000
4.3444	1.113	4.217	2.189	0.000
4.4389	1.119	4.323	2.212	0.000
4.5333	1.125	4.429	2.236	0.000
4.6278	1.132	4.536	2.259	0.000
4.7222	1.138	4.643	2.296	0.000
4.8167	1.145	4.751	2.383	0.000
4.9111	1.151	4.859	2.497	0.000
5.0056	1.158	4.968	2.627	0.000
5.1000	1.164	5.078	2.770	0.000
5.1944	1.171	5.188	2.923	0.000
5.2889	1.177	5.299	3.082	0.000
5.3833	1.184	5.411	3.247	0.000
5.4778	1.190	5.523	3.415	0.000
5.5722	1.197	5.636	3.586	0.000
5.6667	1.204	5.749	3.757	0.000
5.7611	1.210	5.863	3.958	0.000
5.8556	1.217	5.978	4.171	0.000

5.9500	1.224	6.093	4.392	0.000
6.0444	1.230	6.209	4.620	0.000
6.1389	1.237	6.325	5.577	0.000
6.2333	1.244	6.443	5.891	0.000
6.3278	1.250	6.560	6.213	0.000
6.4222	1.257	6.679	6.544	0.000
6.5167	1.264	6.798	6.883	0.000
6.6111	1.270	6.918	7.231	0.000
6.7056	1.277	7.038	7.587	0.000
6.8000	1.284	7.159	7.950	0.000
6.8944	1.291	7.281	8.321	0.000
6.9889	1.298	7.403	8.700	0.000
7.0833	1.304	7.526	9.085	0.000
7.1778	1.311	7.649	9.478	0.000
7.2722	1.318	7.774	9.878	0.000
7.3667	1.325	7.898	10.28	0.000
7.4611	1.332	8.024	10.69	0.000
7.5556	1.339	8.150	11.09	0.000
7.6500	1.346	8.277	11.81	0.000
7.7444	1.353	8.404	12.79	0.000
7.8389	1.360	8.532	13.88	0.000
7.9333	1.367	8.661	14.94	0.000
8.0278	1.374	8.791	15.85	0.000
8.1222	1.380	8.921	16.52	0.000
8.2167	1.387	9.052	16.96	0.000
8.3111	1.395	9.183	17.40	0.000
8.4056	1.402	9.315	17.78	0.000
8.5000	1.409	9.448	18.14	0.000
8.5944	1.416	9.581	18.48	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:18.51
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:8.21
Total Impervious Area:10.3

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	4.327675
5 year	8.805776
10 year	13.068771
25 year	20.274985
50 year	27.198602
100 year	35.66759

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	2.00367
5 year	3.084653
10 year	4.013952
25 year	5.476744
50 year	6.808056
100 year	8.375985

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
2.1638	1501	1458	97	Pass
2.4167	1051	784	74	Pass
2.6696	728	608	83	Pass
2.9225	516	460	89	Pass
3.1753	384	350	91	Pass
3.4282	300	275	91	Pass
3.6811	237	223	94	Pass
3.9340	191	190	99	Pass
4.1868	175	153	87	Pass
4.4397	165	129	78	Pass
4.6926	153	120	78	Pass
4.9455	141	116	82	Pass
5.1984	126	113	89	Pass
5.4512	116	111	95	Pass
5.7041	106	107	100	Pass
5.9570	98	101	103	Pass
6.2099	94	96	102	Pass
6.4627	88	92	104	Pass
6.7156	80	87	108	Pass
6.9685	76	82	107	Pass
7.2214	73	78	106	Pass
7.4742	69	72	104	Pass
7.7271	62	68	109	Pass
7.9800	59	64	108	Pass
8.2329	55	57	103	Pass
8.4857	50	54	108	Pass
8.7386	48	51	106	Pass
8.9915	42	46	109	Pass
9.2444	40	44	110	Pass
9.4973	37	40	108	Pass
9.7501	35	35	100	Pass
10.0030	33	23	69	Pass
10.2559	33	18	54	Pass
10.5088	31	15	48	Pass
10.7616	31	13	41	Pass
11.0145	29	13	44	Pass
11.2674	26	11	42	Pass
11.5203	23	10	43	Pass

11.7731	23	10	43	Pass
12.0260	22	8	36	Pass
12.2789	18	6	33	Pass
12.5318	17	2	11	Pass
12.7846	17	0	0	Pass
13.0375	16	0	0	Pass
13.2904	15	0	0	Pass
13.5433	15	0	0	Pass
13.7962	15	0	0	Pass
14.0490	15	0	0	Pass
14.3019	14	0	0	Pass
14.5548	12	0	0	Pass
14.8077	11	0	0	Pass
15.0605	10	0	0	Pass
15.3134	9	0	0	Pass
15.5663	8	0	0	Pass
15.8192	7	0	0	Pass
16.0720	7	0	0	Pass
16.3249	7	0	0	Pass
16.5778	6	0	0	Pass
16.8307	5	0	0	Pass
17.0835	4	0	0	Pass
17.3364	3	0	0	Pass
17.5893	3	0	0	Pass
17.8422	3	0	0	Pass
18.0951	3	0	0	Pass
18.3479	3	0	0	Pass
18.6008	1	0	0	Pass
18.8537	1	0	0	Pass
19.1066	1	0	0	Pass
19.3594	1	0	0	Pass
19.6123	1	0	0	Pass
19.8652	1	0	0	Pass
20.1181	1	0	0	Pass
20.3709	1	0	0	Pass
20.6238	1	0	0	Pass
20.8767	1	0	0	Pass
21.1296	1	0	0	Pass
21.3824	1	0	0	Pass
21.6353	1	0	0	Pass
21.8882	1	0	0	Pass
22.1411	1	0	0	Pass
22.3940	1	0	0	Pass
22.6468	1	0	0	Pass
22.8997	1	0	0	Pass
23.1526	1	0	0	Pass
23.4055	1	0	0	Pass
23.6583	1	0	0	Pass
23.9112	1	0	0	Pass
24.1641	1	0	0	Pass
24.4170	1	0	0	Pass
24.6698	1	0	0	Pass
24.9227	1	0	0	Pass
25.1756	1	0	0	Pass
25.4285	1	0	0	Pass
25.6813	1	0	0	Pass
25.9342	1	0	0	Pass

26.1871	1	0	0	Pass
26.4400	1	0	0	Pass
26.6928	1	0	0	Pass
26.9457	1	0	0	Pass
27.1986	1	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 3.3391 acre-feet
On-line facility target flow: 4.332 **cfs.**
Adjusted for 15 min: 4.332 **cfs.**
Off-line facility target flow: 2.2814 **cfs.**
Adjusted for 15 min: 2.2814 **cfs.**

FTA Total Basin Calculation

WWHM2012
PROJECT REPORT

Project Name: FTA Bld Out
Site Name: FTA
Site Address: Grouse Ridge Rd
City : North Bend
Report Date: 1/20/2020
Gage : Landsburg
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.71
Version Date: 2016/02/25
Version : 4.2.12

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Ex Basins
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Flat	28.08
C, Forest, Steep	3.45
Pervious Total	31.53

Impervious Land Use	acre
POND	1.96
Impervious Total	1.96
Basin Total	33.49

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Total Basin
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Lawn, Flat	10.25
C, Lawn, Steep	1.85
Pervious Total	12.1

Impervious Land Use	acre
ROADS FLAT	19.53
POND	1.96
Impervious Total	21.49
Basin Total	33.59

Element Flows To:

Surface	Interflow	Groundwater
Detention Pond	Detention Pond	

Name : Detention Pond
Bottom Length: 470.00 ft.
Bottom Width: 150.00 ft.
Depth: 8 ft.
Volume at riser head: 13.5662 acre-feet.
Side slope 1: 3 To 1
Side slope 2: 3 To 1
Side slope 3: 3 To 1
Side slope 4: 3 To 1
Discharge Structure
Riser Height: 7 ft.
Riser Diameter: 18 in.
Notch Type: Rectangular
Notch Width: 1.000 ft.
Notch Height: 2.500 ft.
Orifice 1 Diameter: 9.125 in. **Elevation:** 0 ft.

Element Flows To:

Outlet 1	Outlet 2

Pond Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	1.618	0.000	0.000	0.000
0.0889	1.626	0.144	0.673	0.000
0.1778	1.633	0.289	0.952	0.000

0.2667	1.641	0.434	1.166	0.000
0.3556	1.648	0.580	1.347	0.000
0.4444	1.656	0.727	1.506	0.000
0.5333	1.664	0.875	1.650	0.000
0.6222	1.671	1.023	1.782	0.000
0.7111	1.679	1.172	1.905	0.000
0.8000	1.687	1.322	2.021	0.000
0.8889	1.695	1.472	2.130	0.000
0.9778	1.702	1.623	2.234	0.000
1.0667	1.710	1.775	2.333	0.000
1.1556	1.718	1.927	2.429	0.000
1.2444	1.726	2.080	2.520	0.000
1.3333	1.733	2.234	2.609	0.000
1.4222	1.741	2.389	2.694	0.000
1.5111	1.749	2.544	2.777	0.000
1.6000	1.757	2.700	2.858	0.000
1.6889	1.765	2.856	2.936	0.000
1.7778	1.772	3.013	3.012	0.000
1.8667	1.780	3.171	3.087	0.000
1.9556	1.788	3.330	3.159	0.000
2.0444	1.796	3.489	3.230	0.000
2.1333	1.804	3.649	3.300	0.000
2.2222	1.812	3.810	3.368	0.000
2.3111	1.820	3.971	3.435	0.000
2.4000	1.828	4.134	3.500	0.000
2.4889	1.836	4.296	3.564	0.000
2.5778	1.844	4.460	3.627	0.000
2.6667	1.852	4.624	3.689	0.000
2.7556	1.860	4.789	3.750	0.000
2.8444	1.868	4.955	3.810	0.000
2.9333	1.876	5.121	3.869	0.000
3.0222	1.884	5.289	3.928	0.000
3.1111	1.892	5.456	3.985	0.000
3.2000	1.900	5.625	4.042	0.000
3.2889	1.908	5.794	4.097	0.000
3.3778	1.916	5.964	4.152	0.000
3.4667	1.924	6.135	4.207	0.000
3.5556	1.932	6.306	4.260	0.000
3.6444	1.940	6.478	4.313	0.000
3.7333	1.948	6.651	4.365	0.000
3.8222	1.956	6.825	4.417	0.000
3.9111	1.965	6.999	4.468	0.000
4.0000	1.973	7.174	4.519	0.000
4.0889	1.981	7.350	4.569	0.000
4.1778	1.989	7.526	4.618	0.000
4.2667	1.997	7.704	4.667	0.000
4.3556	2.006	7.882	4.715	0.000
4.4444	2.014	8.060	4.763	0.000
4.5333	2.022	8.240	4.831	0.000
4.6222	2.030	8.420	4.996	0.000
4.7111	2.039	8.601	5.213	0.000
4.8000	2.047	8.782	5.464	0.000
4.8889	2.055	8.965	5.740	0.000
4.9778	2.064	9.148	6.035	0.000
5.0667	2.072	9.332	6.345	0.000
5.1556	2.080	9.516	6.666	0.000
5.2444	2.089	9.702	6.995	0.000

5.3333	2.097	9.888	7.329	0.000
5.4222	2.105	10.07	7.666	0.000
5.5111	2.114	10.26	8.013	0.000
5.6000	2.122	10.45	8.420	0.000
5.6889	2.131	10.64	8.842	0.000
5.7778	2.139	10.83	9.279	0.000
5.8667	2.147	11.02	9.729	0.000
5.9556	2.156	11.21	11.69	0.000
6.0444	2.164	11.40	12.30	0.000
6.1333	2.173	11.59	12.93	0.000
6.2222	2.181	11.79	13.58	0.000
6.3111	2.190	11.98	14.24	0.000
6.4000	2.198	12.17	14.92	0.000
6.4889	2.207	12.37	15.62	0.000
6.5778	2.216	12.57	16.32	0.000
6.6667	2.224	12.76	17.05	0.000
6.7556	2.233	12.96	17.78	0.000
6.8444	2.241	13.16	18.53	0.000
6.9333	2.250	13.36	19.30	0.000
7.0222	2.258	13.56	19.94	0.000
7.1111	2.267	13.76	20.51	0.000
7.2000	2.276	13.96	21.37	0.000
7.2889	2.284	14.17	22.37	0.000
7.3778	2.293	14.37	23.42	0.000
7.4667	2.302	14.58	24.40	0.000
7.5556	2.310	14.78	25.21	0.000
7.6444	2.319	14.99	25.79	0.000
7.7333	2.328	15.19	26.20	0.000
7.8222	2.337	15.40	26.64	0.000
7.9111	2.345	15.61	27.02	0.000
8.0000	2.354	15.82	27.38	0.000
8.0889	2.363	16.03	27.72	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:31.53
Total Impervious Area:1.96

Mitigated Landuse Totals for POC #1
Total Pervious Area:12.1
Total Impervious Area:21.49

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	9.275701
5 year	17.720231
10 year	25.572924

25 year	38.660084
50 year	51.116205
100 year	66.266726

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	4.193979
5 year	6.344462
10 year	8.167987
25 year	11.004833
50 year	13.559557
100 year	16.542525

Stream Protection Duration
POC #1
The Facility PASSED

Facility PASSED.

Flow(cfs)	**Predev**	**Mit**	**Percentage**	**Pass/Fail**
4.6379	1040	1044	100	Pass
5.1073	727	641	88	Pass
5.5768	545	517	94	Pass
6.0463	415	394	94	Pass
6.5158	336	315	93	Pass
6.9852	270	258	95	Pass
7.4547	237	212	89	Pass
7.9242	206	174	84	Pass
8.3937	183	145	79	Pass
8.8632	173	128	73	Pass
9.3326	161	116	72	Pass
9.8021	151	110	72	Pass
10.2716	136	103	75	Pass
10.7411	120	103	85	Pass
11.2105	109	101	92	Pass
11.6800	102	98	96	Pass
12.1495	97	95	97	Pass
12.6190	93	89	95	Pass
13.0885	85	84	98	Pass
13.5579	81	80	98	Pass
14.0274	77	78	101	Pass
14.4969	72	72	100	Pass
14.9664	66	68	103	Pass
15.4359	64	65	101	Pass
15.9053	61	63	103	Pass
16.3748	56	58	103	Pass
16.8443	49	51	104	Pass
17.3138	48	49	102	Pass
17.7832	41	45	110	Pass
18.2527	40	44	110	Pass
18.7222	38	38	100	Pass
19.1917	34	33	97	Pass
19.6612	34	25	73	Pass
20.1306	31	16	51	Pass
20.6001	31	15	48	Pass

21.0696	28	14	50	Pass
21.5391	27	14	51	Pass
22.0085	25	13	52	Pass
22.4780	23	12	52	Pass
22.9475	21	11	52	Pass
23.4170	20	10	50	Pass
23.8865	19	9	47	Pass
24.3559	19	5	26	Pass
24.8254	18	0	0	Pass
25.2949	17	0	0	Pass
25.7644	16	0	0	Pass
26.2339	16	0	0	Pass
26.7033	15	0	0	Pass
27.1728	15	0	0	Pass
27.6423	13	0	0	Pass
28.1118	13	0	0	Pass
28.5812	12	0	0	Pass
29.0507	10	0	0	Pass
29.5202	8	0	0	Pass
29.9897	8	0	0	Pass
30.4592	7	0	0	Pass
30.9286	7	0	0	Pass
31.3981	7	0	0	Pass
31.8676	6	0	0	Pass
32.3371	6	0	0	Pass
32.8066	3	0	0	Pass
33.2760	3	0	0	Pass
33.7455	3	0	0	Pass
34.2150	3	0	0	Pass
34.6845	2	0	0	Pass
35.1539	2	0	0	Pass
35.6234	2	0	0	Pass
36.0929	1	0	0	Pass
36.5624	1	0	0	Pass
37.0319	1	0	0	Pass
37.5013	1	0	0	Pass
37.9708	1	0	0	Pass
38.4403	1	0	0	Pass
38.9098	1	0	0	Pass
39.3792	1	0	0	Pass
39.8487	1	0	0	Pass
40.3182	1	0	0	Pass
40.7877	1	0	0	Pass
41.2572	1	0	0	Pass
41.7266	1	0	0	Pass
42.1961	1	0	0	Pass
42.6656	1	0	0	Pass
43.1351	1	0	0	Pass
43.6046	1	0	0	Pass
44.0740	1	0	0	Pass
44.5435	1	0	0	Pass
45.0130	1	0	0	Pass
45.4825	1	0	0	Pass
45.9519	1	0	0	Pass
46.4214	1	0	0	Pass
46.8909	1	0	0	Pass
47.3604	1	0	0	Pass

47.8299	1	0	0	Pass
48.2993	1	0	0	Pass
48.7688	1	0	0	Pass
49.2383	1	0	0	Pass
49.7078	1	0	0	Pass
50.1772	1	0	0	Pass
50.6467	1	0	0	Pass
51.1162	1	0	0	Pass

APPENDIX B

CONVEYANCE CALCULATIONS

PROJ: **Fire Training Academy**

WO: 26-2013-075

DATE: 9/19/2014

FILE: O:\13\075_WSP Fire Training Academy\Drainage\[FTA Pipe Sizing .xlsx]Pipe Sizing 25yr BASIN

PIPE SIZING

(Runoff by Rational Method)

(Pipe Capacity by Manning's Eqn.)

Calculated by: MAD

Checked by:

Date Checked: 7/6/15

Storm: North Bend 25 Year

c= 0.9 Impervious

c= 0.25 Lawn

a_r 2.66 (see KCSWDM pg 3-13)

b_r 0.65 (see KCSWDM pg 3-13)

P_r 5.5 (see KCSWDM pg 3-16) 24-Hour Isopluvials

From	To	Inc. Area (sf) (Imperv)	Inc. Area (sf) (Perv)	Inc. Area (ac)	Runoff Coef.	A*C	Sum A*C	Time of Conc (min)	Rain Intens (in/hr)	Runoff (cfs)	n Value	Diam (inch)	Slope (%)	Length (feet)	Pipe Capac (cfs)	% Capac Used	Veloc Full (ft/sec)	Flow Time (min)	Remarks
PHASE 1 DEVELOPMENT																			
CB 6	CB 5	2364	0	0.05	0.90	0.05	0.05	5.00	5.14	0.25	0.012	12	5.90	71	9.38	3	11.94	0.10	
CB 5	CB 4	7224.00	2163	0.22	0.75	0.16	0.21	5.10	5.07	1.07	0.012	12	2.30	40	5.85	18	7.45	0.09	
CB 4	CB 3	4244	0	0.10	0.90	0.09	0.30	5.19	5.02	1.50	0.012	12	1.20	119	4.23	35	5.38	0.37	
CB 3	CB 2	8437	4733	0.30	0.67	0.20	0.57	5.56	4.80	2.72	0.012	12	0.56	36	2.89	94	3.68	0.16	
CB 2	PT#1	9095	6465	0.36	0.63	0.23	0.79	5.72	4.71	3.73	0.012	15	0.50	43	4.95	75	4.03	0.18	
PT#1	CB 1	0	0	0.00	0.90	0.00	0.79	5.90	4.62	3.65	0.012	15	0.67	15	5.73	64	4.67	0.05	
CB 8	CB 7	3096	0	0.07	0.90	0.06	0.06	5.00	5.14	0.33	0.012	12	0.34	89	2.25	15	2.87	0.52	
CB 7	CB 3	3235	0	0.07	0.90	0.07	0.07	5.52	4.82	0.32	0.012	12	0.53	141	2.81	11	3.58	0.66	
PHASE 2 DEVELOPMENT																			
CB 13	CB 12	4574	2575	0.16	0.67	0.11	0.11	5.00	5.14	0.56	0.012	12	0.67	30	3.16	18	4.02	0.12	
CB 12	CB 11	1405.00	0	0.03	0.90	0.03	0.14	5.12	5.06	0.70	0.012	12	0.90	78	3.66	19	4.66	0.28	
CB 11	CB 10	11856	0	0.27	0.90	0.24	0.38	5.40	4.89	1.87	0.012	12	2.10	62	5.59	33	7.12	0.15	
CB 10	PT #2	11639	0	0.27	0.90	0.24	1.32	5.55	4.80	6.33	0.012	15	0.55	95	5.19	122	4.23	0.37	
PT#2	CB 9	0	0	0.00	0.90	0.00	1.32	5.92	4.60	6.06	0.012	15	0.59	34	5.38	113	4.38	0.13	
CB 9	EX CB	2574	772	0.08	0.75	0.06	1.86	6.05	4.54	8.43	0.014	15	0.45	62	4.02	209	3.28	0.32	

PROJ: **GRCC Student Life Building**

WO: 21-2012-010

DATE: 9/19/2014

FILE: O:\13\075_WSP Fire Training Academy\Drainage\[FTA Pipe Sizing .xlsx]Pipe Sizing 25yr BASIN

PIPE SIZING

(Runoff by Rational Method)

(Pipe Capacity by Manning's Eqn.)

Calculated by: MAD

Checked by:

Date Checked: 7/6/15

c= 0.9 Impervious

c= 0.25 Lawn

Storm: SeaTac 100 Year

a_r 2.61 (see KCSWDM pg 3-13)

b_r 0.63 (see KCSWDM pg 3-13)

P_r 6.5 (see KCSWDM pg 24-Hour Isopluvials

From	To	Inc. Area (sf) (Imperv)	Inc. Area (sf) (Perv)	Inc. Area (ac)	Runoff Coef.	A*C	Sum A*C	Time of Conc (min)	Rain Intens (in/hr)	Runoff (cfs)	n Value	Diam (inch)	Slope (%)	Length (feet)	Pipe Capac (cfs)	% Capac Used	Veloc Full (ft/sec)	Flow Time (min)	Remarks
PHASE 1 DEVELOPMENT																			
CB 6	CB 5	2364	0	0.05	0.90	0.05	0.05	5.00	6.15	0.30	0.012	12	5.90	71	9.38	3	11.94	0.10	
CB 5	CB 4	7224.00	2163	0.22	0.75	0.16	0.21	5.10	6.08	1.28	0.012	12	2.30	40	5.85	22	7.45	0.09	
CB 4	CB 3	4244	0	0.10	0.90	0.09	0.30	5.19	6.01	1.79	0.012	12	1.20	119	4.23	42	5.38	0.37	
CB 3	CB 2	8437	4733	0.30	0.67	0.20	0.57	5.56	5.76	3.26	0.012	12	0.56	36	2.89	113	3.68	0.16	
CB 2	PT#1	9095	6465	0.36	0.63	0.23	0.79	5.72	5.65	4.48	0.012	15	0.50	43	4.95	90	4.03	0.18	
PT#1	CB 1	0	0	0.00	0.90	0.00	0.79	5.90	5.55	4.39	0.012	15	0.67	15	5.73	77	4.67	0.05	
CB 8	CB 7	3096	0	0.07	0.90	0.06	0.06	5.00	6.15	0.39	0.012	12	0.34	89	2.25	17	2.87	0.52	
CB 7	CB 3	3235	0	0.07	0.90	0.07	0.07	5.52	5.78	0.39	0.012	12	0.53	141	2.81	14	3.58	0.66	
PHASE 2 DEVELOPMENT																			
CB 13	CB 12	4574	2575	0.16	0.67	0.11	0.11	5.00	6.15	0.67	0.012	12	0.67	30	3.16	21	4.02	0.12	
CB 12	CB 11	1405.00	0	0.03	0.90	0.03	0.14	5.12	6.06	0.84	0.012	12	0.90	78	3.66	23	4.66	0.28	
CB 11	CB 10	11856	0	0.27	0.90	0.24	0.38	5.40	5.86	2.25	0.012	12	2.10	62	5.59	40	7.12	0.15	
CB 10	PT #2	11639	0	0.27	0.90	0.24	1.32	5.55	5.76	7.59	0.012	15	0.55	95	5.19	146	4.23	0.37	
PT#2	CB 9	0	0	0.00	0.90	0.00	1.32	5.92	5.53	7.29	0.012	15	0.59	34	5.38	136	4.38	0.13	
CB 9	EX CB	2574	772	0.08	0.75	0.06	1.86	6.05	5.46	10.13	0.014	15	0.45	62	4.02	252	3.28	0.32	

PROJ: **GRCC Student Life Building**

WO: 21-2012-010

DATE: 9/19/2014

FILE: O:\13\075_WSP Fire Training Academy\Drainage\[FTA Pipe Sizing .xlsx]Pipe Sizing 25yr BASIN

PIPE SIZING

(Runoff by Rational Method)

(Pipe Capacity by Manning's Eqn.)

Calculated by: MAD

Checked by:

Date Checked: 7/6/15

c= 0.9 Impervious

c= 0.25 Lawn

Storm: SeaTac 100 Year

a_r 2.61 (see KCSWDM pg 3-13)

b_r 0.63 (see KCSWDM pg 3-13)

P_r 6.5 (see KCSWDM pg 24-Hour Isopluvials

From	To	Inc. Area (sf) (Imperv)	Inc. Area (sf) (Perv)	Inc. Area (ac)	Runoff Coef.	A*C	Sum A*C	Time of Conc (min)	Rain Intens (in/hr)	Runoff (cfs)	n Value	Diam (inch)	Slope (%)	Length (feet)	Pipe Capac (cfs)	% Capac Used	Veloc Full (ft/sec)	Flow Time (min)	Remarks
CB 16	CB 15	8928	366	0.21	0.87	0.19	0.19	5.00	6.15	1.15	0.012	12	0.59	51	2.96	39	3.77	0.23	
CB 15	CB 10	1429	0	0.03	0.90	0.03	0.69	5.23	5.99	4.15	0.012	15	0.58	104	5.33	78	4.34	0.40	
EX CB	CB 14	16143	0	0.37	0.90	0.33	0.33	5.00	6.15	2.05	0.012	12	0.83	125	3.52	58	4.48	0.47	
CB 14	CB 15	6958	0	0.16	0.90	0.14	0.48	5.47	5.82	2.78	0.012	12	1.71	17	5.05	55	6.43	0.04	
CB 17	CB 18	5266	3222	0.19	0.65	0.13	0.13	5.00	6.15	0.78	0.012	12	0.60	33	2.99	26	3.81	0.14	
CB 18	CB 19	4815	657	0.13	0.82	0.10	0.23	5.14	6.05	1.39	0.012	12	0.50	59	2.73	51	3.48	0.28	
CB 19	CB 20	1801	739	0.06	0.71	0.04	0.27	5.43	5.84	1.59	0.012	12	1.20	41	4.23	38	5.38	0.13	
CB 20	CB 9	955	347	0.03	0.73	0.02	0.29	5.55	5.76	1.69	0.012	12	2.00	25	5.46	31	6.95	0.06	
INLET	CB 9	8056	3735	0.27	0.69	0.19	0.19	5.00	6.15	1.16	0.012	12	1.00	90	3.86	30	4.91	0.31	

BACKWATER CALCULATION SHEET

100-Year Storm Event

PROJ: **WSP FTA Burn Building Replacement**
WO: 26-2013-075
DATE: 7/2/2015

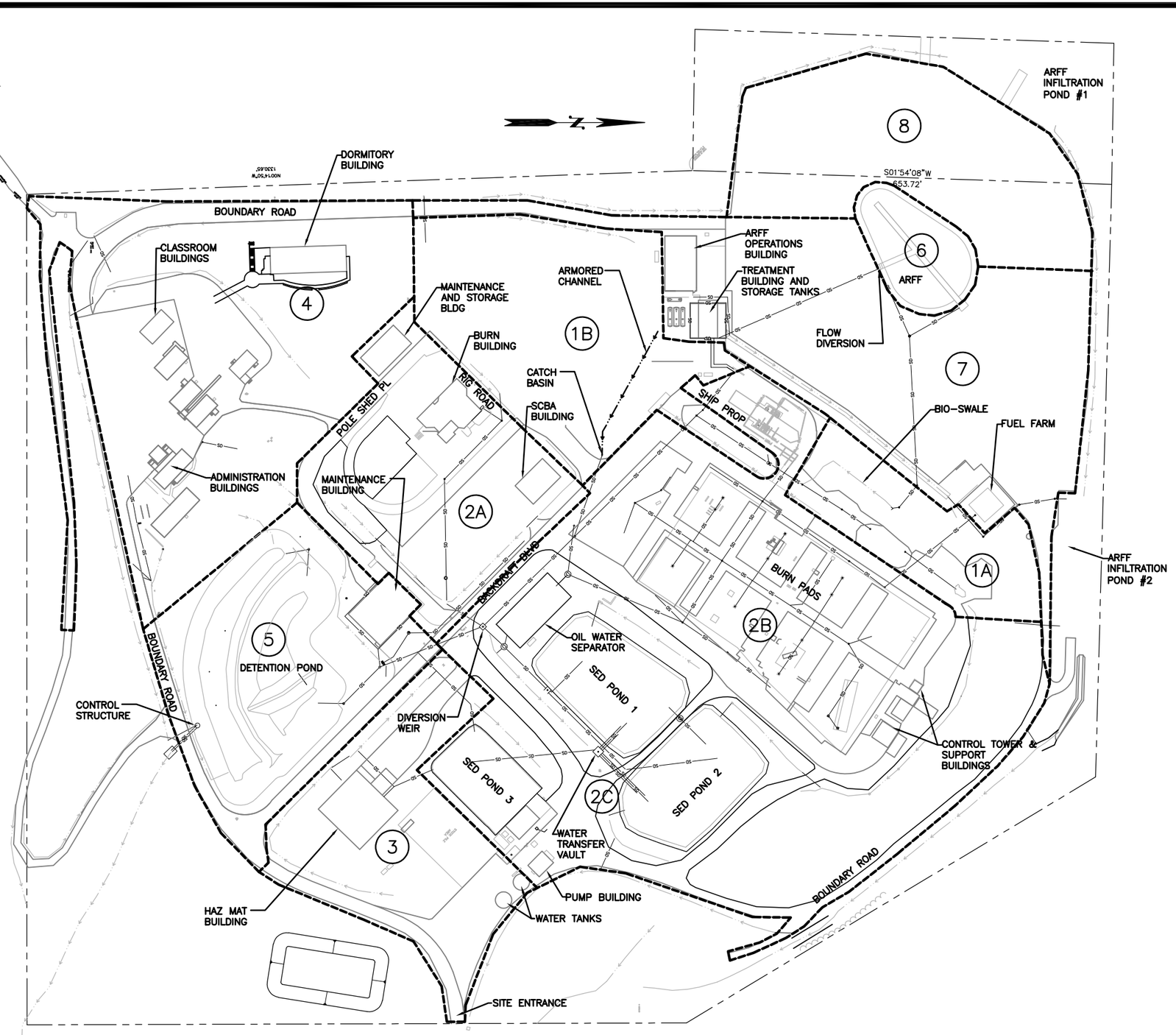
Calculated by: MAD
Checked by:
Date Checked: 7/6/2015

Pipe Segment CB to CB		(1) Q (cfs)	(2) Length (ft)	(3) Pipe Diameter (in)	(4) "n" Value	(5) Outlet Elev (ft)	(6) Inlet Elev (ft)	(7) Barrel Area (sqft)	(8) Barrel Velocity (fps)	(9) Barrel Vel Head (ft)	(10) TW Elev (ft)	(11) Friction Loss (ft)	(12) Entrance HGL Elev (ft)	(13) Entrance head loss (ft)	(14) Exit head loss (ft)	(15) Outlet contr. Elev (ft)	(16) Inlet contr. Elev (ft)	(17) Approach vel. head (ft)	(18) Bend head loss (ft)	(19) Junction head loss (ft)	(20) HW elev. (ft)
PHASE 1 DEVELOPMENT																					
CB 3	CB 7	0.39	141	12	0.012	1549.45	1550.2	0.785	0.497	0.004	1550.450	0.014	1550.464	0.001	0.004	1550.469		0.004	0.000	0.000	1550.465
CB 7	CB 8	0.39	89	12	0.012	1550.2	1550.5	0.785	0.497	0.004	1550.465	0.009	1550.474	0.001	0.004	1550.479		0.000	0.000	0.000	1550.479
																		0.000	0.000	0.000	0.000
CB 1	PT#1	4.39	15	15	0.012	1548.9	1549	1.227	3.577	0.199	1550.150	0.058	1550.208	0.040	0.199	1550.447		0.207	0.000	0.000	1550.240
PT#1	CB 2	4.48	43	15	0.012	1549	1549.25	1.227	3.651	0.207	1550.240	0.175	1550.415	0.041	0.207	1550.663		0.268	0.000	0.000	1550.395
CB 2	CB 3	3.26	36	12	0.012	1549.25	1549.45	0.785	4.151	0.268	1550.395	0.254	1550.650	0.054	0.268	1550.971		0.081	0.000	0.000	1550.890
CB 3	CB 4	1.79	119	12	0.012	1549.45	1550.9	0.785	2.279	0.081	1550.890	0.253	1551.143	0.016	0.081	1551.240		0.041	0.000	0.000	1551.199
CB 4	CB 5	1.28	40	12	0.012	1550.9	1551.8	0.785	1.630	0.041	1551.199	0.044	1551.243	0.008	0.041	1551.292		0.000	0.000	0.000	1551.292
CB 5	CB 6	0.3	71	12	0.012	1551.8	1556	0.785	0.382	0.002	1551.292	0.004	1551.296	0.000	0.002	1551.299		0.000	0.000	0.000	1551.299
PHASE 2 DEVELOPMENT																					
EX CB	CB 9	10.13	62	15	0.012	1545.42	1546	1.227	8.255	1.058	1546.700	1.287	1547.987	0.212	1.058	1549.257		0.548	0.000	0.000	1548.709
CB 9	PT #2	7.29	34	15	0.012	1546	1546.2	1.227	5.940	0.548	1548.709	0.366	1549.074	0.110	0.548	1549.732		0.594	0.000	0.000	1549.138
PT#2	CB 10	7.59	95	15	0.012	1546.2	1546.7	1.227	6.185	0.594	1549.138	1.107	1550.245	0.119	0.594	1550.958		0.127	0.000	0.000	1550.831
CB 10	CB 11	2.25	62	12	0.012	1546.7	1548.3	0.785	2.865	0.127	1550.831	0.209	1551.039	0.025	0.127	1551.192		0.018	0.000	0.000	1551.174
CB 11	CB 12	0.84	78	12	0.012	1548.3	1549	0.785	1.070	0.018	1551.174	0.037	1551.211	0.004	0.018	1551.232		0.000	0.000	0.000	1551.232
CB 12	CB 13	0.67	30	12	0.012	1549	1549.2	0.785	0.853	0.011	1551.232	0.009	1551.241	0.002	0.011	1551.255		0.000	0.000	0.000	1551.255
CB 10	CB 15	4.15	14	15	0.012	1546.7	1547.3	1.227	3.382	0.178	1548.550	0.049	1548.599	0.036	0.178	1548.812		0.033	0.000	0.000	1548.779
CB 15	CB 16	1.15	78	12	0.013	1547.3	1547.6	0.785	1.464	0.033	1548.779	0.080	1548.859	0.007	0.033	1548.899		0.000	0.000	0.000	1548.899
CB 9	CB 20	1.69	25	12	0.012	1546	1546.5	0.785	2.152	0.072	1546.750	0.047	1546.797	0.014	0.072	1546.884		0.004	0.000	0.000	1546.880
CB 20	CB 19	1.59	41	12	0.012	1546.5	1547	0.785	2.024	0.064	1546.880	0.069	1546.949	0.013	0.064	1547.025		0.049	0.000	0.000	1546.977
CB 19	CB 18	1.39	59	12	0.012	1547	1547.5	0.785	1.770	0.049	1546.977	0.076	1547.052	0.010	0.049	1547.111		0.015	0.000	0.000	1547.095
CB 18	CB 17	0.78	33	12	0.012	1548.5	1548.7	0.785	0.993	0.015	1547.095	0.013	1547.109	0.003	0.015	1547.127		0.106	0.000	0.000	1547.021
CB 15	CB 14	2.78	17	12	0.012	1547.3	1547.6	0.785	3.540	0.195	1548.000	0.087	1548.087	0.039	0.195	1548.321		0.268	0.000	0.000	1548.053
CB 14	EX CB	2.05	125	12	0.012	1547.76	1548.79	0.785	2.610	0.106	1548.053	0.349	1548.402	0.021	0.106	1548.529		0.000	0.000	0.000	1548.529

PER PAGE 4.3.4-21 OF THE KING COUNTY SURFACE WATER DESIGN MANUAL

APPENDIX C

DRAINAGE BASIN MAPS



ARFF
SUBAREA 6
SUBAREA 7

TRAINING AREA
SUBAREA 2

CAMPUS AND ADMIN AREA
SUBAREA 1
SUBAREA 3
SUBAREA 4
SUBAREA 5

*SUBAREA 8 FLOWS OFFSITE

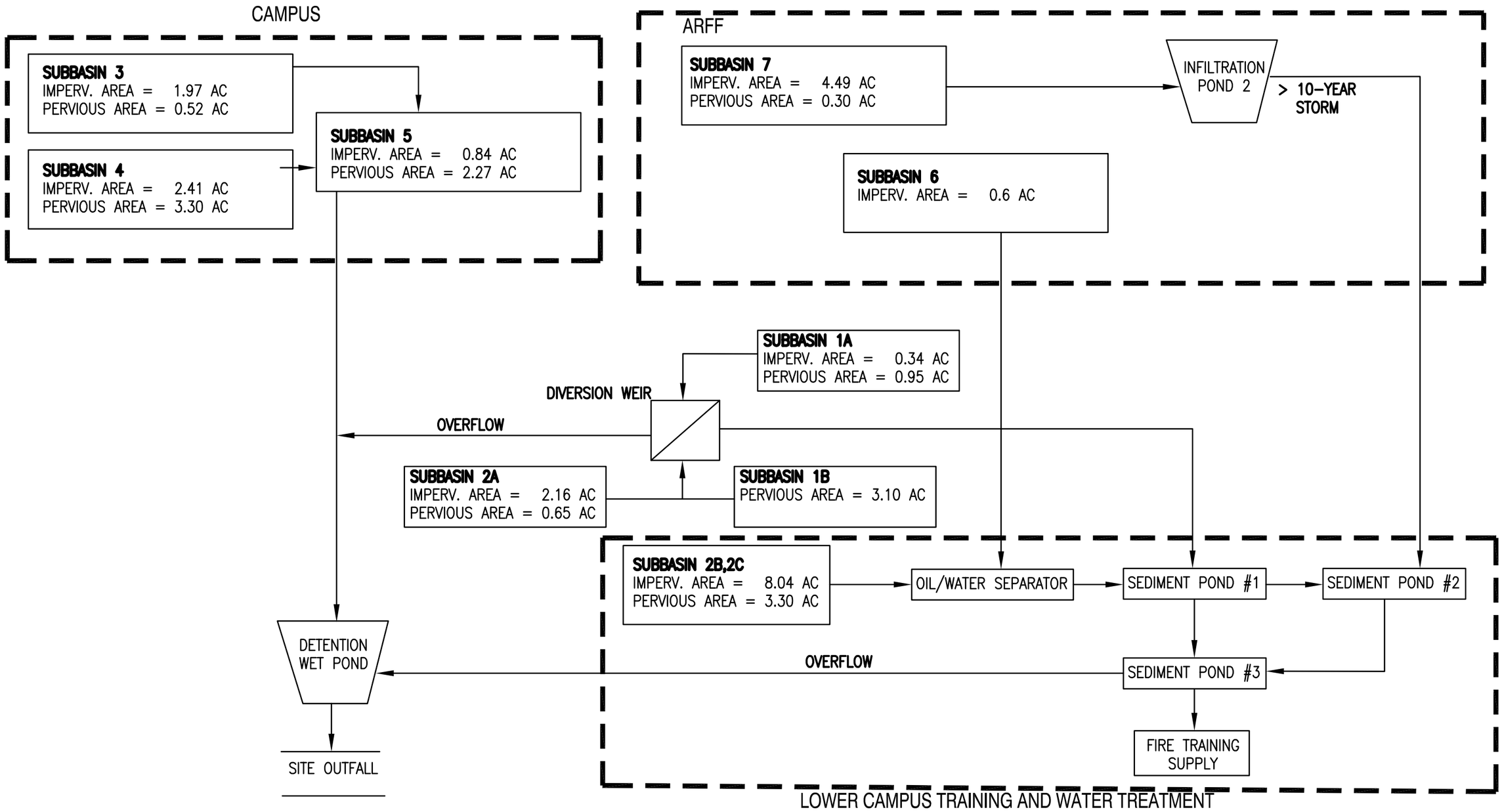
SEE FIGURE C.1 FOR CONVEYANCE SYSTEM NETWORK DIAGRAM

Reid Middleton

EXISTING FTA CAMPUS DRAINAGE BASINS MAP

WSP FTA BURN BUILDING REPLACEMENT

Figure 5



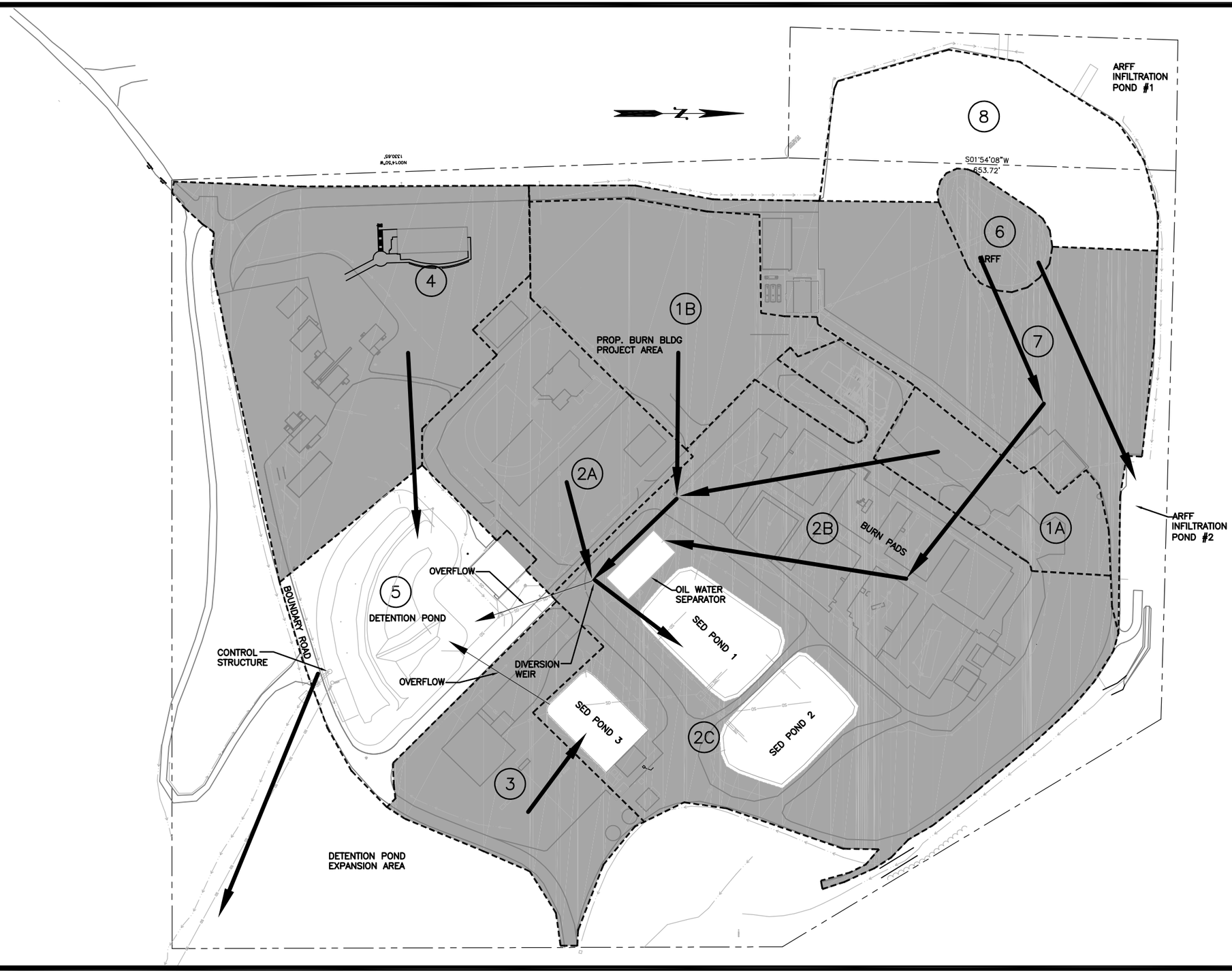
ReidMiddleton

DRAINAGE SYSTEM NETWORK DIAGRAM

WSP FTA BURN BUILDING REPLACEMENT

Figure 5A

05/11/2020 11:40am H:\21Cp\18\019 RFM; WSP New Burn Bldg @ FTA\Drafting\Design – CAD 2018\Work-MAD\Drainage System Network.DWG

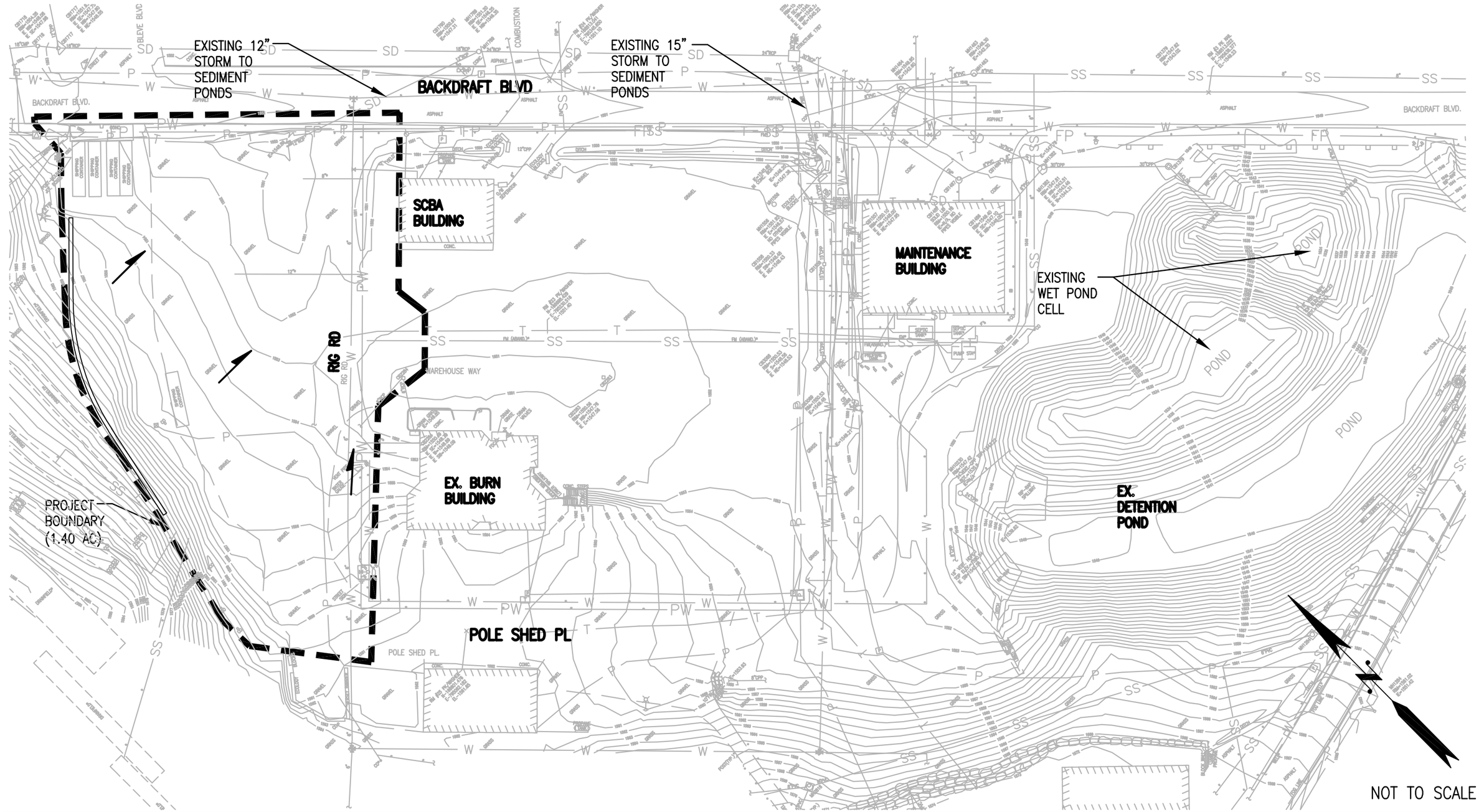


Reid Middleton

EXISTING FTA CAMPUS DRAINAGE SYSTEM NETWORK MAP

WSP FTA BURN BUILDING REPLACEMENT

Figure 5B



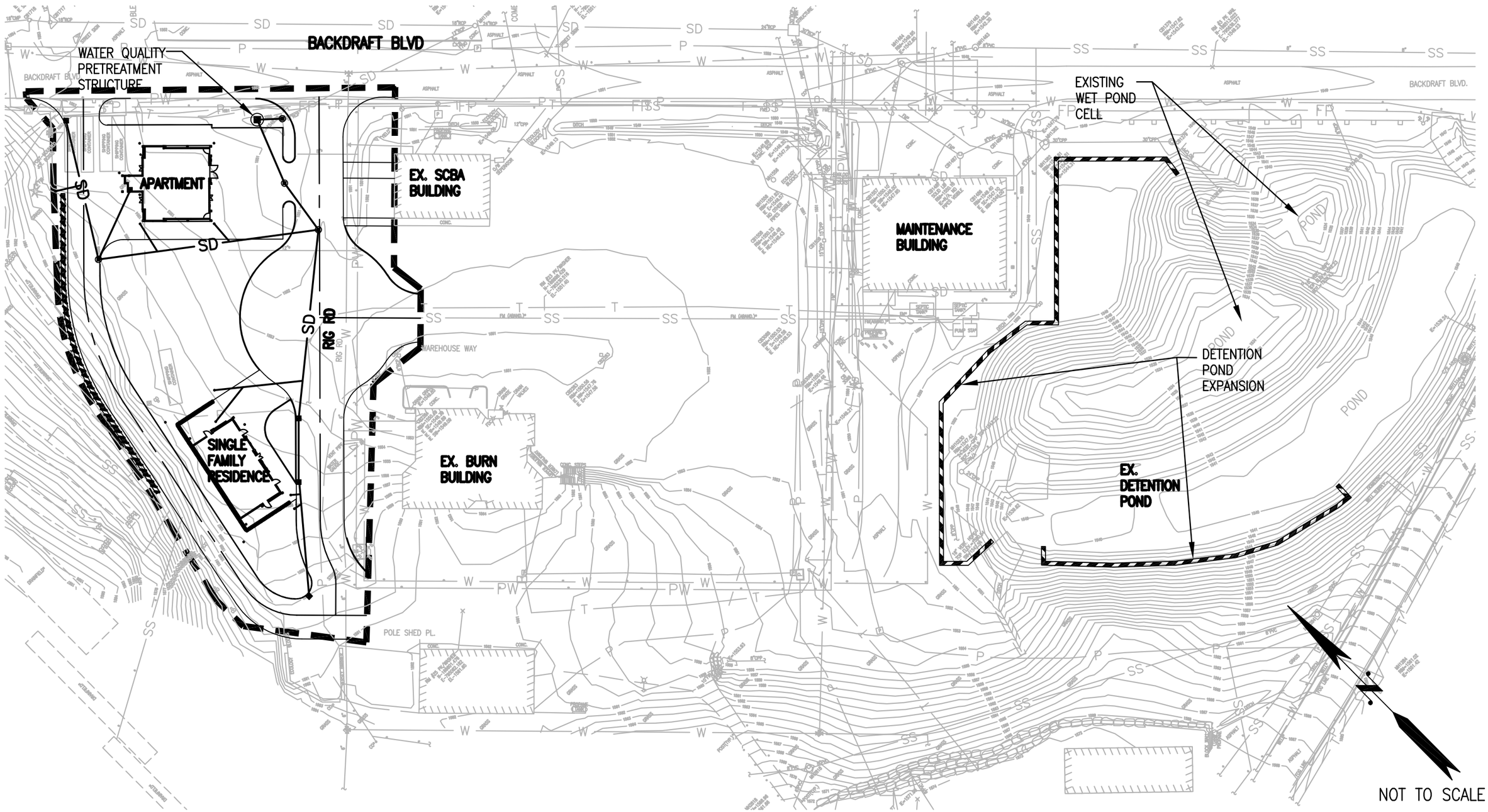
Reid Middleton

EXISTING DRAINAGE BASIN

WSP FTA BURN BUILDING REPLACEMENT

Figure 6

05/11/2020 11:36am H:\21Cp\18\019 RFM; WSP New Burn Bldg @ FTA\Drafting\Design – CAD 2018\Work-MAD\Drainage Basins.dwg



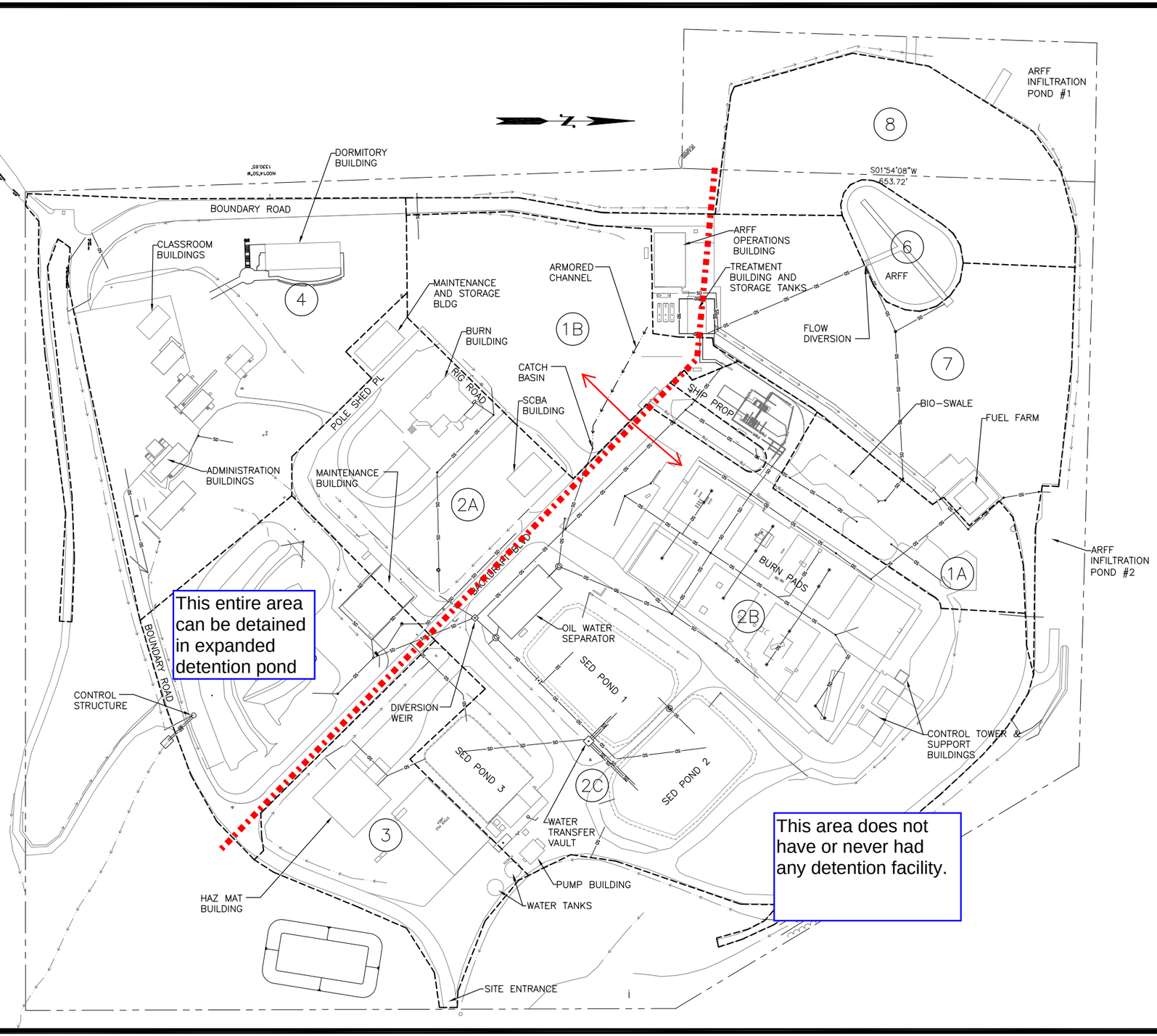
Reid Middleton

DEVELOPED DRAINAGE BASIN

WSP FTA BURN BUILDING REPLACEMENT

Figure 7

05/11/2020 11:37am H:\21Cp\18\019 RFM; WSP New Burn Bldg @ FTA\Drafting\Design – CAD 2018\Work-MAD\Drainage Basins.dwg



ARFF
SUBAREA 6
SUBAREA 7

TRAINING AREA
SUBAREA 2

CAMPUS AND ADMIN AREA
SUBAREA 1
SUBAREA 3
SUBAREA 4
SUBAREA 5

*SUBAREA 8 FLOWS OFFSITE

SEE FIGURE C.1 FOR CONVEYANCE SYSTEM NETWORK DIAGRAM

Reid Middleton

EXISTING FTA CAMPUS DRAINAGE BASINS MAP

Washington State Patrol Fire Training Academey

Figure 6

APPENDIX D

GEOTECHNICAL REPORT

GEOTECHNICAL ENGINEERING INVESTIGATION
WASHINGTON STATE PATROL
FIRE TRAINING ACADEMY
NEW BURN BUILDINGS PROJECT
50810 GROUSE RIDGE ROAD
NORTH BEND, WASHINGTON 98045

PROJECT NO. 092-14005
MAY 27, 2014

Prepared for:

WASHINGTON STATE PATROL
FACILITIES DIVISION
ENGINEERING & ARCHITECTURAL SERVICES
ATTN: MR. PHIL TIMPKE, R.A.
P.O. BOX 41476
OLYMPIA, WASHINGTON 98504-1476

Prepared by:

KRAZAN & ASSOCIATES, INC.
GEOTECHNICAL ENGINEERING DIVISION
4303 – 198TH STREET SW
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(425) 485-5519

Krazan & ASSOCIATES, INC.

GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION MATERIALS TESTING & INSPECTION

May 27, 2014 KA Project No. 092-14005

State of Washington
Facilities Division
Engineering & Architectural Services
P.O. Box 41476
Olympia, Washington 98504-1476

Attention: Mr. Phil Timpke, R.A.
E&AS Project Manager

Reference: Geotechnical Engineering Investigation
DES Project # 2014-001
Fire Training Academy – New Burn Buildings
50810 Grouse Ridge Road
North Bend, Washington 98045

Dear Mr. Timpke,

In accordance with your request, we have completed a Geotechnical Engineering Investigation for the referenced site. The results of our investigation are presented in the attached report.

If you have any questions, or if we can be of further assistance, please do not hesitate to contact our office.

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

Michael D. Rundquist

Michael D. Rundquist, P.E.
Senior Project Manager

JGL/MDR

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May 27, 2014 KA Project No. 092-14005

GEOTECHNICAL ENGINEERING INVESTIGATION
WASHINGTON STATE PATROL
FIRE TRAINING ACADEMY
NEW BURN BUILDINGS PROJECT
50810 GROUSE RIDGE ROAD
NORTH BEND, WASHINGTON 98045

INTRODUCTION

This report presents the results of our Geotechnical Engineering Investigation for the Washington State Petrol Fire Training Academy New Burn Buildings project located at 50810 Grouse Ridge Road near North Bend, Washington as shown on the Vicinity Map in Figure 1. Discussions regarding site conditions are presented in this report, together with conclusions and recommendations pertaining to site preparation, excavations, foundations, structural fill, utility trench backfill, concrete slabs and exterior flatwork, drainage, and erosion control.

A site plan showing the approximate exploratory soil boring locations is presented following the text of this report in Figure 2. A description of the field investigation as well as the exploratory soil boring logs are presented in Appendix A. Appendix B contains a guide to aid in the development of earthwork specifications. Pavement design guidelines are presented in Appendix C. The recommendations in the main text of the report have precedence over the more general specifications in the appendices.

PURPOSE AND SCOPE

This investigation was conducted to evaluate the subsurface soil and groundwater conditions at the site, to develop geotechnical engineering recommendations for use in design of specific construction elements and to provide criteria for site preparation and earthwork construction.

Our scope of services was performed in general accordance with our proposal for this project, dated March 6, 2014 (Proposal Number G14-150WAL) and included the following:

- Explore the subsurface soil and groundwater conditions at the project site by conducting thirteen (13) soil borings using a subcontracted drill rig;
- Prepare a site plan showing geotechnical boring locations, comprehensive boring logs including soil stratification and classification, and groundwater levels where applicable;
- Provide recommendations for foundation design including allowable bearing pressure, anticipated settlements (both total and differential), coefficient of horizontal friction and frost penetration depth;

- Provide recommendations for seismic design considerations including site coefficient and ground acceleration information and an analysis of liquefaction potential for the site if warranted;
- Provide soil parameters for the design of slab-on-grade floors including recommendations for placement of capillary break material and vapor barrier below the slabs;
- Provide recommendations for structural fill placement and compaction in building and pavement areas;
- Discuss construction and excavation considerations, topsoil/unsuitable soil stripping depth, identification of potentially problematic soils or groundwater conditions, and depth of over-excavation if required;
- Provide recommendations for lateral earth pressures (active and passive);
- Provide design criteria for temporary excavations;
- Provide recommendations for pavement design;
- Provide recommendations for site drainage and erosion control.

PROPOSED CONSTRUCTION

It is our understanding that the project will include three new burn buildings, including a 60-foot tall concrete commercial tower, a 30-foot apartment building, and a 25-foot single family residence. Two other structures are proposed, including a rehab building and a pallet storage structure. We understand that grading for the project will include retaining walls, new pavement and expansion of the stormwater pond.

SITE LOCATION AND DESCRIPTION

The site is located at 50810 Grouse Ridge Road, east of North Bend, Washington, and is situated at the base of the Cascade Mountains. The approximate site elevation is 1,500 feet above sea level.

It is our understanding that the site had previously been developed as a sand and gravel pit. The near surface soils at the site appear to consist of modified land resulting from the reclamation and grading of the area after the mining activities were completed and prior to the construction of the Fire Training Academy.

The site currently contains office and storage buildings as well as structures which provide several scenarios for demonstration of and training in firefighting techniques. The central portion of the facility includes nearly level ground, with gentle to steep slopes surrounding the fire training center. The mountains adjacent to the east side of the site rise to elevations of over 4,000 feet.

The fire training development area in the central portion of the site is generally clear of vegetation. Heavily forested terrain surrounds the site on all sides. The site is accessed by a relatively narrow paved road near the southeastern corner of the property. Interstate 90 is located a few miles to the south of the site.

GEOLOGIC SETTING

The Geologic Map of the Snoqualmie Pass 30 x 60 Minute Quadrangle, Washington by R.W. Tabor, et al. (USGS, 2000) indicates that the site is underlain by Quaternary glacial recessional outwash (Qvr_1). Recessional outwash was deposited by meltwater streams from receding glacial ice, and typically consists of poorly to moderately sorted sand with some interbedded layers of silt and clay.

The materials encountered in the upper portions of our subsurface explorations generally were interpreted to be modified land underlain by glacial recessional outwash. Dense sand and hard clayey silt were encountered in the deeper portions of the soil borings, and these materials were interpreted to be have been compacted by the weight of glacial ice. Quaternary pre-Fraser (Qpf) deposits are mapped nearby to the west. We interpreted the dense sand and hard clayey silt to be compact pre-Fraser deposits.

FIELD INVESTIGATION

Thirteen (13) exploratory soil borings were completed to evaluate the subsurface soil and groundwater conditions at the project location. The soil borings were conducted from April 28, 2014 to April 30, 2014 by a Krazan subcontractor utilizing a truck-mounted drill rig. The soil borings were advanced to depths ranging from 19.0 to 41.5 feet below the existing ground surface. A field engineer from Krazan and Associates was present during the explorations, examined the subsurface soils conditions encountered, obtained samples of the subsurface soils, and maintained logs of the explorations.

Representative samples of the soils encountered in the geotechnical explorations were collected and sealed in plastic bags. These samples were transported to our laboratory for further examination and testing. The materials encountered in the geotechnical explorations were continuously examined and visually classified in general accordance with the Unified Soil Classification System (USCS). A more detailed description of the field investigation is presented in Appendix A.

SOIL PROFILE AND SUBSURFACE CONDITIONS

The information provided below includes a brief summary of the materials encountered in the soil explorations. Detailed logs of the borings are presented in Appendix A.

Boring B-1 was located southwest of the existing burn building in the central portion of the project area near the planned commercial tower burn building. The soil boring encountered approximately 0.5 feet

of topsoil. Underlying the topsoil, Boring B-1 encountered loose to medium dense silty sand with gravel and traces of wood debris to a depth of about 12.0 feet below the ground surface. We interpreted this material to be undocumented fill. Below the undocumented fill, the soil boring encountered layers of sand, silty sand and clayey silt to the depth explored at approximately 41.5 feet below grade. We interpreted the sand, silty sand and clayey silt to be native soils.

Boring B-2 was located south of the existing burn building in the central portion of the project area near the planned commercial tower burn building. The soil boring encountered approximately 0.5 feet of topsoil. Underlying the topsoil, Boring B-2 encountered loose to medium dense silty sand with gravel and traces of wood debris to a depth of about 7.0 feet below the ground surface. We interpreted this material to be undocumented fill. Below the undocumented fill, the soil boring encountered sand, silty sand and clayey silt to the depth explored at approximately 39.0 feet below grade. We interpreted the sand, silty sand and clayey silt to be native soils.

Boring B-3 was located near the northwest side of the western cell of the stormwater pond. Boring B-3 encountered loose sand with variable amounts of silt and gravel to a depth of about 4.5 feet below the ground surface. We interpreted this material to be loose fill. Below the loose fill, the soil boring encountered medium dense sand with variable amounts of silt and gravel to the depth explored at approximately 19.0 feet below grade. We interpreted the medium dense sand to be native recessional outwash.

Boring B-4 was located north of the existing maintenance building in the area of the proposed pallet storage building. Boring B-4 encountered medium dense to dense sand with gravel to a depth of about 9.5 feet below the ground surface. We interpreted this material to be compact fill. Below the compact fill, the soil boring encountered loose sand to a depth of approximately 12.0 feet below grade. We interpreted this material to be loose fill. Underlying the loose fill, the soil boring encountered medium dense sand with trace gravel to a depth of about 17.0 feet below the ground surface. We interpreted this material to be native recessional outwash. Below the recessional outwash, the soil boring encountered dense sand with silt to the depth explored at approximately 19.0 feet below the ground surface. We interpreted the dense sand to be native, glacially compacted soil.

Boring B-5 was located in a storage yard on the north side of the maintenance building near the proposed pallet storage building. Boring B-5 encountered loose sand to a depth of about 2.0 feet below the ground surface. We interpreted the sand to be loose fill. Below the loose fill, the soil boring encountered medium dense sand with variable amounts of silt and gravel to a depth of about 9.5 feet below grade. We interpreted this material to be compact fill. Below the compact fill, the soil boring encountered loose sand to a depth of approximately 12.0 feet below grade. We interpreted this soil to be loose fill. Underlying the loose fill, the soil boring encountered medium dense sand with trace gravel to a depth of about 16.0 feet below the ground surface. We interpreted the medium dense sand to be native recessional outwash. Below the recessional outwash, the soil boring encountered dense silty sand

to the depth explored at approximately 19.0 feet below the ground surface. We interpreted the dense silty sand to be native, glacially compacted soil.

Boring B-6 was located in a storage yard north of the maintenance building near the proposed rehab and classroom building. Soil boring B-6 encountered medium dense to dense sand with gravel to a depth of about 4.5 feet below grade. We interpreted this soil to be compact fill. Underlying the compact fill, the soil boring encountered medium dense sand with variable amounts of silt and gravel to the depth explored at approximately 16.5 feet below the ground surface. We interpreted the medium dense sand to be native glacial recessional outwash.

Boring B-7 was located in a gravel parking lot to the east of the existing burn building. Boring B-7 encountered medium dense to dense sand with gravel to a depth of about 9.5 feet below the ground surface. We interpreted this soil to be compact fill. Below the compact fill, the soil boring encountered loose sand with variable amounts of gravel and trace organics to a depth of approximately 16.0 feet below grade. We interpreted this material to be loose fill. Underlying the loose fill, the soil boring encountered medium dense sand and very stiff silt to the depth explored at approximately 19.0 feet below the ground surface. We interpreted the medium dense sand and very stiff silt to be native recessional outwash.

Boring B-8 was located near the proposed apartment building fire training structure in the northern portion of the project area. Boring B-8 encountered medium dense sand and stiff clayey silt to a depth of about 12.0 feet below grade. We interpreted this soil to be compact fill. Below the compact fill, the soil boring encountered loose sand to a depth of approximately 15.0 feet below grade. We interpreted this soil to be loose fill. Underlying the loose fill, the soil boring encountered medium dense sand with trace silt to a depth of about 30.0 feet below the ground surface. We interpreted the medium dense sand to be native recessional outwash. Below the recessional outwash sand, the soil boring encountered very dense sand with trace silt to the depth explored at approximately 38.8 feet below the ground surface. We interpreted the very dense sand to be native, glacially compacted soil.

Boring B-9 was located near the proposed apartment building fire training structure in the northern portion of the project area. Boring B-9 encountered loose sand to a depth of about 7.0 feet below the ground surface. We interpreted this soil to be loose fill. Below the loose fill, the soil boring encountered medium dense sand to a depth of about 11.0 feet below grade. We interpreted this soil to be compact fill. Below the compact fill, the soil boring encountered loose sand to a depth of approximately 17.0 feet below grade. We interpreted this soil to be loose fill. Underlying the loose fill, the soil boring encountered medium dense sand with variable amounts of silt to a depth of about 31.0 feet below the ground surface. We interpreted the medium dense sand to be native recessional outwash. Below the recessional outwash, the soil boring encountered dense sand to the depth explored at approximately 34.0 feet below the ground surface. We interpreted the dense sand to be native, glacially compacted soil.

Boring B-10 was located near the proposed single family residence fire training structure in the northern portion of the project area. Boring B-10 encountered loose sand to a depth of about 4.5 feet below the ground surface. We interpreted this soil to be loose fill. Underlying the loose fill, the soil boring encountered medium dense sand with variable amounts of silt and gravel to a depth of about 22.8 feet below the ground surface. We interpreted the medium dense sand to be native recessional outwash. Below the recessional outwash, the soil boring encountered dense to very dense sand and hard silt to the depth explored at approximately 31.5 feet below the ground surface. We interpreted the dense to very dense sand and hard silt to be native, glacially compacted soil.

Boring B-11 was located near the proposed single family residence fire training structure in the northern portion of the project area. Boring B-11 encountered loose sand to a depth of about 2.0 feet below the ground surface. We interpreted this soil to be loose fill. Underlying the loose fill, the soil boring encountered medium dense sand with variable amounts of silt to a depth of about 17.0 feet below the ground surface. We interpreted the medium dense sand to be native recessional outwash. Below the recessional outwash, the soil boring encountered dense sand and hard silt to the depth explored at approximately 31.5 feet below the ground surface. We interpreted the dense sand and hard silt to be native, glacially compacted soil.

Boring B-12 was located near the top of a short hillside in the northern portion of the site in a proposed roadway alignment. Soil boring B-12 encountered loose sand and stiff silt to a depth of about 7.0 feet below the ground surface. We interpreted this soil to be loose fill. Below the loose fill, the soil boring encountered marginally medium dense sand to a depth of about 9.5 feet below the ground surface. We interpreted this soil to be fill. Below the fill, the soil boring encountered loose silty sand to a depth of about 12.0 feet below the ground surface. We interpreted this soil to be loose fill. Below the loose fill, the soil boring encountered medium dense sand and stiff silt to the depth explored at approximately 19.0 feet below grade. We interpreted the medium dense sand and stiff silt to be recessional outwash.

Boring B-13 was located south of the existing maintenance building near a stormwater pond. Exploratory boring B-13 encountered medium dense sand and silty sand to a depth of about 9.5 feet below grade. We interpreted this material to be compact fill. Below the compact fill, the soil boring encountered marginally medium dense sand to a depth of approximately 13.0 feet below grade. We interpreted this soil to be fill. Underlying the fill, the soil boring encountered dense sand, dense silty sand, and hard clayey silt to the depth explored at about 19.0 feet below the ground surface. We interpreted the dense sand, dense silty sand and hard clayey silt to be native, glacially compacted soil.

GROUNDWATER

The exploratory soil borings were checked for the presence of groundwater during the drilling operation. Perched water was interpreted to underlie the site at variable depths. Perched groundwater occurs when surface water infiltrates through less dense, more permeable soils and accumulates on top

of a relatively low permeability soil layer. Perched water does not represent a regional groundwater "table" within the upper soil horizons. Perched water tends to vary spatially and is dependent upon the amount of rainfall. We would expect the amount of perched water to decrease during drier times of the year and increase during wetter periods.

It should be recognized that water table elevations may fluctuate with time. The groundwater level will also be dependent upon seasonal precipitation, irrigation, land use, and climatic conditions, as well as other factors. Therefore, water levels at the time of the field investigation may be different from those encountered during the construction phase of the project. The evaluation of such factors is beyond the scope of this report.

GEOLOGIC HAZARDS

Erosion Concern/Hazard

The Natural Resources Conservation Services (NRCS) map for King County Area, Washington, classifies the site area as Pits (i.e. sand and gravel pits). The NRCS indicates that these site soils are not rated. The soil type that surrounds most of the site area is identified as the Klaus sandy loam, windswept, 0 to 8 percent slopes. NRCS indicates that these soils have a slight potential for erosion in a disturbed state.

It has been our experience that soil erosion potential can be minimized through landscaping and surface water runoff control. Typically, erosion of exposed soils will be most noticeable during periods of rainfall and may be controlled by the use of normal temporary erosion control measures, i.e., silt fences, hay bales, mulching, control ditches or diversion trenching, and contour furrowing. Erosion control measures should be in place before the onset of wet weather.

Seismic Hazard

In our opinion, the overall soil profile corresponds to Site Class D as defined by Table 1613.3.2 of the 2012 International Building Code (IBC). Site Class D applies to a stiff soil profile.

We referred to the U.S. Geological Survey (USGS) Earthquake Hazards Program Website and 2012 IBC to obtain values for S_S, S_{MS}, S_{DS}, S_1, S_{M1}, S_{D1}, F_a, and F_v. The USGS website includes the most updated published data on seismic conditions. The seismic design parameters for this site are tabulated below:

Seismic Item	Value	IBC Reference
Site Coefficient F_a	1.083	Table 1613.3.3 (1)
S_s	1.043	Figure 1613.3.1 (1)
S_{MS}	1.129	Table 1613.3.3
S_{DS}	0.753	Table 1613.3.4
Site Coefficient F_v	1.618	Table 1613.3.3 (2)
S_1	0.391	Figure 1613.3.1 (2)
S_{M1}	0.633	Section 1613.3.3
S_{D1}	0.422	Section 1613.3.4

Additional seismic considerations include liquefaction potential and amplification of ground motions by loose/soft soil deposits. Liquefaction usually occurs under vibratory conditions such as those induced by seismic events. The liquefaction potential is highest for loose sand with a high groundwater table. The medium dense to very dense native granular soils and the very stiff to hard cohesive soils interpreted to underlie this site should have a low potential for liquefaction.

CONCLUSIONS AND RECOMMENDATIONS

General

It is our opinion from a geotechnical standpoint that the site is compatible with the planned development, provided that the geotechnical recommendations presented in this report are included in the project design and implemented during construction.

Based on our explorations, the near surface soils at the site are interpreted as modified land consisting of loose fill and compact fill soils extending to depths of approximately 2 to 17 feet below the current ground surface. The modified ground fill material is anticipated to be quite variable with respect to soil types and relative densities of the materials. Our explorations did not encounter significant amounts of debris, compressible soil, organic soil, or other deleterious materials; however, such deleterious materials may be present in unexplored areas of the site.

Underlying the modified ground, the explorations encountered medium dense to very dense native granular soils and medium stiff to hard silt and clay soils.

In our opinion, if some risk of settlement and differential settlement is acceptable, structures may be founded on a layer of structural fill supported on the modified ground materials. Due to the potential variability of the modified ground, it is difficult to quantify the amount of potential settlement for

structures supported on a subgrade of modified ground. However, the potential for differential settlement can be reduced by improving a portion of the foundation subgrade soil to structural fill specifications.

If some risk of settlement is not acceptable, the building foundations should be supported on the medium dense/very stiff or firmer native soils or on structural fill extending to the medium dense/very stiff or firmer native soils. Alternatively, deep foundation systems could be used to transfer the foundation loads through the modified ground to the competent native soils underlying the site.

Some of the near-surface soils encountered on this site are considered moisture-sensitive and will be easily disturbed and difficult to compact when wet. We recommend that construction take place during the drier summer months, if possible. If construction is to take place during wet weather, additional expenses and delays should be expected due to the wet conditions. Additional expenses could include the need for placing a blanket of rock spalls to protect exposed subgrades and construction traffic areas.

In our opinion, the granular on-site soils may be appropriate for use as structural fill material provided the soils are near the optimal moisture content for compaction at the time of construction. Krazan should be consulted at the time of construction regarding the use of the on-site soils. The on-site organic soils and cohesive soils are not considered suitable as structural fill material.

Site Preparation

General site clearing should include removal of any organics, abandoned utilities, structures including foundations, basement walls and floors, rubble, and rubbish. Site stripping should extend until all organics in excess of 3 percent by volume are removed. These materials will not be suitable for use as structural fill. However, stripped topsoil may be stockpiled and reused in landscape or non-structural areas.

After stripping operations and removal of any loose and/or debris-laden fill, the building pad areas should be visually inspected to identify any loose areas. Any remaining loose soils should be excavated to the level of the medium dense or firmer soils. The resulting excavations should be filled with approved on site material, or imported structural fill. Structural fill material should be within ± 2 percent of the optimum moisture content, and the soils should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM Test Method D1557.

During wet weather conditions, subgrade stability problems and grading difficulties may develop due to excess moisture, disturbance of sensitive soils and/or the presence of perched groundwater. Construction during the extended periods of wet weather could result in the need to remove wet disturbed soils if they cannot be suitably compacted due to elevated moisture contents. Some of the near surface soils have significant silt content in the explored areas and are moisture sensitive, and can be easily disturbed when wet. If over-excavation is necessary, it should be confirmed through

continuous monitoring and testing by a qualified geotechnical engineer or geologist. Soils that have become unstable may require drying and recompaction. Selective drying may be accomplished by scarifying or windrowing surficial material during extended periods of dry, warm weather (typically during the summer months). If the soils cannot be dried back to a workable moisture condition, remedial measures may be required. General project site winterization should consist of the placement of aggregate base and the protection of exposed soils during the construction phase. It should be understood that even if Best Management Practices (BMP's) for wintertime soil protection are implemented and followed there is a significant chance that moisture disturbed soil mitigation work will still be required.

Any buried structures encountered during construction should be properly removed and backfilled. Excavations, depressions, or soft and pliant areas extending below the planned finish subgrade levels should be excavated to expose firm undisturbed soil, and backfilled with structural fill. In general, any septic tanks, underground storage tanks, debris pits, cesspools, or similar structures should be completely removed. Concrete footings should be removed to an equivalent depth of at least 3 feet below proposed footing elevations or as recommended by the geotechnical engineer. The resulting excavations should be backfilled with structural fill.

A representative of our firm should be present during all site clearing and grading operations to test and observe earthwork construction. This testing and observation is an integral part of our service, as acceptance of earthwork construction is dependent upon compaction and stability of the material. The geotechnical engineer may reject any material that does not meet compaction and stability requirements. Further recommendations, contained in this report, are predicated upon the assumption that earthwork construction will conform to the recommendations set forth in this section and in the Structural Fill Section.

Temporary Excavations

The on-site soils have variable cohesion strengths, therefore the safe angles to which these materials may be cut for temporary excavations is limited, as the soils may be prone to caving and slope failures in temporary excavations deeper than 4 feet. Temporary excavations in the medium dense undocumented fill and the native soils should be sloped no steeper than 1 H:1V (horizontal to vertical) where room permits.

All temporary cuts should be in accordance with Washington Administrative Code (WAC) Part N, Excavation, Trenching, and Shoring. The temporary slope cuts should be visually inspected daily by a qualified person during construction work activities and the results of the inspections should be included in daily reports. The contractor is responsible for maintaining the stability of the temporary cut slopes and minimizing slope erosion during construction. The temporary cut slopes should be covered with plastic sheeting to help minimize erosion during wet weather and the slopes should be

closely monitored until the permanent retaining systems are complete. Materials should not be stored and equipment operated within 10 feet of the top of any temporary cut slope.

A Krazan & Associates geologist or geotechnical engineer should observe, at least periodically, the temporary cut slopes during the excavation work. The reasoning for this is that all soil conditions may not be fully delineated during the previous geotechnical exploratory work. In the case of temporary slope cuts, the existing soil conditions may not be fully revealed until the excavation work exposes the soil. Typically, as excavation work progresses the maximum inclination of the temporary slope will need to be reevaluated by the geotechnical engineer so that supplemental recommendations can be made. Soil and groundwater conditions can be highly variable. Scheduling for soil work will need to be adjustable, to deal with unanticipated conditions, so that the project can proceed smoothly and required deadlines can be met. If any variations or undesirable conditions are encountered during construction, Krazan & Associates should be notified so that supplemental recommendations can be made.

Structural Fill

Fill placed beneath foundations, pavement, or other settlement-sensitive structures should be placed as structural fill. Structural fill, by definition, is placed in accordance with prescribed methods and standards, and is monitored by an experienced geotechnical professional or soils technician. Field monitoring procedures would include the performance of a representative number of in-place density tests to document the attainment of the desired degree of relative compaction. The area to receive the fill should be suitably prepared as described in the **Site Preparation** subsection of this report prior to beginning fill placement.

Best Management Practices (BMP's) should be followed when considering the suitability of the existing materials for use as structural fill. The native soils are generally considered suitable for reuse as structural fill, provided the soil is relatively free of organic material and debris, and it is within ± 2 percent of the optimum moisture content.

If the native soils are stockpiled for later use as structural fill, the stockpiles should be covered to protect the soil from wet weather conditions. We recommend that a representative of Krazan & Associates be on site during the excavation work to determine which soils are suitable for structural fill.

It should not be taken for granted that the on-site soils may be used as the sole source for structural fill (especially during winter construction activities). During wet weather conditions, the soils with higher silt contents will be moisture sensitive, easily disturbed, and may be difficult or impossible to compact to structural fill requirements. Furthermore, during the winter, soils typically have elevated natural moisture contents, which will limit the use of these materials as structural fill without proper mitigation measures. The contractor should use Best Management Practices to protect the soils during construction activities and be familiar with wet weather and

wintertime soil work. An allowance for importing structural fill should be incorporated into the construction cost of the project (for wintertime construction this may be as high as 100 percent import).

Imported structural fill material should consist of well-graded gravel or a sand and gravel mixture with a maximum grain size of 3 inches and less than 5 percent fines (material passing the U.S. Standard No. 200 Sieve). All structural fill material should be submitted for approval to the geotechnical engineer at least 48 hours prior to delivery to the site.

Fill soils should be placed in horizontal lifts not exceeding 8 inches loose thickness, moisture-conditioned as necessary, (moisture content of soil shall not vary by more than ±2 percent of optimum moisture) and the material should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. In place density tests should be performed on all structural fill to document proper moisture content and adequate compaction. Additional lifts should not be placed if the previous lift did not meet the compaction requirements or if soil conditions are not considered stable.

Foundations

Based on our explorations, the near surface soils at the site are interpreted as modified land consisting of loose fill and compact fill soils extending to depths of approximately 2 to 17 feet below the current ground surface. The modified ground fill material could be highly variable with respect to the soil materials and the relative densities of the soils. Underlying the modified ground, the explorations encountered medium dense to very dense native granular soils and medium stiff to hard silt and clay soils. We are providing some alternatives for foundation design due to the presence of modified ground conditions and the potential for structure settlement. If some risk of settlement is not acceptable, the building foundations should be supported on the medium dense/very stiff or firmer native soils or on structural fill extending to the medium dense/very stiff or firmer native soils. Alternatively, deep foundation systems could be used to transfer the foundation loads through the modified ground to the competent native soils underlying the site.

"Floating" Foundations: In our opinion, if some risk of settlement/differential settlement is acceptable, it may be feasible to float the structures on the modified ground soils. Due to the potential variability of the modified ground, it is difficult to quantify the amount of potential settlement for structures supported on the modified ground. However, the potential for settlement and differential settlement can be reduced with ground improvement techniques such as placing a layer of structural fill in planned foundation areas.

If some risk of settlement/differential settlement is acceptable, we recommend removing at least four feet of the modified ground (undocumented fill) in the planned foundation areas and replacing it with structural fill. The excavation in the modified ground would need to be widened to extend at least two

feet horizontally beyond both the interior and exterior edges of the footings. The exposed subgrade soil in the trench should be compacted for a firm and unyielding condition. Any areas of wet loose/soft soils should be removed and replaced with structural fill. Depending on the subgrade soils exposed in the trench it may be necessary to place a geotextile over the base of the excavation such as Mirafi 500X or equivalent. The need for geotextile will need to be determined at the time of construction. A representative of the geotechnical engineer should evaluate the excavations and subgrade preparation prior to placement of structural fill.

Foundations should have a minimum embedment depth of 18 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is lower. Footing widths should be based on the anticipated loads and allowable soil bearing pressure. Water should not be allowed to accumulate in footing trenches. Footings should have a minimum width of 12 inches regardless of load. All loose or disturbed soil should be removed from the foundation excavation prior to placing concrete.

If some risk of settlement is acceptable, **for "floating" foundations** prepared as outlined above, we recommend an allowable design bearing pressure of **2,000 pounds per square foot (psf)** be used for the foundation design. A representative of Krazan and Associates should evaluate the foundation bearing soil and structural fill placement.

Conventional Spread Foundations: The proposed new buildings may be supported on a conventional spread foundation system bearing on the medium dense of firmer native soils, or on structural fill extending to the medium dense or firmer native soils. These bearing soils were encountered at approximately 2 feet to 17 feet below the existing site grades. Deeper areas of loose soils could be encountered in the unexplored areas of the site. Footings should extend through any organic soil, loose soil, or undocumented fill/modified ground and be founded on the underlying medium dense or firmer native soil or on structural fill extending to the competent native soils.

Conventional shallow spread foundations should be placed on the undisturbed medium dense or firmer native soils or be supported on structural fill, such as compacted soil, rock spalls or Controlled Density Fill (CDF), extending to the medium dense or firmer native soils. CDF is a lean concrete mixture and typically achieves strengths in the range of 100 to 200 pounds per square inch (psi). Where loose soils or undocumented fill/modified ground are encountered at the planned footing elevations, the subgrade should be excavated to expose native medium dense or firmer bearing soil prior to placing structural fill.

If footings are supported on structural fill such as compacted soil or rock spalls, the fill zone should extend horizontally beyond the interior and exterior edges of the footing a distance equal to one-half of the depth of the excavation below the bottom of the footing. If the excavations are backfilled with CDF, the excavations need only be slightly wider than the footing width (6 inches wider on each side). To reduce the volume of extra excavation needed for the footing trenches and to simplify structural fill

placement, it may be practical to place CDF to fill the deeper footing trenches to the planned footing subgrade elevations.

Foundations should have a minimum depth of 18 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is lower. Footing widths should be based on the anticipated loads and allowable soil bearing pressure. Water should not be allowed to accumulate in footing trenches. Footings should have a minimum width of 12 inches regardless of load. All loose or disturbed soil should be removed from the foundation excavation prior to placing concrete.

For conventional spread foundations resting on competent native soil or on structural fill extending to competent native soil, as outlined above, we recommend an allowable design bearing pressure of **3,500 pounds per square foot (psf)** be used. A representative of Krazan and Associates should evaluate the foundation bearing soil. We should be consulted if higher bearing pressures are needed.

A 1/3 increase in the above values may be used for short duration wind and seismic loads. Structural fill should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. Footing excavations should be inspected to verify that the foundations will bear on suitable material.

For foundations constructed as recommended, the total settlement is not expected to exceed 1 inch. Differential settlement, along a 20-foot exterior wall footing, or between adjoining column footings should be less than ½ inch. Most settlement is expected to occur during construction, as the loads are applied. However, additional post-construction settlement may occur if the foundation soils are flooded or saturated. It should be noted that the risk of liquefaction is considered low, given the composition and density of the native, on site soils.

Seasonal rainfall, water run-off, and the normal practice of watering trees and landscaping areas around the proposed structures, should not be permitted to flood and/or saturate footings. To limit the buildup of water within the footing areas, continuous footing drains (with cleanouts) should be provided at the bases of the footings. The footing drains should consist of a minimum 4-inch diameter perforated pipe, sloped to drain, with perforations placed down and enveloped by one-inch sized washed rock in all directions and filter fabric to limit the migration of silt into the drains.

Resistance to lateral footing displacement can be computed using an allowable friction factor of 0.35 acting between the bases of foundations and the supporting subgrade. Lateral resistance for footings can alternatively be developed using an allowable equivalent fluid passive pressure of 200 pounds per cubic foot (pcf) acting against the appropriate vertical footing faces (neglecting the upper 12 inches). The allowable friction factor and allowable equivalent fluid passive pressure values include a factor of safety of 1.5. The frictional and passive resistance of the soil may be combined without reduction in

determining the total lateral resistance. A 1/3 increase in the above values may be used for short duration, wind and seismic loads.

Deep Foundations

Alternatively, it may be feasible to install a deep foundation system to transfer the building loads through the modified ground/undocumented fill and support the structures on the dense to very dense native glacially compacted soils underlying the site. The deep foundation system could be used to limit excavation at the site.

We present some preliminary recommendations for deep foundation systems in the following paragraphs. We are available to consult with the design team if deep foundations are considered suitable for portions of this project.

Pin Piles: Pin piles consist of sections of steel pipe that are typically driven with hydraulic hammers to penetrate loose/soft soils and transfer foundation loads to the underlying competent native soils. For this project it may be feasible to support some of the foundations on 4-inch or 6-inch diameter steel pipe piles driven to refusal in the underlying dense to very dense native soils. We recommend using schedule 40 or stronger pile sections, and a tractor-mounted hydraulic hammer.

The driving criteria for pile refusal are developed based on the pile diameter and the energy rating of the hydraulic hammer. We would also recommend that all piles penetrate a minimum of 10 feet into the dense to very dense native soils in order to develop the design axial capacity. Typical axial design capacities for 4-inch and 6-inch diameter pin piles driven to refusal would be about 10 tons and 15 tons, respectively.

A test pile program should be developed to verify the design values with field testing of the pile capacities. We recommend that the piles be loaded to at least 200 percent of the design capacity, and that we be retained to observe the pile load tests. A factor of safety of 2 could be used to reduce the ultimate capacity achieved from the pile load test to a design capacity. Actual pile load test procedure could be discussed with the contractor at the time of testing. We do not recommend using a design capacity of more than 10 tons for 4-inch pin piles, or 15 tons for 6-inch pin piles, regardless of the outcome of the pile load test.

Final pile depths should be expected to vary somewhat and will depend on the depth of the loose material, groundwater conditions, and the nature of the underlying competent soils. Based on our explorations, we would anticipate pile depths of approximately 35 to 45 feet in the vicinity of the proposed commercial tower burn building. The pin piles should penetrate a minimum of 10 feet into the native soil in order to develop the design capacity. Piles that do not meet this minimum embedment criterion should be rejected, and replacement piles should be driven after consulting with the structural engineer on new pile locations.

If debris exists in the fill material at the site, there is a possibility that this material may obstruct some piles. There should be contingencies in the budget and design for additional/relocated piles to replace piles that may be obstructed by debris in the fill.

Due to the relatively small slenderness ratio of pin piles, maintaining pin pile confinement and lateral support is essential to preventing pile buckling. Pin piles should not stick above the finished ground surface.

Vertically driven pin piles do not provide meaningful lateral capacity. However, battered piles can provide a lateral resistance component. The structural engineer should determine the degree of batter, and the number and locations of battered piles. We recommend that the battered piles be embedded a minimum of six inches into the foundation concrete and that sufficient steel reinforcement be placed around the piles to ensure a good connection to the foundation.

Auger-Cast Piles: If higher pile capacities and/or greater lateral resistance are needed, auger-cast piles may provide a more suitable alternative to pin piles for this project. Auger-cast piles are constructed with a hollow stem auger drilled to the desired depth. After reaching the minimum recommended penetration into bearing soils, a pressure head is created when grout is pumped through the hollow stem of the auger and into the boring before starting withdrawal of the auger. After the head is developed, withdrawal of the auger is timed to maintain the grout pressure head and limit intrusion of loose soil into the sides of the pile excavation or discontinuity or "necking" of the pile. The actual volume of the concrete pumped into each pile is recorded and compared with the theoretical volume of the pile. Piles with a ratio of actual to theoretical volume less than 1.1 should be re-drilled.

The piles would provide the necessary vertical support for the structure as well as part, or all, of the needed lateral resistance. The success of this method will depend, in part, on site access for the drill rig as well as obstacles encountered in the fill. Obstructed piles should be relocated and/or additional piles installed. Some discussion on relocation of piles should be made with your structural engineer prior to start of drilling. It is best to make any changes while the drill rig is on site.

For preliminary design, we recommend that these piles also penetrate a minimum of 10 feet into the medium dense to dense glacially compacted deposits to provide adequate end bearing. We can work with the design team to provide appropriate pile diameters, lengths and capacities as the project plans are developed.

Erosion and Sediment Control

Erosion and sediment control (ESC) is used to minimize the transportation of sediment to wetlands, streams, lakes, drainage systems, and adjacent properties. Erosion and sediment control measures should be taken and these measures should be in general accordance with local regulations. At a

minimum, the following basic recommendations should be incorporated into the design of the erosion and sediment control features of the site:

1) Phase the soil, foundation, utility, and other work, requiring excavation or the disturbance of the site soils, to take place during the dry season (generally May through September). However, provided precautions are taken using Best Management Practices (BMP's), grading activities can be undertaken during the wet season (generally October through April). It should be noted that this typically increases the overall project cost.

2) All site work should be completed and stabilized as quickly as possible.

3) Additional perimeter erosion and sediment control features may be required to reduce the possibility of sediment entering the surface water. This may include additional silt fences, silt fences with a higher Apparent Opening Size (AOS), construction of a berm, or other filtration systems.

4) Any runoff generated by dewatering discharge should be treated through construction of a sediment trap if there is sufficient space. If space is limited other filtration methods will need to be incorporated.

Drainage

The ground surface should slope away from building pads and pavement areas and toward appropriate drop inlets or other surface drainage devices. It is recommended that adjacent exterior grades be sloped a minimum of 2 percent for a minimum distance of 5 feet away from structures. Roof drains should be tightlined away from foundations. Roof drains should not be connected to the footing drains.

Subgrade soils in pavement areas should be sloped a minimum of 1 percent and drainage gradients should be maintained to carry all surface water to collection facilities and off site. These grades should be maintained for the life of the project.

Subsurface Utility Installations

We recommend that utility trench backfill be placed in general accordance with typical recommendations for structural fill placement. A firm and unyielding subgrade should allow for the proper placement of subsurface utilities. This could include the placement of geotextile and quarry rock in the bottom of utility trenches prior to placement of pipe bedding, utilities and trench backfill.

Utility trenches should be excavated according to accepted engineering practices following OSHA (Occupational Safety and Health Administration) standards, by a contractor experienced in such work.

The responsibility for the safety of open trenches should be borne by the contractor. Traffic and vibration adjacent to trench walls should be minimized; cyclic wetting and drying of excavation side slopes should be avoided. Depending upon the location and depth of some utility trenches, groundwater flow into open excavations could be experienced, especially during or shortly following periods of precipitation.

All utility trench backfill for this project should consist of imported structural fill. We recommend that all fill materials used on this site consist of clean rock materials that will not require vibratory compaction. Due to the presence of soft/loose moisture sensitive and liquefiable soils there is potential for adverse impacts to this property and neighboring properties if large compaction equipment is used. Control Density Fill (CDF), also called "flowable fill," is a lean concrete mixture and typically achieves strengths in the range of 100 to 200 pounds per square inch (psi) which might also be appropriate for some uses on this project. We should be retained to evaluate proposed structural fill materials prior to construction to provide recommendations regarding how to place and evaluate fill performance. Pipe bedding should be in accordance with the pipe manufacturer's recommendations.

Lateral Earth Pressures

We have developed criteria for the design of retaining or below grade walls. Our design parameters are based on retention of fill soils. The parameters are also based on a level ground conditions at the toe of the wall and behind the top of the wall. Walls may be designed as "restrained" retaining walls based on "at-rest" earth pressures, plus any surcharge on top of the walls as described below, if the walls are attached to the buildings and/or movement is not acceptable. Unrestrained walls may be designed based on "active" earth pressure, if the walls are not part of the buildings and some movement of the retaining walls is acceptable. Acceptable lateral movement equal to at least 0.2 percent of the wall height would warrant the use of "active" earth pressure values for design.

The following table, titled **Wall Design Criteria**, presents the recommended soil related design parameters for retaining walls with level backfill/backslope. Contact Krazan & Associates, Inc. if an alternate retaining wall geometry is used.

Wall Design Criteria	
"At-rest" Conditions (Lateral Earth Pressure - LEP)	55 pcf (EFD – Equivalent Fluid Density)
"Active" Conditions (Lateral Earth Pressure - EFD)	35 pcf (EFD – Equivalent Fluid Density)
Seismic Increase for "At-rest" Conditions (LEP)	12H* (Uniform Distribution)
Seismic Increase for "Active" Conditions (LEP)	6H* (Uniform Distribution)
Passive Earth Pressure on Toe (Low) Side of Wall (Allowable, includes F.S. = 1.5)	Neglect upper 2 feet, 200 pcf EFD in structural fill, 300 pcf EFD in dense native soils.
Soil-Footing Coefficient of Sliding Friction (Allowable; includes F.S. = 1.5)	0.35

*H is the height of the wall; Increase based on one in 2,500 year seismic event (2 percent probability of being exceeded in 50 years)

The stated lateral earth pressures do not include the effects of hydrostatic pressure (from water accumulation) or loads imposed by construction equipment, roadways, slopes, or foundations (surcharge loads). Uniform horizontal lateral active and at-rest pressures on the retaining wall from vertical surcharges behind the wall may be calculated using active and at-rest lateral earth pressure coefficients of 0.3 and 0.5, respectively. The soil unit weight of 125 pcf may be used to calculate vertical earth surcharges.

To minimize the lateral earth pressure and prevent the buildup of water pressure against the walls, continuous footing drains (with cleanouts) should be provided at the bases of the walls. The footing drains should consist of a minimum 4-inch diameter perforated pipe, sloped to drain, with perforations placed down and enveloped by 6 inches of washed gravel drain rock in all directions and wrapped with filter fabric to limit the migration of silt into the drain. The backfill adjacent to and extending a lateral distance, behind the walls, of at least 2 feet should consist of free-draining granular material. All free draining backfill should contain less than 5 percent fines (passing the U.S. Standard No. 200 Sieve) based upon the fraction passing the U.S. Standard No. 4 Sieve with at least 30 percent of the material being retained on the U.S. Standard No. 4 Sieve. It should be realized that the primary purpose of the free-draining material is the reduction of hydrostatic pressure. Some potential for the moisture to contact the back face of the wall may exist, even with treatment, which may require that more extensive waterproofing be specified for walls, which require interior moisture sensitive finishes.

We recommend that the wall backfill be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. In place density tests should be performed to verify adequate compaction. Soil compactors place transient surcharges on the wall and backfill. Consequently, only

light hand operated compaction equipment is recommended for use within 3 feet of walls so that excessive stress is not imposed on the walls.

Pavement Design

Most of the near surface soils generally consist of loose to medium dense silty sand with gravel, which we interpreted to be undocumented fill. In areas where undocumented fill was encountered, we recommend a minimum of 24 inches of the existing subgrade material be moisture conditioned (as necessary) and re-compacted to prepare for the construction of pavement sections. The subgrade should be compacted to at least 95 percent of the maximum dry density as determined by ASTM Test Method D1557. In place density tests should be performed to verify proper moisture content and adequate compaction. The resulting surface should be proof-rolled under a loaded dump truck. Areas observed to pump or weave during the proof-roll test should be over-excavated and replaced with structural fill or rock spalls to prepare a stable subgrade.

However, if the subgrade soil consists of firm and unyielding native glacial soils a proof roll of the pavement subgrade soil may be performed in lieu of compacting the subgrade and compaction tests.

We estimate that the subgrade will have a California Bearing Ratio (CBR) value of 10 and a modulus of subgrade reaction value of k = 200 pounds per cubic inch, provided the subgrade is prepared in general accordance with our recommendations. The recommended flexible and rigid pavement sections are based on design assumptions that these values of CBR and modulus of subgrade reaction (k) values will be achieved with proper subgrade preparation. It should be noted that subgrade soils that have relatively high silt contents may be highly sensitive to moisture conditions. The subgrade strength and performance characteristics of a silty subgrade material may be dramatically reduced if this material becomes wet.

Based on our knowledge of the proposed project, we expect the traffic to range from light duty (passenger automobiles) to heavy duty (fire trucks and busses). The following tables show the recommended pavement sections for light duty and heavy duty use.

ASPHALTIC CONCRETE (FLEXIBLE) PAVEMENT
LIGHT DUTY (PARKING AREA)

Asphaltic Concrete	Aggregate Base*	Compacted Subgrade* **
2.0 in.	6.0 in.	12.0 in.

** 95% compaction based on ASTM Test Method D1557*
*** A proof roll may be performed in lieu of in place density tests*

ASPHALTIC CONCRETE (FLEXIBLE) PAVEMENT
HEAVY DUTY (HEAVY TRUCK AREA)

Asphaltic Concrete	Aggregate Base*	Compacted Subgrade* **
3.0 in.	6.0 in.	12.0 in.

** 95% compaction based on ASTM Test Method D1557*
*** A proof roll may be performed in lieu of in place density tests*

PORTLAND CEMENT CONCRETE (RIGID) PAVEMENT

Minimum PCC	Aggregate Base*	Compacted Subgrade* **
6.0 in.	6.0 in.	12.0 in.

** 95% compaction based on ASTM Test Method D1557*
*** A proof roll may be performed in lieu of in place density tests*

The asphaltic concrete depth in the flexible pavement tables should be a surface course type asphalt, such as Washington Department of Transportation (WSDOT) ½ inch HMA. The rigid pavement design is based on a Portland Cement Concrete (PCC) mix that has a 28 day compressive strength of 4,000 pounds per square inch (psi). The design is also based on a concrete flexural strength or modulus of rupture of 550 psi.

Testing and Inspection

A representative of Krazan & Associates, Inc. should be present at the site during the earthwork activities to confirm that actual subsurface conditions are consistent with the exploratory fieldwork. This activity is an integral part of our services as acceptance of earthwork construction is dependent upon compaction testing and stability of the material. This representative can also verify that the intent of these recommendations is incorporated into the project design and construction. Krazan & Associates, Inc. will not be responsible for grades or staking, since this is the responsibility of the Prime Contractor. Furthermore, Krazan & Associates is not responsible for the contractor's procedures, methods, scheduling or management of the work site.

LIMITATIONS

Geotechnical engineering is one of the newest divisions of Civil Engineering. This branch of Civil Engineering is constantly improving as new technologies and understanding of earth sciences improves. Although your site was analyzed using the most appropriate current techniques and methods, undoubtedly there will be substantial future improvements in this branch of engineering. In addition to improvements in the field of geotechnical engineering, physical changes in the site either due to excavation or fill placement, new agency regulations or possible changes in the proposed structure after the time of completion of the soils report may require the soils report to be professionally reviewed. In light of this, the owner should be aware that there is a practical limit to the usefulness of this report without critical review. Although the time limit for this review is strictly arbitrary, it is suggested that two years be considered a reasonable time for the usefulness of this report.

Foundation and earthwork construction is characterized by the presence of a calculated risk that soil and groundwater conditions have been fully revealed by the original foundation investigation. This risk is derived from the practical necessity of basing interpretations and design conclusions on limited sampling of the earth. Our report, design conclusions and interpretations should not be construed as a warranty of the subsurface conditions. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report.

The recommendations made in this report are based on the assumption that soil conditions do not vary significantly from those encountered during our field investigation. The findings and conclusions of this report can be affected by the passage of time, such as seasonal weather conditions, manmade influences, such as construction on or adjacent to the site, natural events such as earthquakes, slope instability, flooding, or groundwater fluctuations. If any variations or undesirable conditions are encountered during construction, the geotechnical engineer should be notified so that supplemental recommendations can be made.

The conclusions of this report are based on the information provided regarding the proposed construction. If the proposed construction is relocated or redesigned, the conclusions in this report may not be valid. The geotechnical engineer should be notified of any changes so that the recommendations can be reviewed and reevaluated.

Misinterpretations of this report by other design team members can result in project delays and cost overruns. These risks can be reduced by having Krazan & Associates, Inc. involved with the design teams meetings and discussions after submitting the report. Krazan & Associates, Inc. should also be retained for reviewing pertinent elements of the design team's plans and specifications. Contractors can also misinterpret this report. To reduce this, risk Krazan & Associates. Inc. should participate in pre-bid and preconstruction meetings, and provide construction observations during the site work.

This report is a geotechnical engineering investigation with the purpose of evaluating the soil conditions in terms of foundation design. The scope of our services did not include any environmental site assessment for the presence or absence of hazardous and/or toxic materials in the soil, groundwater or atmosphere, or the presence of wetlands. Any statements, or absence of statements, in this report or on any boring log regarding odors, unusual or suspicious items, or conditions observed are strictly for descriptive purposes and are not intended to convey engineering judgment regarding potential hazardous and/or toxic assessments.

The geotechnical information presented herein is based upon professional interpretation utilizing standard engineering practices and a degree of conservatism deemed proper for this project. It is not warranted that such information and interpretation cannot be superseded by future geotechnical developments. We emphasize that this report is valid for this project as outlined above, and should not be used for any other site. Our report is prepared for the exclusive use of our client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing.

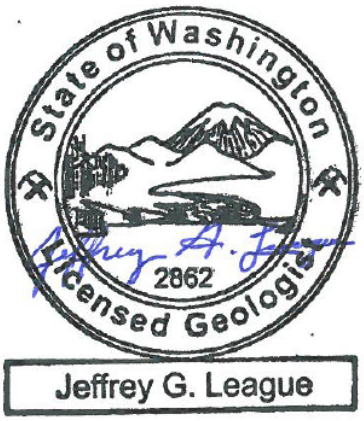
o-O-o

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (425) 485-5519.

Respectfully submitted,

KRAZAN & ASSOCIATES, INC.

5/27/14



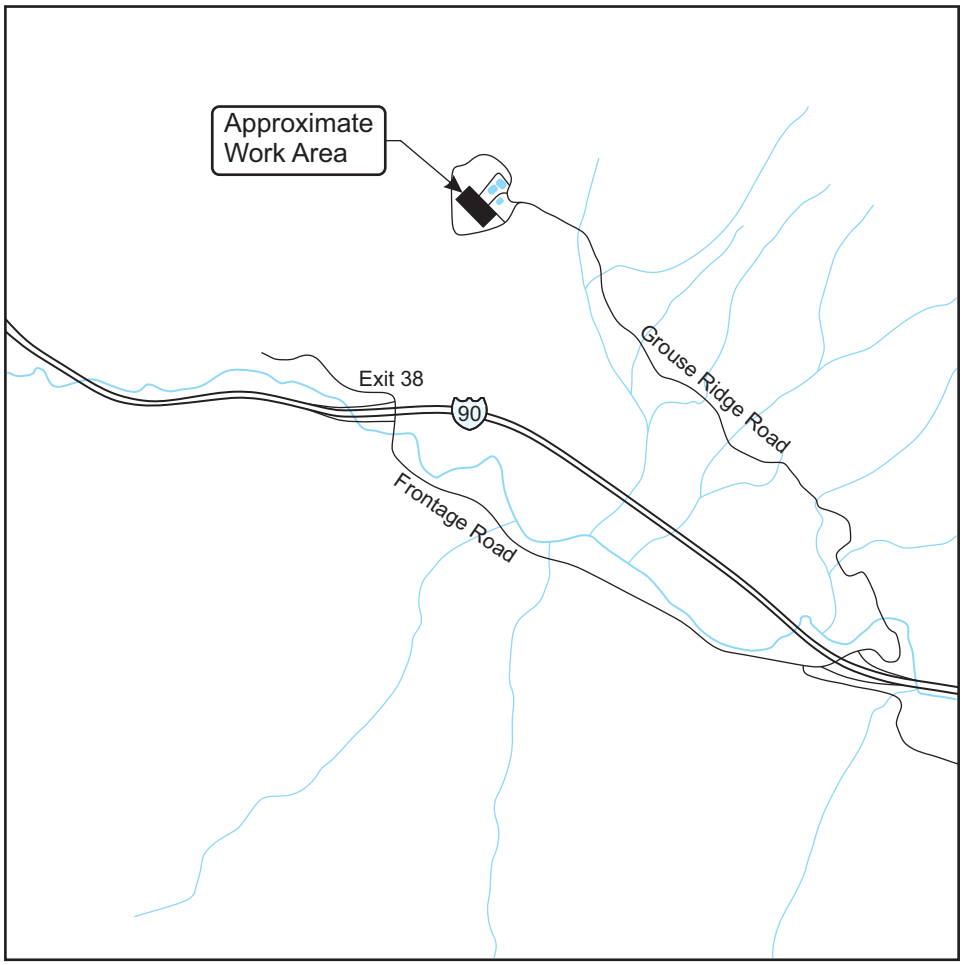
Michael D. Rundquist, P.E.
Senior Project Manager

Jeffrey G. League, L.G.
Project Geologist

JGL/MDR

Vicinity Map

(Not to Scale)



North Bend area, King County, WA

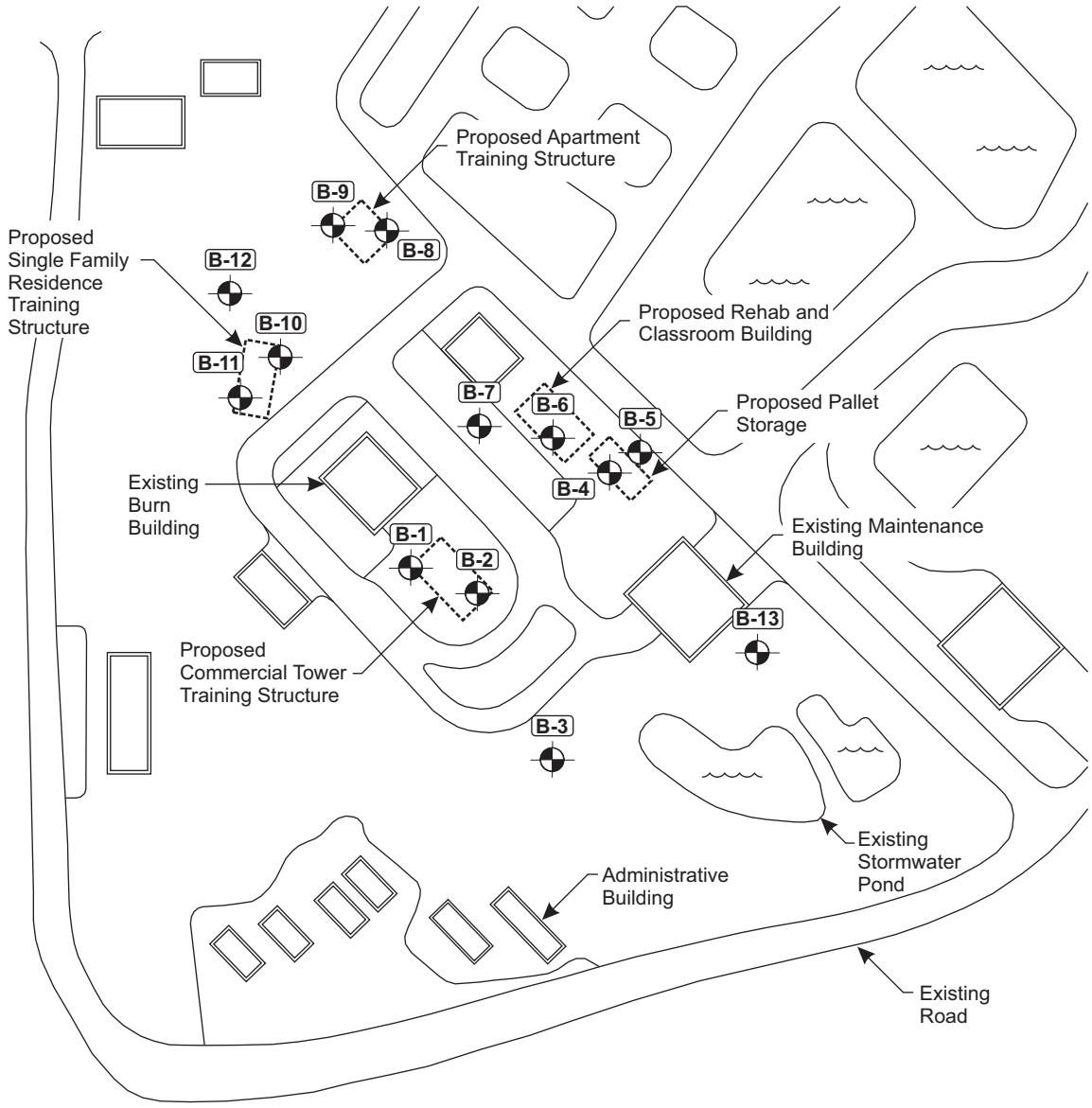
Reference: The Vicinity Map is based on a USGS Topographic Map titled, "Chester Morse Lake Quadrangle, Washington - King Co. - 7.5-Minute Series," dated 2014.

Krazan & ASSOCIATES, INC.

Fire Training Academy, North Bend, WA		
Date: May 2014	Project Number: 092-14005	
Drawn By: KGM	Figure 1	Not to scale

Site Plan

(Not to Scale)



Reference: The Site Plan is based on an untitled conceptual plan edited by Rice Fergus Miller Architecture & Planning on February 20, 2014, as well as King County iMAP.

LEGEND

B-1 Number and Approximate Location of Soil Boring

Krazan & ASSOCIATES, INC.

Fire Training Academy, North Bend, WA		
Date: May 2014	Project Number: 092-14005	
Drawn By: KGM	Figure 2	Not to scale

APPENDIX A

FIELD INVESTIGATION – LABORATORY TESTING – LIQUEFACTION ANALYSES

Field Investigation

The field investigation consisted of a surface reconnaissance and a subsurface exploration program. Thirteen (13) exploratory soil borings were drilled and sampled for the subsurface investigation at this site. The soil borings were completed on April 28, 2014 through April 30, 2014 by a Krazan subcontractor utilizing a truck-mounted drill rig. The soil borings were advanced to depths ranging from 16.5 to 41.5 feet below the existing ground surface. The approximate exploratory boring locations are shown on the Site Plan (Figure 2). The depths shown on the attached boring logs are from the existing ground surface at the time of our exploration.

The drilled borings were advanced using a truck mounted drilling rig. Soil samples were obtained by using the Standard Penetration Test (SPT) as described in ASTM Test Method D1586. The Standard Penetration Test and sampling method consists of driving a standard 2-inch outside-diameter, split barrel sampler into the subsoil with a 140-pound hammer free falling a vertical distance of 30 inches. The summation of hammer-blows required to drive the sampler the final 12-inches of an 18-inch sample interval is defined as the Standard Penetration Resistance, or N-value. The blow count is presented graphically on the boring log in this appendix. The resistance, or "N" value, provides a measure of the relative density of granular soils or of the relative consistency of cohesive soils.

The soils encountered were logged in the field during the exploration are described in accordance with the Unified Soil Classification System (USCS). All samples were returned to a Krazan laboratory for evaluation. The log of the soil explorations are presented in this appendix.

Laboratory Testing

The laboratory testing program was developed primarily to determine the index properties of the soils. Test results were used for soil classification and as criteria for determining the engineering suitability of the subsurface materials encountered.

Soil Classification

USCS Soil Classification				
Major Division			Group Description	
Coarse-Grained Soils < 50% passes #200 sieve	Gravel and Gravelly Soils < 50% coarse fraction passes #4 sieve	Gravel (with little or no fines)	GW	Well-Graded Gravel
			GP	Poorly Graded Gravel
		Gravel (with > 12% fines)	GM	Silty Gravel
			GC	Clayey Gravel
	Sand and Sandy Soils > 50% coarse fraction passes #4 sieve	Sand (with little or no fines)	SW	Well-Graded Sand
			SP	Poorly Graded Sand
		Sand (with > 12% fines)	SM	Silty Sand
			SC	Clayey Sand
Fine-Grained Soils > 50% passes #200 sieve	Silt and Clay Liquid Limit < 50		ML	Silt
			CL	Lean Clay
			OL	Organic Silt and Clay (Low Plasticity)
	Silt and Clay Liquid Limit > 50		MH	Inorganic Silt
			CH	Inorganic Clay
			OH	Organic Clay and Silt (Med. to High Plasticity)
Highly Organic Soils			PT	Peat

Relative Density with Respect to SPT N-Value			
Coarse-Grained Soils		Fine-Grained Soils	
Density	N-Value (Blows/Ft)	Density	N-Value (Blows/Ft)
Very Loose	0 - 4	Very Soft	0 - 1
Loose	5 -10	Soft	2 - 4
Medium Dense	11 - 30	Medium Stiff	5 - 8
Dense	31 - 50	Stiff	9 - 15
Very Dense	> 50	Very Stiff	16 - 30
		Hard	> 30

Krazan & ASSOCIATES, INC.

Fire Training Academy, North Bend, WA

Date: May 2014 | References: USCS

Drawn By: JGL | | Project Number: 092-14005

KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

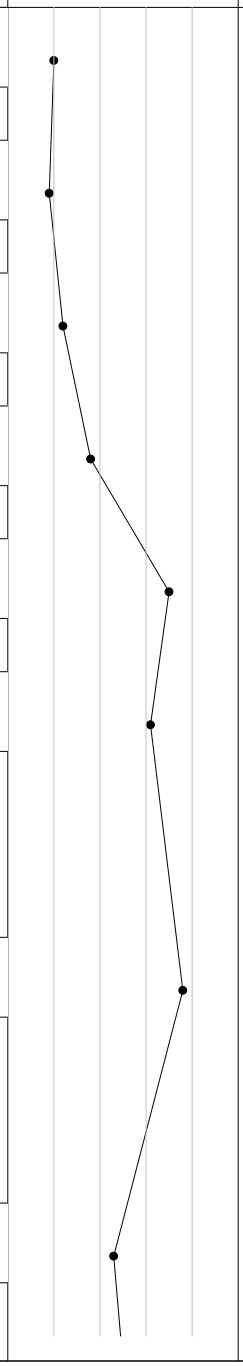
LOG OF EXPLORATORY BORING B-1

PROJECT: Fire Training Academy | **DATE: 4/28/14**
PROJECT NO.: 09214005 | **PAGE: 1 of 2**
LOGGED BY: JL/KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES
			Grass Surface	5		
			Loose Fill Brown fine to medium sand with silt and trace gravel (moist to wet)	5 5	10	
				3 4 5	9	
5			**Compact Fill** Brown fine to medium sand with trace silt (medium dense, moist to wet)	4 4 8	12	
				6 8 10	18	
			-becomes silty sand			
10			-becomes silty sand with wood debris	9 12 23	35	
			Poorly Graded Sand (SP) Gray fine to medium sand (medium dense, moist to wet) (recessional outwash)	14 17 14	31	
15			**Silt (ML)** Brown silt with clay (hard, moist) (lacustrine deposit - recessional outwash)			
			Poorly Graded Sand (SP) Brown fine to medium sand with trace gravel (dense, moist to wet) (recessional outwash)			
			-high N-value possibly due to the sampler pounding on a rock	9 16 22	38	
20			**Silt (ML)** Gray silt with clay and trace fine sand (medium dense, moist to wet) (lacustrine deposit - recessional outwash)			
			Silty Sand (SM) Gray silty fine sand (medium dense, moist) (recessional outwash)	6 8 15	23	
25						

N-VALUE (GRAPH): 10 20 30 40

Natural Moisture Content (Percent): 10 20 30 40



Water Level Initial: ▽ Final: ▼

Water Observations: Moist to wet conditions encountered near the surface. Perched groundwater observed at approximately 33 feet.

Notes:

KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-1

PROJECT: Fire Training Academy | **DATE: 4/28/14**
PROJECT NO.: 09214005 | **PAGE: 2 of 2**
LOGGED BY: JL/KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES	N-VALUE (GRAPH) 10 20 30 40	Natural Moisture Content (Percent) 10 20 30 40
				10 14 14	28			
			Silt (ML) Gray silt with clay and trace fine sand (medium dense, moist to wet) (lacustrine deposit - recessional outwash)					
30			**Poorly Graded Sand (SP)** Gray fine to medium sand with trace silt (dense, moist) (glacially compacted soils)	10 17 22	39			
		▼	-becomes moist to wet					
35				11 17 22	39			
40				11 15 25	40			
			Silty Sand (SM) Gray silty fine sand (dense, moist to wet) (glacially compacted soils)					
			End of Exploratory Boring					
45								
50								

Water Level Initial: ▽ Final: ▼

Water Observations: Moist to wet conditions encountered near the surface. Perched groundwater observed at approximately 33 feet.

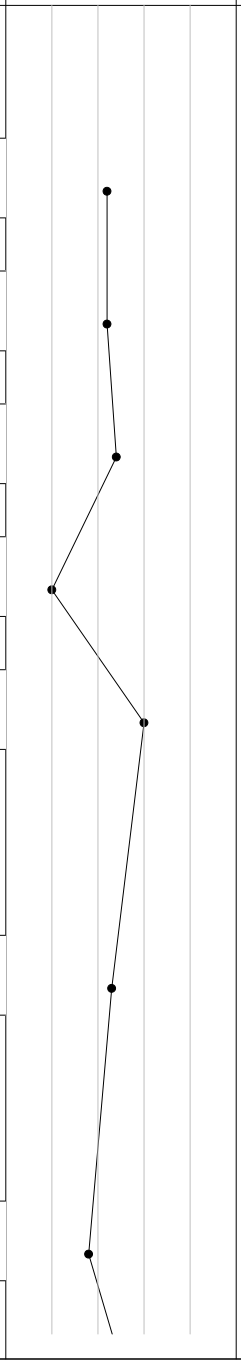
Notes:

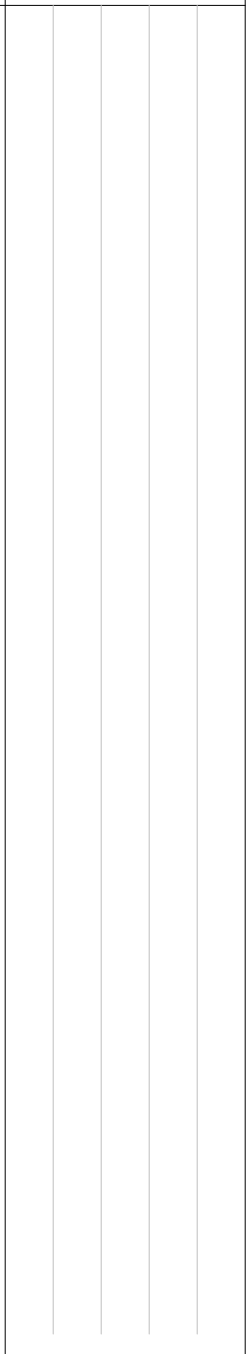
KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-2

PROJECT: Fire Training Academy | **DATE: 4/28/14**
PROJECT NO.: 09214005 | **PAGE: 1 of 2**
LOGGED BY: JL/KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES
			Grass Surface			
			Compact Fill Gray to brown fine to medium sand with trace gravel and trace silt (medium dense, moist to wet)	7 10 12	22	
5			-becomes silty sand with gravel and trace wood debris and trace charcoal	6 10 12	22	
			-becomes sand with trace silt and trace gravel	8 12 12	24	
10			**Loose Fill** Brown fine to medium sand (moist to wet)	3 3 7	10	
			Poorly Graded Sand (SP) Brown fine to medium sand (medium dense to dense, moist to wet) (recessional outwash)	10 11 19	30	
15			-becomes fine sand with silt	7 9 14	23	
20			**Silt (ML)** Brown silt with clay (very stiff, moist) (lacustrine deposit - recessional outwash)			
			Poorly Graded Sand (SP) Gray fine to medium sand with trace silt (medium dense, moist to wet) (recessional outwash)			
			Silt (ML) Brown to gray silt with fine sand and trace clay (very stiff, moist to wet) (lacustrine deposit - recessional outwash)	5 7 11	18	
25						





Water Level Initial: ▽ Final: ▼

Water Observations: Moist to wet conditions encountered near the surface.

Notes:

KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-2

PROJECT: Fire Training Academy | **DATE: 4/28/14**
PROJECT NO.: 09214005 | **PAGE: 2 of 2**
LOGGED BY: JL/KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES
			Poorly Graded Sand (SP) Gray fine to medium sand (dense, moist to wet) (glacially compacted soil)	15 15 20	35	
30				12 23 25	48	
35			-becomes fine sand with silt	15 20 22	42	
40			End of Exploratory Boring			
45						
50						

N-VALUE (GRAPH): 10 20 30 40

Natural Moisture Content (Percent): 10 20 30 40

Water Level Initial: ▽ Final: ▼

Water Observations: Moist to wet conditions encountered near the surface.

Notes:

KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-3

PROJECT: Fire Training Academy | **DATE: 4/28/14**
PROJECT NO.: 09214005 | **PAGE: 1 of 1**
LOGGED BY: KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES
			Loose Fill Brown fine to medium sand with silt lenses and trace gravel (moist to wet)	2 2 3	5	
			-becomes with gravel	8 3 3	6	
5			**Poorly Graded Sand (SP)** Brown to gray fine to medium sand with silt and trace gravel (medium dense, wet) (recessional outwash)	10 12 17	29	
			-becomes with gravel; moist to wet	12 12 10	22	
10			-less gravel	7 9 9	18	
				9 11 15	26	
15			-becomes dark gray; sand becomes fine-grained	8 14 14	28	
			End of Exploratory Boring			
20						

N-VALUE (GRAPH)
10 20 30 40

Natural Moisture Content
(Percent)
10 20 30 40

Water Level Initial: ▽ Final: ▼

Water Observations: Wet soil conditions observed at approximately 5 feet.

Notes:

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4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-4

PROJECT: Fire Training Academy | **DATE: 4/28/14**
PROJECT NO.: 09214005 | **PAGE: 1 of 1**
LOGGED BY: KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES
			Compact Fill Brown fine to medium sand with gravel (dense, moist)	7 14 20	34	
5			Brown sand with silt, woody debris, and trace brick (medium dense, moist)	7 8 8	16	
			Gray fine to medium sand (medium dense, moist) -becomes brown	4 5 12	17	
10			**Loose Fill** Dark gray fine to medium sand with trace silt (moist to wet)	4 4 5	9	
			Poorly Graded Sand with Silt (SP-SM) Gray to brown fine to medium sand with silt and trace gravel (medium dense, moist to wet) (recessional outwash)	6 7 6	13	
15		▼	**Poorly Graded Sand with Silt (SP-SM)** Brown fine sand with silt (dense, wet) (glacially compacted soil)	11 15 19	34	
20			End of Exploratory Boring			

N-VALUE (GRAPH): 10 20 30 40

Natural Moisture Content (Percent): 10 20 30 40

Water Level Initial: ▽ Final: ▼

Water Observations: Perched groundwater observed at approximately 17 feet.

Notes:

KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-5

PROJECT: Fire Training Academy | **DATE: 4/28/14**
PROJECT NO.: 09214005 | **PAGE: 1 of 1**
LOGGED BY: KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES
			Moss Covered Gravel	3		
			Loose Fill Brown fine to medium sand with trace gravel (moist)	4 6	10	
			Compact Fill Brown fine to medium sand with gravel (medium dense, moist)	10 12 16	28	
5			-becomes with silt, gravel, woody debris and charcoal	4 9 12	21	
			-gravel, woody debris and charcoal not observed	7 10 9	19	
10		▼	**Loose Fill** Dark gray fine to medium sand (moist to wet)	2 2 3	5	
			Poorly Graded Sand with Silt and Gravel (SP-SM) Dark gray fine to medium sand with silt and gravel (medium dense, wet) (recessional outwash)	2 3 9	12	
15			**Silty Sand (SM)** Brown silty fine sand (dense, wet) (glacially compacted soil)	10 15 17	32	
20			End of Exploratory Boring			

N-VALUE (GRAPH): 10 20 30 40

Natural Moisture Content (Percent): 10 20 30 40

Water Level Initial: ▽ Final: ▼

Water Observations: Perched groundwater observed at approximately 10 feet.

Notes:

KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-6

PROJECT: Fire Training Academy | **DATE: 4/29/14**
PROJECT NO.: 09214005 | **PAGE: 1 of 1**
LOGGED BY: KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES
			Compact Fill Brown fine to medium sand with silt and gravel (medium dense, moist to wet)	6 12 15	27	
5			-becomes with trace organics; dense	7 20 15	35	
			Poorly Graded Sand (SP) Gray fine to medium sand with trace silt (medium dense, moist to wet) (recessional outwash)	6 11 12	23	
10			-becomes with gravel; wet	19 11 11	22	
15			-less gravel -becomes brown fine sand; moist	4 7 12	19	
			End of Exploratory Boring			
20						

N-VALUE (GRAPH): 10 20 30 40

Natural Moisture Content (Percent): 10 20 30 40

Water Level Initial: ▽ Final: ▼

Water Observations: Perched groundwater observed at approximately 5.5 feet.

Notes: Refusal at 10 ft due to obstruction, restarted drilling ~5 feet northwest

KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-7

PROJECT: Fire Training Academy | **DATE: 4/29/14**
PROJECT NO.: 09214005 | **PAGE: 1 of 1**
LOGGED BY: KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES
			Crushed Rock Paving	9		
			Compact Fill Brown fine to medium sand with gravel and trace silt (medium dense, moist)	9 14	23	
			-becomes brown to gray	9 11 14	25	
5			-becomes dense; moist to wet	14 22 19	41	
			-becomes moist	7 14 19	33	
10			**Loose Fill** Gray to brown fine to medium sand with gravel, trace silt and trace organics (moist to wet)	8 5 3	8	
			-becomes dark gray; less gravel and organics; wet	2 4 4	8	
15			**Poorly Graded Sand with Silt (SP-SM)** Brown to gray fine sand with silt (medium dense, moist to wet) (recessional outwash)			
			Silt with Sand and Clay (ML-SP) Gray to brown silt with sand and clay (very stiff, moist to wet) (lacustrine deposit - recessional outwash)	11 8 11	19	
20			End of Exploratory Boring			

N-VALUE (GRAPH) — 10 20 30 40

Natural Moisture Content (Percent) — 10 20 30 40

Water Level Initial: ▽ Final: ▼

Water Observations: Perched groundwater observed at approximately 5.5 feet.

Notes:

KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-8

PROJECT: Fire Training Academy | **DATE: 4/29/14**
PROJECT NO.: 09214005 | **PAGE: 1 of 2**
LOGGED BY: KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES
			Compact Fill Brown fine to medium sand with silt (medium dense, moist to wet)	5 6 8	14	
5			-becomes with trace gravel	7 6 13	19	
			Brown clayey silt (stiff, moist)	4 4 6	10	
			Brown fine to medium sand (medium dense, moist to wet)	12 9 14	23	
			Loose Fill Brown fine to medium sand (moist)	4 4 6	10	
15			**Poorly Graded Sand with Silt (SP-SM)** Brown fine to medium sand with silt (medium dense, moist to wet) (recessional outwash)	4 5 7	12	
20				10 12	29	

N-VALUE (GRAPH): 10 20 30 40

Natural Moisture Content (Percent): 10 20 30 40

Water Level Initial: ▽ Final: ▼

Water Observations: Moist to wet conditions encountered near the surface. Perched groundwater observed at approximately 25 feet.

Notes:

KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-8

PROJECT: Fire Training Academy | **DATE: 4/29/14**
PROJECT NO.: 09214005 | **PAGE: 2 of 2**
LOGGED BY: KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES	N-VALUE (GRAPH) 10 20 30 40	Natural Moisture Content (Percent) 10 20 30 40
				17				
28				8 12 14	26			
			Poorly Graded Sand (SP) Brown fine to medium sand (dense to very dense, moist to wet) (glacially compacted material)					
33			-becomes fine sand with trace silt; very dense	19 35 50(4)	85+			
38			-becomes fine to medium sand	10 31 50(3)	81+			
			End of Exploratory Boring					
43								

Water Level Initial: ▽ Final: ▼

Water Observations: Moist to wet conditions encountered near the surface. Perched groundwater observed at approximately 25 feet.

Notes:

KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-9

PROJECT: Fire Training Academy | **DATE: 4/29/14**
PROJECT NO.: 09214005 | **PAGE: 1 of 2**
LOGGED BY: KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES
			Grass Surface and Topsoil	3 4 7	11	
			Loose Fill Brown silty sand with gravel, trace charcoal and trace organics (moist)			
			Brown fine to coarse sand with silt and trace gravel (moist)	1 2 3	5	
5			-becomes silty fine to medium sand with silt and gravel; moist to wet	4 4 4	8	
		▼	**Compact Fill** Brown fine to medium sand (medium dense, moist to wet)	4 8 15	23	
10			-becomes silty fine sand; moist to wet	7 8 11	19	
				4 4 7	11	
15			**Poorly Graded Sand (SP)** Brown fine to medium sand (medium dense, moist to wet) (recessional outwash)	8 11 14	25	
20				12 14	28	

N-VALUE (GRAPH): 10 20 30 40

Natural Moisture Content (Percent): 10 20 30 40

Water Level Initial: ▽ Final: ▼

Water Observations: Perched groundwater observed at approximately 8 feet.

Notes:

KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-9

PROJECT: Fire Training Academy | **DATE: 4/29/14**
PROJECT NO.: 09214005 | **PAGE: 2 of 2**
LOGGED BY: KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES	N-VALUE (GRAPH) 10 20 30 40	Natural Moisture Content (Percent) 10 20 30 40
			-becomes with silt	14				
28				8 12 11	23			
			Poorly Graded Sand (SP) Brown fine to medium sand (dense, moist to wet) (glacially compated soil)					
33				8 15 27	42			
			End of Exploratory Boring					
38								
43								

Water Level Initial: ▽ Final: ▼

Water Observations: Perched groundwater observed at approximately 8 feet.

Notes:

KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-10

PROJECT: Fire Training Academy | **DATE: 4/29/14**
PROJECT NO.: 09214005 | **PAGE: 1 of 2**
LOGGED BY: KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES
			Loose Fill Brown fine to medium sand (moist to wet)	2 4 5	9	
5			**Poorly Graded Sand (SP)** Brown fine to medium sand (medium dense, moist to wet) (recessional outwash)	4 8 10	18	
			-becomes brown to gray; moist	4 5 10	15	
10				7 10 11	21	
				6 10 10	20	
15			**Poorly Graded Sand with Silt and Gravel (SP-SM)** Brown fine to medium sand with gravel and silt nodules (medium dense, moist to wet) (recessional outwash)	7 9 15	24	
20			-becomes medium dense to dense; less gravel and silt			
			Silt (ML) Brown silt with clay (very stiff to hard, moist) (glacially compacted material)	9 15 21	36	
25						

N-VALUE (GRAPH): 10 20 30 40

Natural Moisture Content (Percent): 10 20 30 40

Water Level Initial: ▽ Final: ▼

Water Observations: Moist to wet conditions encountered near the surface.

Notes:

KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-10

PROJECT: Fire Training Academy | **DATE: 4/29/14**
PROJECT NO.: 09214005 | **PAGE: 2 of 2**
LOGGED BY: KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES	N-VALUE (GRAPH) 10 20 30 40	Natural Moisture Content (Percent) 10 20 30 40
			Poorly Graded Sand (SP) Brown fine to medium sand (dense, moist) (glacially compacted soil)					
			-becomes very dense	12 19 33	52			
30			-becomes dense; moist to wet	11 19 28	47			
			End of Exploratory Boring					
35								
40								
45								
50								

Water Level Initial: ▽ Final: ▼

Water Observations: Moist to wet conditions encountered near the surface.

Notes:

KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-11

PROJECT: Fire Training Academy | **DATE: 4/30/14**
PROJECT NO.: 09214005 | **PAGE: 1 of 2**
LOGGED BY: KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES
			Loose Fill Brown fine to medium sand with silt nodules, trace gravel and trace organics (moist)	4 4 6	10	
			Poorly Graded Sand (SP) Dark gray to brown fine to medium sand (medium dense, moist) (recessional outwash)	5 7 9	16	
5				5 7 11	18	
				8 11 14	25	
10				5 9 12	21	
			-becomes with trace silt; moist to wet	7 8 8	16	
15			**Poorly Graded Sand with Silt (SP-SM)** Dark gray to brown, fine to medium sand with silt nodules (dense, moist to wet) (glacially compacted soil)	10 8 31	39	
20			-less silt	10 15 26	41	
25						

N-VALUE (GRAPH): 10 20 30 40

Natural Moisture Content (Percent): 10 20 30 40

Water Level Initial: ▽ Final: ▼

Water Observations: Moist to wet conditions observed at approximately 13 feet. Perched groundwater observed at approximately 25 feet.

Notes:

KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-11

PROJECT: Fire Training Academy | **DATE: 4/30/14**
PROJECT NO.: 09214005 | **PAGE: 2 of 2**
LOGGED BY: KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES	N-VALUE (GRAPH) 10 20 30 40	Natural Moisture Content (Percent) 10 20 30 40
			-trace gravel					
			Silt (ML) Brown silt with clay and trace sand (hard, moist to wet) (glacially compacted soil)	9 12 25	37			
30			**Poorly Graded Sand (SP)** Brown fine to medium sand (dense, moist) (glacially compacted soil)	14 23 22	45			
			-becomes with silt nodules					
			End of Exploratory Boring					
35								
40								
45								
50								

Water Level Initial: ▽ Final: ▼

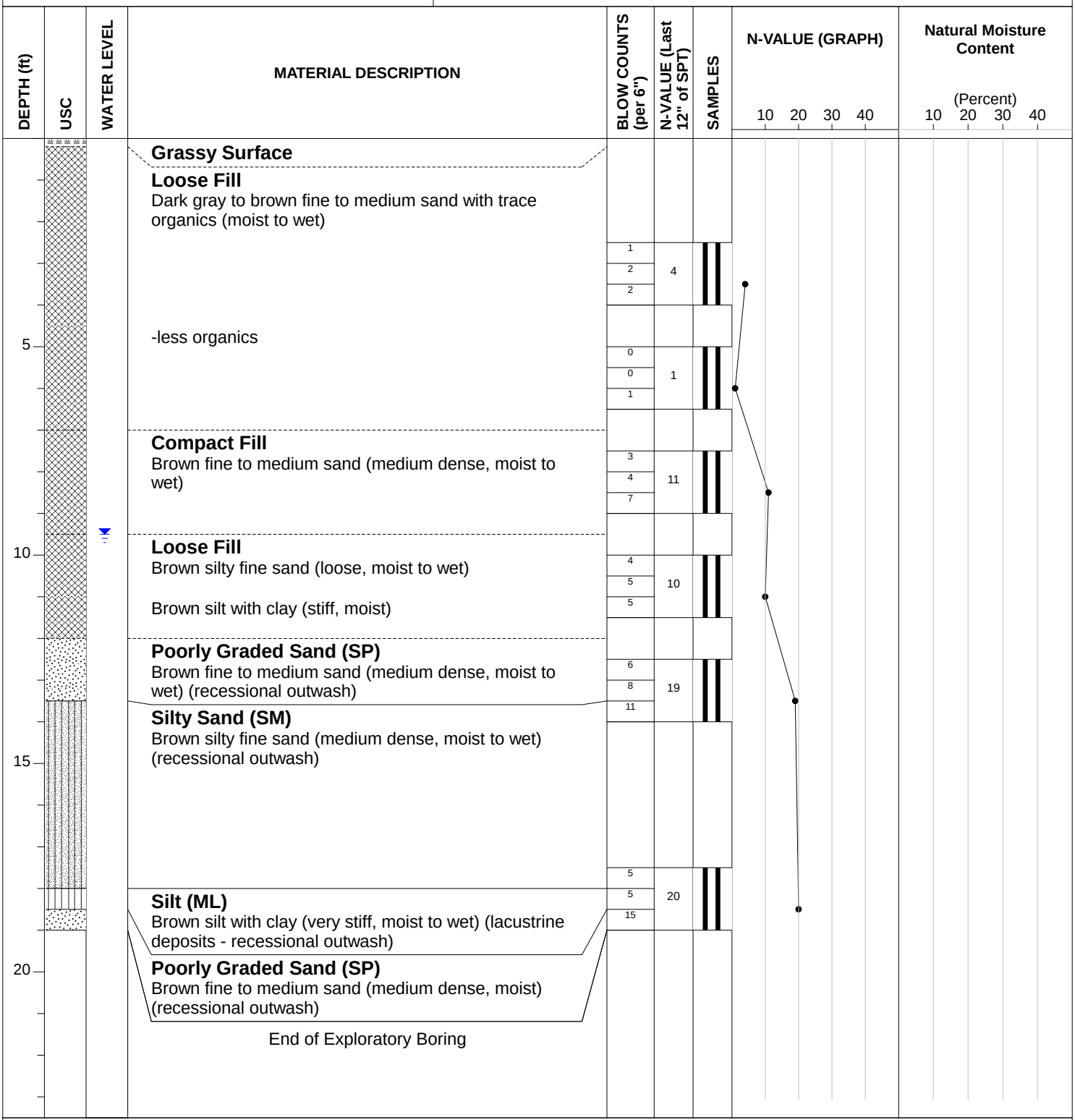
Water Observations: Moist to wet conditions observed at approximately 13 feet. Perched groundwater observed at approximately 25 feet.

Notes:

KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-12

PROJECT: Fire Training Academy | **DATE: 4/30/14**
PROJECT NO.: 09214005 | **PAGE: 1 of 1**
LOGGED BY: KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**



Water Level Initial: ▽ Final: ▼

Water Observations: Moist to wet conditions observed near the surface. Perched groundwater observed at approximately 9.5 feet.

Notes:

KRAZAN AND ASSOCIATES, INC.
4303 - 198th St SW
Lynnwood, WA

LOG OF EXPLORATORY BORING B-13

PROJECT: Fire Training Academy | **DATE: 4/30/14**
PROJECT NO.: 09214005 | **PAGE: 1 of 1**
LOGGED BY: KM | **SURFACE ELEVATION:**
CONTRACTOR: EDI | **BORING TYPE: HSA**
SAMPLE METHOD: SPT, Split, Spoon | **LOCATION: North Bend, WA**

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES
			Grassy Surface	5		
			Compact Fill Brown fine to medium sand with silt, trace gravel and trace organics (medium dense, moist)	7 9	16	
			-becomes brown fine to medium sand with trace gravel	6		
			-becomes brown Silty Sand with trace organics	15	28	
			-becomes gray to brown silty sand with trace gravel	25		
			-becomes brown fine to medium sand; less gravel and silt			
5				6		
				8	16	
				8		
			-becomes moist to wet	4		
				7	15	
				8		
10			-becomes brown to dark gray	4		
				5	11	
				6		
				8		
			Silty Sand (SM) Silty fine sand (dense, moist to wet) (glacially compacted soil)	11 24	35	
15			**Clayey Silt (ML)** Brown clayey silt (hard, moist to wet) (glacially compacted soil)			
				10		
			Poorly Graded Sand (SP) Brown fine to medium sand with silt (dense, moist to wet) (glacially compacted soil)	12 19	31	
20			End of Exploratory Boring			

N-VALUE (GRAPH): 10 20 30 40

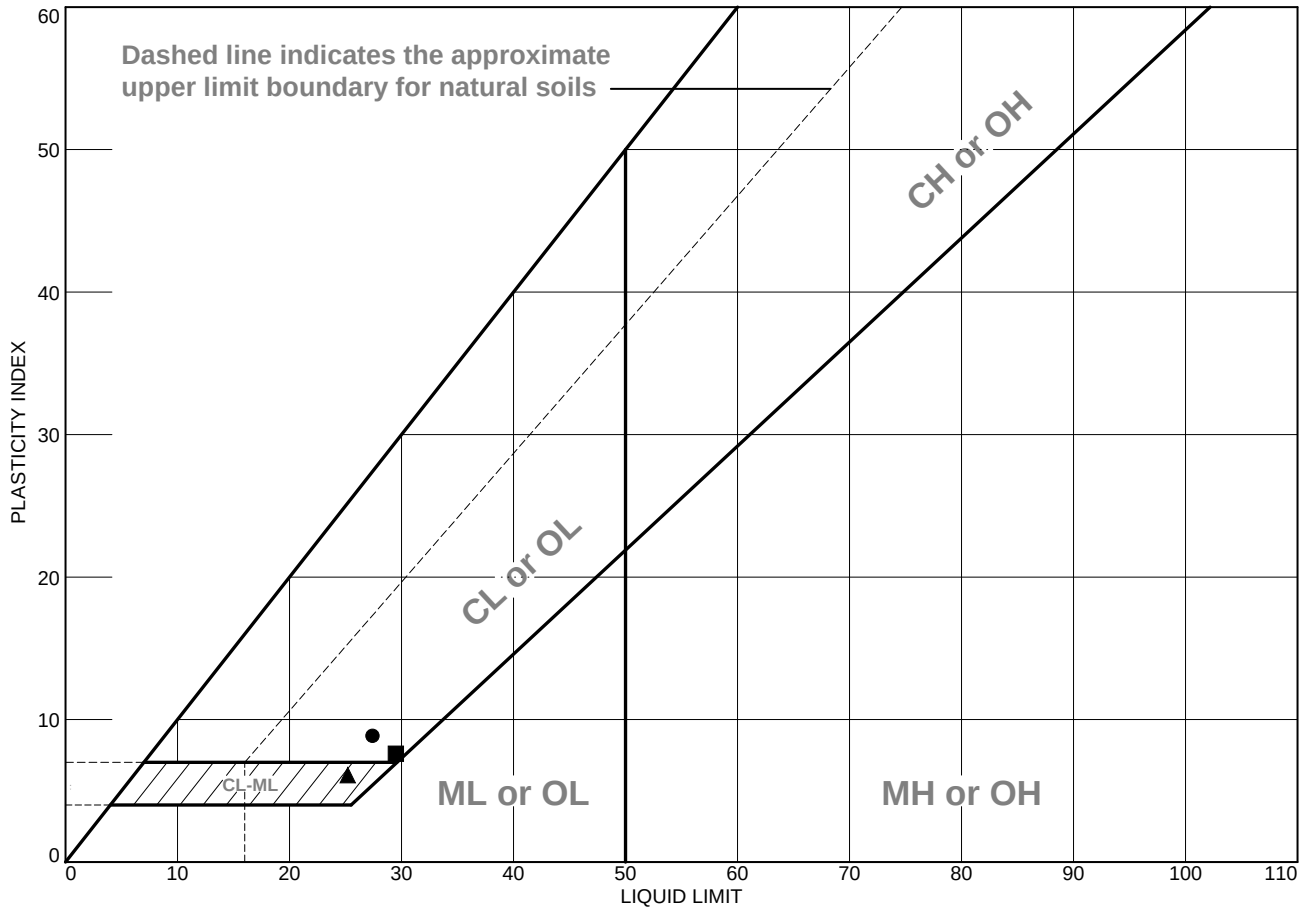
Natural Moisture Content (Percent): 10 20 30 40

Water Level Initial: ▽ Final: ▼

Water Observations: Moist to wet conditions observed at approximately 7 feet. Perched groundwater observed at approximately 11 feet.

Notes:

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Light brown clayey silt	27.5	18.7	8.8	0.3	N/A	CL-ML
■	Grayish-brown clayey silt	29.5	21.9	7.6	1.0	N/A	CL-ML
▲	Gray clayey silt with sand	25.2	19.1	6.1	12.1	N/A	CL-ML

Project No. 09214005 **Client:** WA State Dept. of Enterprise Svcs., Facilities

Project: Fire Training Academy - New Burn Building

●**Location:** Boring 1 **Depth:** 12.5' - 14' **Sample Number:** 48224-A
■**Location:** Boring 2 **Depth:** 17.5' - 19' **Sample Number:** 48224-B
▲**Location:** Boring 2 **Depth:** 22.5' - 24' **Sample Number:** 48224-C

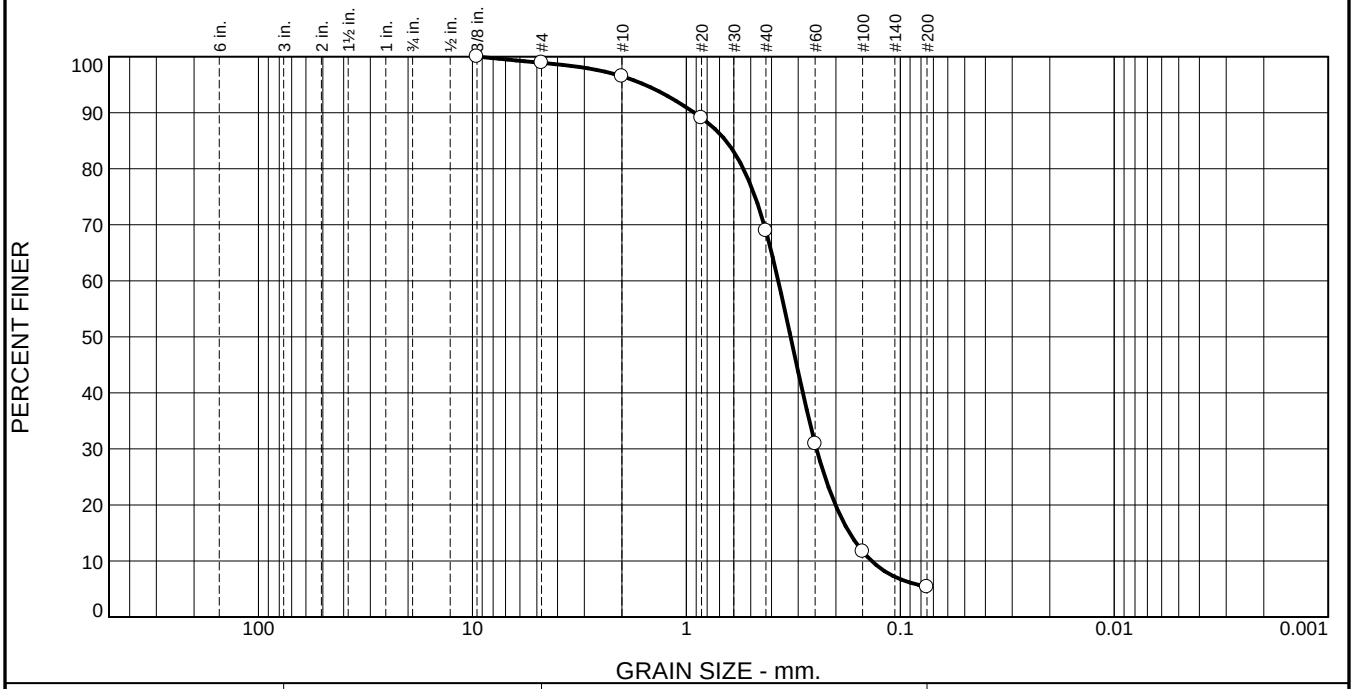
Krazan

Remarks:
●Sample ID: 48224-A.
■Sample ID: 48224-B.
▲Sample ID: 48224-C.

Figure

Tested By: Corbett Mercer **Checked By:** Corbett Mercer

Krazan & Associates Sieve Analysis



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.1	2.4	27.6	63.5	5.4	

Test Results (ASTM C-136 & ASTM C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.375	100.0		
#4	98.9		
#10	96.5		
#20	89.1		
#40	68.9		
#60	30.9		
#100	11.7		
#200	5.4		

* (no specification provided)

Material Description

Dark gray poorly graded sand with silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=** A-3

Coefficients

D_{90}= 0.9191 D_{85}= 0.6530 D_{60}= 0.3718
D_{50}= 0.3257 D_{30}= 0.2463 D_{15}= 0.1727
D_{10}= 0.1361 C_u= 2.73 C_c= 1.20

Remarks

Sample ID: 48224-D.

Date Received: 5/12/14 **Date Tested:** 5/14/14

Tested By: Corbett Mercer

Checked By: Corbett Mercer

Title: Lab Manager

Location: Boring 3 **Date Sampled:** 4/29/14

Sample Number: 48224-D **Depth:** 10' - 11.5'

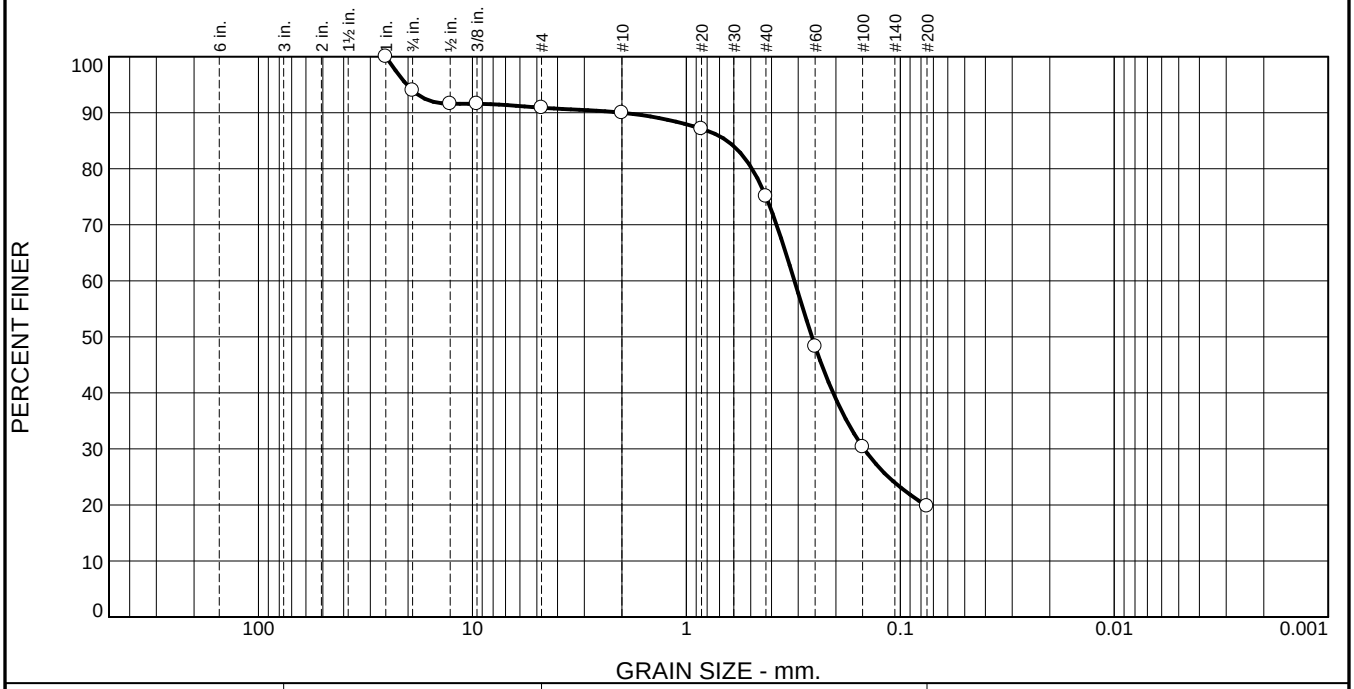
Krazan

Client: WA State Dept. of Enterprise Svcs., Facilities

Project: Fire Training Academy - New Burn Building

Project No: 09214005 **Figure**

Krazan & Associates Sieve Analysis



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.0	3.1	0.9	14.9	55.3	19.8	

Test Results (ASTM C-136 & ASTM C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1	100.0		
.75	94.0		
.5	91.6		
.375	91.6		
#4	90.9		
#10	90.0		
#20	87.1		
#40	75.1		
#60	48.3		
#100	30.4		
#200	19.8		

* (no specification provided)

Material Description

Light gray silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 2.0088 D_{85}= 0.6458 D_{60}= 0.3126
D_{50}= 0.2589 D_{30}= 0.1477 D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID: 48224-E.

Date Received: 5/12/14 **Date Tested:** 5/14/14

Tested By: Corbett Mercer

Checked By: Corbett Mercer

Title: Lab Manager

Location: Boring 9
Sample Number: 48224-E **Depth:** 5' - 6.5'

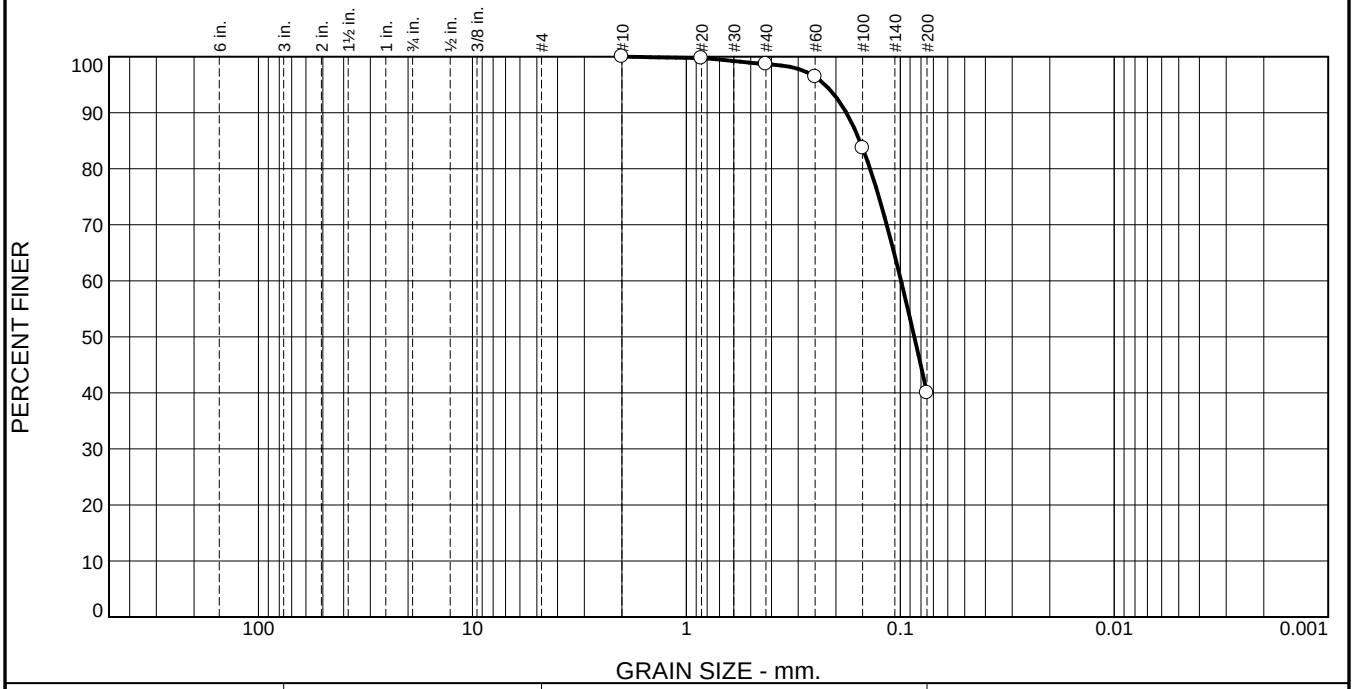
Date Sampled: 4/29/14

Krazan

Client: WA State Dept. of Enterprise Svcs., Facilities
Project: Fire Training Academy - New Burn Building

Project No: 09214005 **Figure**

Krazan & Associates Sieve Analysis



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.3	58.7	40.0	

Test Results (ASTM C-136 & ASTM C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#10	100.0		
#20	99.7		
#40	98.7		
#60	96.4		
#100	83.7		
#200	40.0		

* (no specification provided)

Material Description

Olive-brown silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.1789 D_{85}= 0.1547 D_{60}= 0.0992
D_{50}= 0.0860 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID: 48224-H.

Date Received: 5/12/14 **Date Tested:** 5/14/14

Tested By: Corbett Mercer

Checked By: Corbett Mercer

Title: Lab Manager

Location: Boring 13
Sample Number: 48224-H **Depth:** 13' - 14'

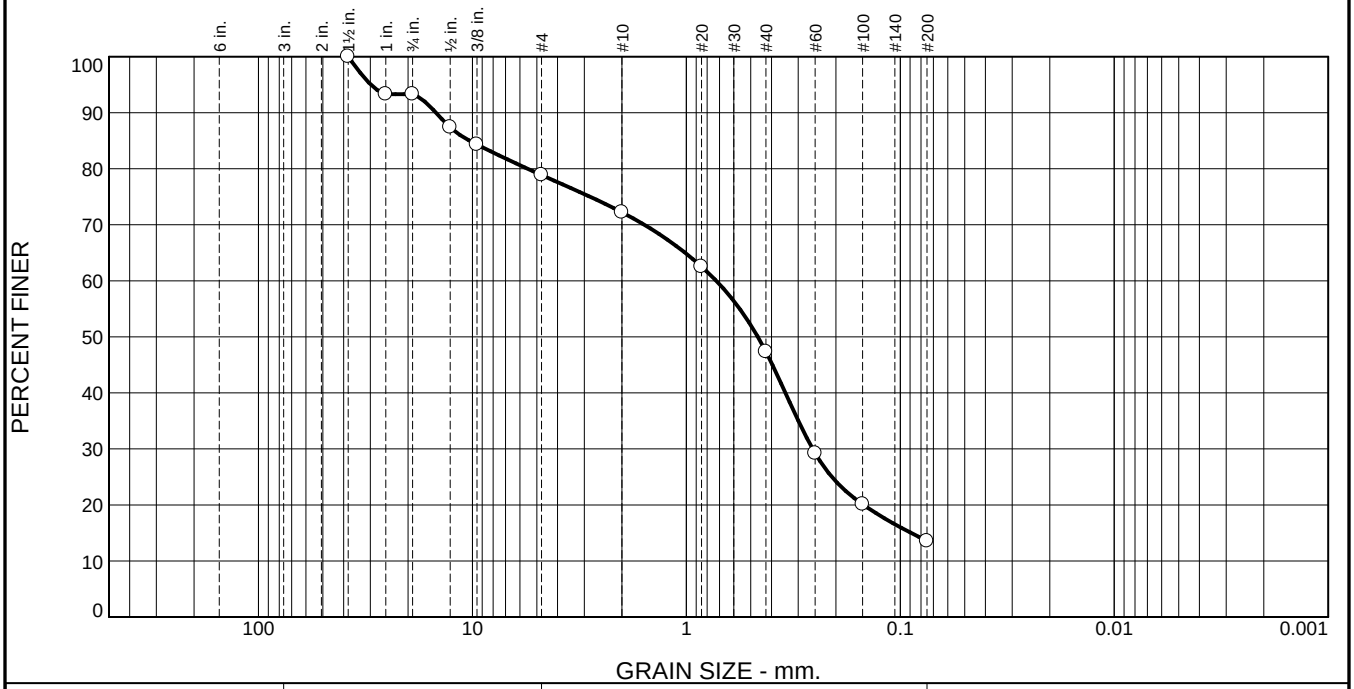
Date Sampled: 4/29/14

Krazan

Client: WA State Dept. of Enterprise Svcs., Facilities
Project: Fire Training Academy - New Burn Building

Project No: 09214005 **Figure**

Krazan & Associates Sieve Analysis



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.7	14.4	6.7	24.8	33.8	13.6	

Test Results (ASTM C-136 & ASTM C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100.0		
1	93.3		
.75	93.3		
.5	87.4		
.375	84.3		
#4	78.9		
#10	72.2		
#20	62.5		
#40	47.4		
#60	29.2		
#100	20.1		
#200	13.6		

* (no specification provided)

Material Description

Olive-gray silty sand with gravel

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 14.8001 D_{85}= 10.3104 D_{60}= 0.7251
D_{50}= 0.4635 D_{30}= 0.2569 D_{15}= 0.0889
D_{10}= C_u= C_c=

Remarks

Sample ID: 48224-I.

Date Received: 5/12/14 **Date Tested:** 5/14/14

Tested By: Corbett Mercer

Checked By: Corbett Mercer

Title: Lab Manager

Location: Boring 4
Sample Number: 48224-I **Depth:** 12.5' 14'

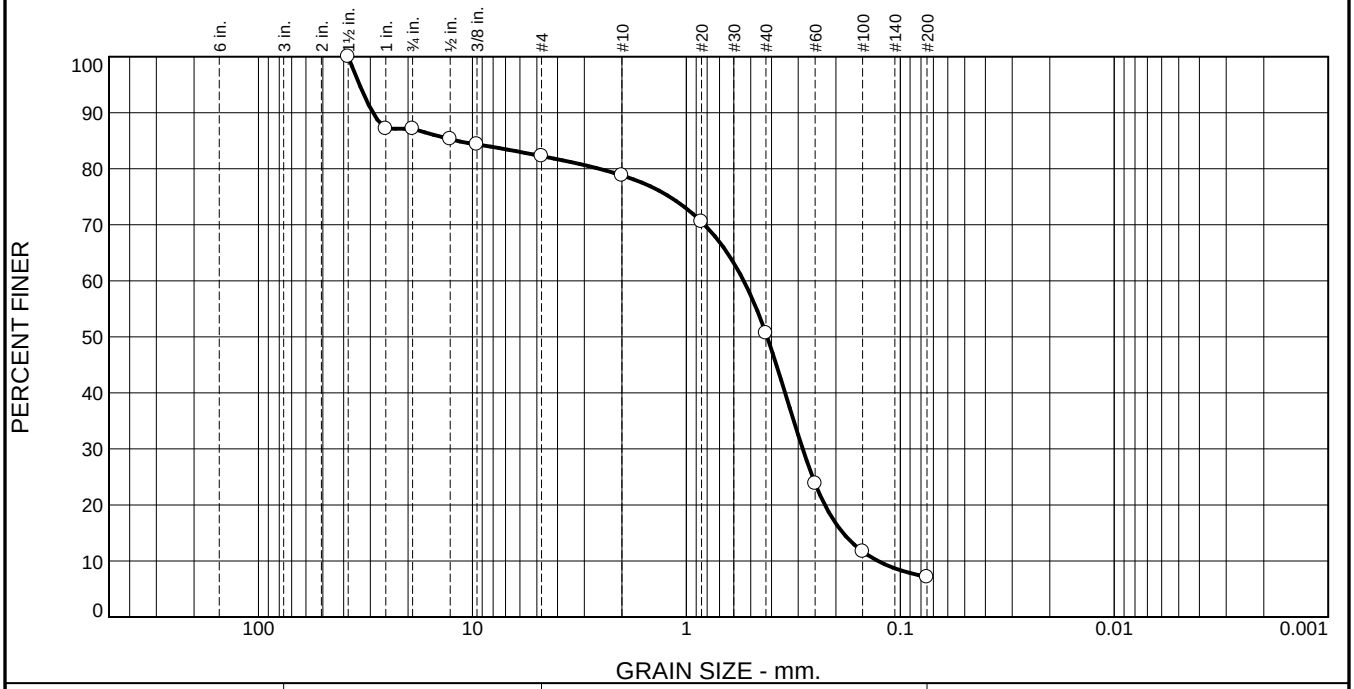
Date Sampled: 4/29/14

Krazan

Client: WA State Dept. of Enterprise Svcs., Facilities
Project: Fire Training Academy - New Burn Building

Project No: 09214005 **Figure**

Krazan & Associates Sieve Analysis



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.9	4.8	3.5	28.1	43.6	7.1	

Test Results (ASTM C-136 & ASTM C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100.0		
1	87.1		
.75	87.1		
.5	85.3		
.375	84.3		
#4	82.3		
#10	78.8		
#20	70.5		
#40	50.7		
#60	23.8		
#100	11.7		
#200	7.1		

* (no specification provided)

Material Description

Olive-gray poorly graded sand with silt and gravel

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=** A-3

Coefficients

D_{90}= 29.1600 D_{85}= 11.8799 D_{60}= 0.5393
D_{50}= 0.4191 D_{30}= 0.2861 D_{15}= 0.1854
D_{10}= 0.1272 C_u= 4.24 C_c= 1.19

Remarks

Sample ID: 48224-J.

Date Received: 5/12/14 **Date Tested:** 5/14/14

Tested By: Corbett Mercer

Checked By: Corbett Mercer

Title: Lab Manager

Location: Boring 5 **Date Sampled:** 4/29/14

Sample Number: 48224-J **Depth:** 12.5' - 14'

Krazan

Client: WA State Dept. of Enterprise Svcs., Facilities

Project: Fire Training Academy - New Burn Building

Project No: 09214005 **Figure**

KRAZAN & ASSOCIATES, INC. TESTING REPORT

Job Name: Fire Training Academy - New Burn Building
Job # : 092-14005

Client: WA State Dept. of Enterprises Svcs., Facilities
Date: 5/12/2014

Laboratory Determination of Water (Moisture) Content of Soils by Mass (ASTM D-2216)

Sample ID	Sample Description	Boring	Sample	Depth	Wet & Tare	Dry &Tare	Tare	Results
48224-D	Dark gray poorly graded sand with silt	B-3	--	10' - 11.5'	1965.8	1845.6	1252.1	**20.25%**
48224-E	Light gray silty sand	B-9	--	5' - 6.5'	1846.7	1752.9	1338.2	**22.62%**
48224-F	Gray silty sand with gravel	B-9	--	7.5' - 9'	1419.1	1352.2	965.1	**17.28%**
48224-G	Dark gray sand with silt and gravel	B-10	--	5' - 6.5'	1680.2	1660.7	1254.5	**4.80%**
48224-H	Olive-brown silty sand	B-13	--	13' - 14'	1920.9	1802.9	1257.8	**21.65%**
48224-I	Olive-gray silty sand with gravel	B-4	--	12.5' - 14'	1991.1	1901	1277.2	**14.44%**
48224-J	Olive-gray poorly graded sand with silt and gravel	B-5	--	12.5' - 14'	1895.0	1788.2	1235.9	**19.34%**

Amount of Material in Soils Finer Than the No. 200 Sieve (ASTM D-1140)

48224-F	Gray silty sand with gravel	B-9	--	7.5' - 9'	1352.2	1320.4	965.1	**8.2%**
48224-G	Dark gray sand with silt and gravel	B-10	--	5' - 6.5'	1660.7	1638.6	1254.5	**5.4%**

Tested By: Corbett Mercer

Checked By: Corbett Mercer Lab Manager

5/28/201411:39 AM

APPENDIX B

EARTHWORK SPECIFICATIONS

GENERAL

If the text of the report conflicts with the general specifications in this appendix, the recommendations in the report have precedence.

SCOPE OF WORK: These specifications and applicable plans pertain to and include all earthwork associated with the site rough grading, including but not limited to the furnishing of all labor, tools, and equipment necessary for site clearing and grubbing, stripping, preparation of foundation materials for receiving fill, excavation, processing, placement and compaction of fill and backfill materials to the lines and grades shown on the project grading plans, and disposal of excess materials.

PERFORMANCE: The Contractor shall be responsible for the satisfactory completion of all earthwork in accordance with the project plans and specifications. This work shall be inspected and tested by a representative of Krazan and Associates, Inc., hereinafter known as the Geotechnical Engineer and/or Testing Agency. Attainment of design grades when achieved shall be certified to by the project Civil Engineer. Both the Geotechnical Engineer and Civil Engineer are the Owner's representatives. If the contractor should fail to meet the technical or design requirements embodied in this document and on the applicable plans, he shall make the necessary readjustments until all work is deemed satisfactory as determined by both the Geotechnical Engineer and Civil Engineer. No deviation from these specifications shall be made except upon written approval of the Geotechnical Engineer, Civil Engineer or project Architect.

No earthwork shall be performed without the physical presence or approval of the Geotechnical Engineer. The Contractor shall notify the Geotechnical Engineer at least 2 working days prior to the commencement of any aspect of the site earthwork.

The Contractor agrees that he shall assume sole and complete responsibility for job site conditions during the course of construction of this project, including safety of all persons and property; that this requirement shall apply continuously and not be limited to normal working hours; and that the Contractor shall defend, indemnify and hold the Owner and the Engineers harmless from any and all liability, real or alleged, in connection with the performance of work on this project, except for liability arising from the sole negligence of the Owner of the Engineers.

TECHNICAL REQUIREMENTS: All compacted materials shall be densified to a density not less than 95 percent of maximum dry density as determined by ASTM Test Method D1557 as specified in the technical portion of the Geotechnical Engineering Report. The results of these tests and compliance with these specifications shall be the basis upon which satisfactory completion of work will be judged by the Geotechnical Engineer.

SOIL AND FOUNDATION CONDITIONS: The Contractor is presumed to have visited the site and to have familiarized himself with existing site conditions and the contents of the data presented in the soil report.

The Contractor shall make his own interpretation of the data contained in said report, and the Contractor shall not be relieved of liability under the contractor for any loss sustained as a result of any variance between conditions indicated by or deduced from said report and the actual conditions encountered during the progress of the work.

DUST CONTROL: The work includes dust control as required for the alleviation or prevention of any dust nuisance on or about the site or the borrow area, or off-site if caused by the Contractor's operation either during the performance of the earthwork or resulting from the conditions in which the Contractor leaves the site. The Contractor shall assume all liability, including Court costs of codefendants, for all claims related to dust or windblown materials attributable to his work.

SITE PREPARATION

Site preparation shall consist of site clearing and grabbing and preparations of foundation materials for receiving fill.

CLEARING AND GRUBBING: The Contractor shall accept the site in this present condition and shall demolish and/or remove from the area of designated project, earthwork all structures, both surface and subsurface, trees, brush, roots, debris, organic matter, and all other matter determined by the Geotechnical Engineer to be deleterious. Such materials shall become the property of the Contractor and shall be removed from the site.

Tree root systems in proposed building areas should be removed to a minimum depth of 3 feet and to such an extent which would permit removal of all roots larger than 1 inch. Tree root removed in parking areas may be limited to the upper 1½ feet of the ground surface. Backfill or tree root excavation should not be permitted until all exposed surfaces have been inspected and the Geotechnical Engineer is present for the proper control of backfill placement and compaction. Burning in areas, which are to receive fill materials, shall not be permitted.

SUBGRADE PREPARATION: Surfaces to receive Structural fill shall be prepared as outlined above, excavated/scarified to a depth of 12 inches, moisture-conditioned as necessary, and compacted to 95 percent compaction.

Loose and/or areas of disturbed soils shall be moisture conditioned and compacted to 95 percent compaction. All ruts, hummocks, or other uneven surface features shall be removed by surface grading prior to placement of any fill material. All areas which are to receive fill materials, shall be approved by the Geotechnical Engineer prior to the placement of any of the fill material.

EXCAVATION: All excavation shall be accomplished to the tolerance normally defined by the Civil Engineer as shown on the project grading plans. All over excavation below the grades specified shall be backfilled at the Contractor's expense and shall be compacted in accordance with the applicable technical requirements.

FILL AND BACKFILL MATERIAL: No material shall be moved or compacted without the presence of the Geotechnical Engineer. Material from the required site excavation may be utilized for construction site fills provided prior approval is given by the Geotechnical Engineer. All materials

utilized for constructing site fills shall be free from vegetation or other deleterious matter as determined by the Geotechnical Engineer.

PLACEMENT, SPREADING AND COMPACTION: The placement and spreading of approved fill materials and the processing and compaction of approved fill and native materials shall be the responsibility of the Contractor. However, compaction of fill materials by flooding, ponding, or jetting shall not be permitted unless specifically approved by local code, as well as the Geotechnical Engineer.

Both cut and fill shall be surface compacted to the satisfaction of the Geotechnical Engineer prior to final acceptance.

SEASONAL LIMITS: No fill material shall be placed, spread, or rolled while it is frozen or thawing or during unfavorable wet weather conditions. When the work is interrupted by heavy rains, fill operations shall not be resumed until the Geotechnical Engineer indicates that the moisture content and density of previously placed fill are as specified.

APPENDIX C

PAVEMENT SPECIFICATIONS

1. DEFINITIONS – The term "pavement" shall include asphalt concrete surfacing, untreated aggregate base, and aggregate subbase. The term "subgrade" is that portion of the area on which surfacing, base, or subbase is to be placed.

2. SCOPE OF WORK – This portion of the work shall include all labor, materials, tools and equipment necessary for and reasonable incidental to the completion of the pavement shown on the plans and as herein specified, except work specifically notes as "Work Not Included."

3. PREPARATION OF THE SUBGRADE – The Contractor shall prepare the surface of the various subgrades receiving subsequent pavement courses to the lines, grades, and dimensions given on the plans. The upper 12 inches of the soil subgrade beneath the pavement section shall be compacted to a minimum compaction of 95% of maximum dry density as determined by test method ASTM D1557. The finished subgrades shall be tested and approved by the Geotechnical Engineer prior to the placement of additional pavement of additional pavement courses.

4. AGGREGATE BASE – The aggregate base shall be spread and compacted on the prepared subgrade in conformity with the lines, grades, and dimensions shown on the plans. The aggregate base should conform to WSDOT Standard Specification for Crushed Surfacing Base Course or Top Course (Item 9-03.9(3)). The base material shall be compacted to a minimum compaction of 95% as determined by ASTM D1557. Each layer of subbase shall be tested and approved by the Geotechnical Engineer prior to the placement of successive layers.

5. ASPHALTIC CONCRETE SURFACING – Asphaltic concrete surfacing shall consist of a mixture of mineral aggregate and paving grade asphalt, mixed at central mixing plant and spread and compacted on a prepared base in conformity with the lines, grades, and dimensions shown on the plans. The viscosity grade of the asphalt shall be AR-4000. The mineral aggregate shall be WSDOT ½ inch Hot Mix Asphalt (HMA). The drying, proportioning, and mixing of the materials shall conform to WSDOT Specifications.

The prime coat, spreading and compacting equipment, and spreading and compacting the mixture shall conform to WSDOT Specifications, with the exception that no surface course shall be placed when the atmospheric temperature is below 50 degrees F. The surfacing shall be rolled with combination steel-wheel and pneumatic rollers, as described in WSDOT Specifications. The surface course shall be placed with an approved self-propelled mechanical spreading and finishing machine.

6. TACK COAT – The tack (mixing type asphaltic emulsion) shall conform to and be applied in accordance with the requirements of WSDOT Specifications.

July 1, 2014 KA Project No. 092-14005

State of Washington
Facilities Division
Engineering & Architectural Services
P.O. Box 41476
Olympia, Washington 98504-1476

Attention: Mr. Phil Timpke, R.A.
E&AS Project Manager

Reference: Geotechnical Engineering Investigation
DES Project # 2014-001
Fire Training Academy – New Burn Buildings
50810 Grouse Ridge Road
North Bend, Washington 98045

Dear Mr. Timpke,

This letter presents supplemental foundation recommendations for the proposed Fire Training Academy project located near North Bend, Washington. We previously issued a geotechnical engineering report for this project dated May 27, 2014.

Introduction

We received an email, dated June 28, 2014, from Mr. Roger LeBoeuf of ELA Engineers, requesting that we provide additional geotechnical engineering recommendations for ground improvement and a mat foundation for the proposed apartment burn building. Borings B-8 and B-9, in the area of the proposed apartment burn building, encountered approximately 17 feet of undocumented fill overlying competent native soils.

Recommendations

Raft/Mat Foundation: As an alternative to conventional spread footings, the foundations could be designed as a reinforced raft or mat to reduce the potential for differential settlement. A raft or mat foundation is a combined footing and slab that usually covers the entire area beneath a structure and supports all walls and columns. In order to reduce the effects of differential settlement we recommend that the raft or mat foundation to be placed on an improved subgrade. We recommend that underground utilities be installed with flexible connections due to the anticipated settlement.

We recommend improving the foundation subgrade with the placement of a two-foot thick layer of structural fill in the planned building location. The structural fill pad should also extend at least two feet horizontally beyond the edges of the building foundations. After the excavation of the building pad area, the exposed subgrade soil should be compacted to a firm and unyielding condition. Any areas of wet, loose/soft soils should be removed and replaced with structural fill. Depending on the subgrade soils exposed in the

excavation it may be necessary to place a geotextile over the base of the excavation such as Mirafi 500X or equivalent. The need for geotextile can be determined at the time of construction. A representative of the geotechnical engineer should evaluate the excavations and subgrade preparation prior to placement of structural fill.

The structural fill could consist of 2 to 4-inch rock spalls or granular soils compacted to at least 95 percent of the ASTM D 1557 maximum dry density for the materials. It may be feasible to use the excavated materials for the structural fill placement, provided the moisture content is near optimum, the material is granular, and there are not deleterious materials in the fill. If rock spalls are used, they may be capped with a layer of ¾-inch clean rock chips for grading purposes, if needed. The foundation excavation/subgrade and rock spall/structural fill placement should be monitored by a representative of the geotechnical engineer.

Building foundations should extend at least 18 inches below the lowest adjacent finished ground surface for frost protection and bearing capacity considerations. Footings should conform to current International Building Code (IBC) guidelines. Water should not be allowed to accumulate in foundation excavations. All loose or disturbed soil should be removed from the foundation excavations prior to placing concrete.

For the reinforced foundation design, we recommend a Modulus of Subgrade Reaction of no more than 200 pounds per cubic inch be used for the recommended layer of 2- to 4-inch rock spalls or structural fill overlying the undocumented fill soils.

For foundations constructed as outlined above, we recommend an allowable design bearing pressure of not more than **1,000 pounds per square foot (psf) be used for the structural mat design** if placed on at least two (2) feet of rock spalls or structural fill. A representative of Krazan and Associates should evaluate the foundation excavation and structural fill placement. Current IBC guidelines should be used when considering increased allowable bearing pressure for short-term transitory wind or seismic loads. The estimated potential foundation elastic settlement using the recommended 1,000 psf allowable bearing pressure should be less than 1.5 inches under static conditions. The rock fill/structural fill and structurally reinforced mat foundation should significantly reduce the potential for problems associated with differential settlement.

Lateral loads may be resisted by friction on the base of the foundation. A coefficient of friction of 0.35 may be used to calculate the base friction and should be applied to the vertical dead load only. This incorporates a safety factor of 1.5 applied to the estimated ultimate value for frictional resistance.

Testing and Inspection

A representative of Krazan & Associates, Inc. should be present at the site during the earthwork activities to confirm that actual subsurface conditions are consistent with the exploratory fieldwork. This activity is an integral part of our services as acceptance of earthwork construction is dependent upon compaction testing and stability of the material. This representative can also verify that the intent of these recommendations is incorporated into the project design and construction. Krazan & Associates, Inc. will not be responsible for grades or staking, since this is the responsibility of the Prime Contractor. Furthermore, Krazan & Associates is not responsible for the contractor's procedures, methods, scheduling or management of the work site.

LIMITATIONS

The recommendations made in this letter are based on the assumption that soil and groundwater conditions do not vary significantly from those disclosed during our field investigation. If any variations or undesirable conditions are encountered during construction, the geotechnical engineer should be notified so that supplemental recommendations can be made.

The information presented herein is based upon professional interpretation utilizing standard engineering practices and a degree of conservatism deemed proper for this project. It is not warranted that such information and interpretation cannot be superseded by future developments. We emphasize that this letter is valid for this project as outlined above, and should not be used for any other site.

We appreciate the opportunity to provide service to you on this project. If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (425) 485-5519.

Respectfully submitted,

KRAZAN & ASSOCIATES, INC.

07/01/14

Michael D. Rundquist, P.E.
Senior Project Manager

JGL:MDR

July 9, 2014 KA Project No. 092-14005

State of Washington
Facilities Division
Engineering & Architectural Services
P.O. Box 41476
Olympia, Washington 98504-1476

Attention: Mr. Phil Timpke, R.A.
E&AS Project Manager

Reference: Geotechnical Engineering Addendum Letter
Mat Foundation Subgrade Preparation and Frost Penetration Depth
DES Project # 2014-001
Fire Training Academy – New Burn Buildings
50810 Grouse Ridge Road
North Bend, Washington 98045

Dear Mr. Timpke,

This letter presents supplemental foundation recommendations for the proposed Fire Training Academy project located near North Bend, Washington. We previously issued a geotechnical engineering report for this project dated May 27, 2014. We also issued a geotechnical letter regarding raft/mat foundation recommendations, date July 1, 2014.

Introduction

We received an email, dated July 3, 2014, from Mr. Roger LeBoeuf of ELA Engineers, requesting that we provide additional geotechnical engineering recommendations for the apartment burn building foundation subgrade preparation as well as information regarding frost penetration depth.

In our geotechnical letter dated July 1, 2014, we recommended removing 2 feet of undocumented fill and then placing granular structural fill. We estimated that the potential foundation elastic settlement should be less than 1.5 inches under static conditions, using an allowable soil bearing pressure of not more than 1,000 pounds per square foot (psf). We have been requested to provide additional recommendations that would reduce the potential foundation settlement to less than 1 inch.

Our geotechnical report dated May 27, 2014 indicated a frost penetration depth of 18 inches below the ground surface. We have been requested to review the anticipated depth of frost penetration for the site location, and to update the frost penetration depth as appropriate.

Recommendations

Subgrade Preparation – Apartment Burn Building: We recommend removing a minimum of 4 feet of undocumented fill and replacing the material with structural fill in order to reduce the anticipated building settlement to less than 1-inch for a design bearing pressure of 1,000 psf. The structural fill should extend horizontally beyond the perimeter of the planned building at least 4 feet for lateral support. We recommend that the structural fill consist of granular material. It may be possible to re-use some of the excavated material, provided that it consists of sand and gravel, and is compacted to structural fill specifications.

Frost Penetration Depth: Typically, the anticipated maximum frost penetration depth is 18 inches for western Washington State based on the NOAA Geodetic Bench Marks. The project site is located at the base of the Cascade Mountains a few miles east of North Bend, Washington, at an elevation of roughly 1,500 feet above sea level. Accordingly, the maximum frost penetration depth could be greater than 18 inches.

We referred to PavementInteractive.org for more detailed information regarding frost depth in Washington State. The "Frost Depth Contour Map" indicates a frost depth of approximately 30 inches for the uplands east of North Bend.

Testing and Inspection

A representative of Krazan & Associates, Inc. should be present at the site during the earthwork activities to confirm that actual subsurface conditions are consistent with the exploratory fieldwork. This activity is an integral part of our services as acceptance of earthwork construction is dependent upon compaction testing and stability of the material. This representative can also verify that the intent of these recommendations is incorporated into the project design and construction. Krazan & Associates, Inc. will not be responsible for grades or staking, since this is the responsibility of the Prime Contractor. Furthermore, Krazan & Associates is not responsible for the contractor's procedures, methods, scheduling or management of the work site.

LIMITATIONS

The recommendations made in this letter are based on the assumption that soil and groundwater conditions do not vary significantly from those disclosed during our field investigation. If any variations or undesirable conditions are encountered during construction, the geotechnical engineer should be notified so that supplemental recommendations can be made.

The information presented herein is based upon professional interpretation utilizing standard engineering practices and a degree of conservatism deemed proper for this project. It is not warranted that such information and interpretation cannot be superseded by future developments. We emphasize that this letter is valid for this project as outlined above, and should not be used for any other site.

We appreciate the opportunity to provide service to you on this project. If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (425) 485-5519.

Respectfully submitted,

KRAZAN & ASSOCIATES, INC.

7/9/14

Michael D. Rundquist, P.E.
Senior Project Manager

JGL:MDR

November 6, 2014 KA Project No. 092-14005

State of Washington
Facilities Division
Engineering & Architectural Services
P.O. Box 41476
Olympia, Washington 98504-1476

Attention: Mr. Phil Timpke, R.A.
E&AS Project Manager

Reference: Geotechnical Engineering Investigation Addendum Letter
DES Project # 2014-001
Fire Training Academy – New Burn Buildings
50810 Grouse Ridge Road
North Bend, Washington 98045

Dear Mr. Timpke,

This letter is an addendum to our report titled "Geotechnical Engineering Investigation – Washington State Petrol Fire Training Academy – New Burn Buildings Project – 50810 Grouse Ridge Road, North Bend, Washington 98045," dated May 27, 2014. It has come to our attention that our May 27, 2014 geotechnical engineering report did not include recommendations for slab-on-grade subgrade preparation and geotechnical parameters for slab design. This letter presents our recommendations for floor slabs and exterior flatwork for this project.

Floor Slabs and Exterior Flatwork

Based on our explorations, the near surface soils at the site are interpreted as modified land consisting of loose fill and compact fill soils extending to depths of approximately 2 to 17 feet below the current ground surface. The modified ground fill material is anticipated to be quite variable with respect to soil types and relative densities. Our explorations did not encounter significant amounts of debris, compressible soil, organic soil, or other deleterious materials; however, such deleterious materials may be present in unexplored areas of the site. Further exploration of the areal extent, depth and composition of the fill may be needed as the structural plans become more defined during the project design process.

At a minimum, we recommend that 24 inches of any existing undocumented fill or loose subgrade be removed in the planned slab areas and be replaced with structural fill. However, if buried organic materials or debris are encountered in the fill, these materials should be removed from all slab areas.

If the existing fill is to be left in place, we recommend that the surface of the fill be compacted to a non-yielding condition using a heavy vibratory compactor. The resulting surface should be proof-rolled under a loaded dump truck. Areas observed to pump or weave during the proof-roll test should be over-excavated and replaced with structural fill or rock spalls to prepare a stable subgrade. If the existing fill is left in place, there may be an increased potential for settlement/cracking and maintenance of the slab.

Floor slabs supported on subgrade soils prepared as recommended may be designed using a modulus of subgrade reaction value of k = 150 pounds per cubic inch (pci).

In areas where it is desired to reduce floor dampness, such as areas covered with moisture sensitive floor coverings, we recommend that concrete slab-on-grade floors be underlain by a water vapor retarder system. According to ASTM Guidelines, the water vapor retarder should consist of a vapor retarder sheeting (recommended minimum 10 mil thickness) underlain by a minimum of 4-inches of compacted clean (less than 5 percent passing the U.S. Standard No. 200 Sieve), open-graded rock of ¾-inch maximum size. The vapor retarder sheeting should be protected from puncture damage.

The exterior floors should be placed separately in order to act independently of the walls and foundation system. All fill materials required to bring the building pads to grade should be placed as structural fill.

It is recommended that the utility trenches within the structure be compacted to structural fill specifications, as specified in this report, to minimize the transmission of moisture through the utility trench backfill. Special attention to the immediate drainage and irrigation around the building is recommended. Positive drainage should be established away from the structure and should be maintained throughout the life of the structure. Water should not be allowed to accumulate adjacent to the structure. Over-irrigation within landscaped areas adjacent to the structure should not be allowed. In addition, adequate ventilation of the structure (i.e. ventilation fans) is recommended to reduce the accumulation of interior moisture.

Testing and Inspection

A representative of Krazan & Associates, Inc. should be present at the site during the earthwork activities to confirm that actual subsurface conditions are consistent with the findings from exploratory fieldwork. This activity is an integral part of our services as acceptance of earthwork construction is dependent upon soil inspections, compaction testing and the stability of the material. This representative can also verify that the intent of these recommendations is incorporated into the project design and construction. Krazan & Associates, Inc. will not be responsible for grades or staking, since this is the responsibility of the Prime Contractor. Furthermore, Krazan & Associates is not responsible for the contractor's procedures, methods, scheduling or management of the work site.

Limitations

The recommendations made in this letter are based on the assumption that soil and groundwater conditions do not vary significantly from those disclosed during our field investigation. If any variations or undesirable conditions are encountered during construction, the geotechnical engineer should be notified so that supplemental recommendations can be made.

The information presented herein is based upon professional interpretation utilizing standard engineering practices and a degree of conservatism deemed proper for this project. It is not warranted that such information and interpretation cannot be superseded by future developments. We emphasize that this letter is valid for this project as outlined above, and should not be used for any other site.

We appreciate the opportunity to provide service to you on this project. If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (425) 485-5519.

Respectfully submitted,

KRAZAN & ASSOCIATES, INC.

11/6/14

Michael D. Rundquist, P.E.
Senior Project Manager

JGL:MDR

Krazan & ASSOCIATES, INC.

GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

November 20, 2014 KA Project No. 092-14005

State of Washington
Facilities Division
Engineering & Architectural Services
P.O. Box 41476
Olympia, Washington 98504-1476

Attention: Mr. Phil Timpke, R.A. email: phil.timpke@des.wa.gov
E&AS Project Manager phone: 360-377-8390

Reference: Geotechnical Engineering Investigation Addendum Letter
DES Project # 2014-001
Fire Training Academy – Retaining Walls
50810 Grouse Ridge Road
North Bend, Washington 98045

Dear Mr. Timpke,

This letter is an addendum to our report titled "Geotechnical Engineering Investigation – Washington State Patrol Fire Training Academy – New Burn Buildings Project – 50810 Grouse Ridge Road, North Bend, Washington 98045," dated May 27, 2014. Mr. Mark Davis, PE with Reid Middleton has informed us that the project will include retaining walls with surcharge loads due to slopes above the walls. Mr. Davis has also provided preliminary plan sheets C3.01, titled "Phase 2 Grading Plan" and C3.02, titled "Phase 1 Grading Plan," showing the planned wall locations and topography. This letter presents our recommendations for lateral pressures on these walls based on the planned slope geometry above the walls.

We understand that a wall is planned along a new road at the toe of an east-facing slope in the western portion of the project between the new apartment building and the new single family residence. The maximum slope in this area will be approximately 3 horizontal to 1 vertical (3H:1V).

We understand that a wall is planned along the toe of a north-facing slope along the south edge of the stormwater pond in the southeastern portion of the project. The maximum slope in this area will be approximately 2 horizontal to 1 vertical (2H:1V).

Lateral Earth Pressures

We have developed criteria for the design of retaining walls supporting slopes with inclinations of 3H: 1V and 2H:1V. Our design parameters are based on retention of the onsite soils. The parameters are also based on level ground conditions at the toe of the walls. The walls may be designed as "restrained" retaining walls based on "at-rest" earth pressures if movement is not acceptable. Unrestrained walls may be designed based on "active" earth pressures, if some movement of the retaining walls is acceptable. Acceptable lateral movement equal to at least 0.2 percent of the wall height would warrant the use of "active" earth pressure values for design.

The following table, titled **Wall Design Criteria**, presents the recommended soil related design parameters for retaining walls supporting slopes with inclinations of 3H:1V and 2H:1V. Contact Krazan & Associates, Inc. if an alternate retaining wall geometry is used.

Wall Design Criteria	
"At-rest" Conditions (Lateral Earth Pressure - LEP) 3 Horizontal to1 Vertical backslope	70 pcf (EFD – Equivalent Fluid Density)
"Active" Conditions (Lateral Earth Pressure - LEP) 3 Horizontal to1 Vertical backslope	45 pcf (EFD – Equivalent Fluid Density)
"At-rest" Conditions (Lateral Earth Pressure - LEP) 2 Horizontal to1 Vertical backslope;	82 pcf (EFD – Equivalent Fluid Density)
"Active" Conditions (Lateral Earth Pressure - LEP) 2 Horizontal to1 Vertical backslope	53 pcf (EFD – Equivalent Fluid Density)
Passive Earth Pressure on Toe (Low) Side of Wall (Allowable, includes F.S. = 1.5)	Neglect upper 2 feet, 200 pcf EFD in structural fill.
Soil-Footing Coefficient of Sliding Friction (Allowable; includes F.S. = 1.5)	0.35

The stated lateral earth pressures do not include the effects of water accumulation behind the walls (hydrostatic pressure) or loads imposed by construction equipment, roadways, or foundations (surcharge loads).

To minimize the lateral earth pressure and prevent the buildup of water pressure behind the wall adjacent to the road in the western portion of the site, a continuous footing drain (with cleanouts) should be placed along the base of the wall. The footing drains should consist of a minimum 4-inch diameter perforated pipe, sloped to drain, and with perforations placed near the bottom. The drain pipe should be enveloped by 6 inches of drain rock in all directions and wrapped with filter fabric to limit the migration of silt into the drain.

The backfill adjacent to the walls and extending a lateral distance of at least 12 inches behind the walls, should consist of free-draining granular material. All free-draining backfill should contain less than 5 percent fines (passing the U.S. Standard No. 200 Sieve) based upon the fraction passing the U.S. Standard ¾-inch Sieve. It should be realized that the primary purpose of the free-draining material is the reduction of hydrostatic pressure.

We recommend that the wall backfill be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557 (Modified Proctor). In-place density tests should be performed to verify adequate compaction. Soil compactors place transient surcharges on the wall and backfill. Consequently, only light hand-operated compaction equipment is recommended for use within 3 feet of walls so that excessive stress is not imposed on the walls. It would be prudent to cap the wall fill with a layer of 2-inch

minus crushed rock, at least one-foot thick, to support the toe of the slope and limit migration of surface water into the free draining material behind the wall.

We appreciate the opportunity to provide service to you on this project. If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (425) 485-5519.

Respectfully submitted,

KRAZAN & ASSOCIATES, INC.

11/20/14

Michael D. Rundquist, P.E.
Senior Project Manager

JGL:MDR

APPENDIX E

DRAINAGE COMPLAINTS

King County Water and Land Resources Division - Drainage Services Section

Complaint Search Printed : 2/6/2015 7:31:46 AM

Number	Type	Type of Problem			Address of Problem	Comments	Tbros Page
2000-0114	FCC	SWM FEE	50810	SE	GROUSE RIDGE RD	REQUEST TO DETERMINE SWM FEE	661J7
2005-0123	EM	MNM	50810	SE	GROUSE RIDGE RD	Related WQA 2008-0673	661J7
2008-0673	WQA	WQAI	50810	SE	GROUSE RIDGE RD	Related maintenance enforcement 2005-	661J7
2009-0900	FI	REM				2.9%	661J6

FCC = Commercial Facility Complaint
SWM FEE = SWM Fee questions
EM = Enforcement Maintenance
MNM = Needs Maintenance
WQA = Water Quality Site Audit
WQAI = Water Quality Audit Inspection
FI = Fee Investigation
REM = Remeasure

APPENDIX F

BOND QUANTITIES WORKSHEET

Site Improvement Bond Quantity Worksheet

King County

Department of Permitting & Environmental Review
35030 SE Douglas Street, Suite 210
Snoqualmie, Washington 98065-9266
206-296-6600 TTY Relay 711

For alternate formats, call 206-296-6600.

Project Name: WSP Fire Training Academy Burn Bldg Replacement
Location: FTA Campus, North Bend
Date: 28-Jul-15
Project No.:
Activity No.:

Clearing greater than or equal to 5,000 board feet of timber?

_____ yes x no

If yes,
Forest Practice Permit Number: _____
(RCW 76.09)

Note: All prices include labor, equipment, materials, overhead and profit. Prices are from RS Means data adjusted for the Seattle area or from local sources if not included in the RS Means database.

Unit prices updated: 3/2/2015
Version: 3/2/2015
Report Date: 7/28/2015

Site Improvement Bond Quantity Worksheet

		Reference #	Unit Price	Unit	Quantity	# of Applications	Cost
EROSION/SEDIMENT CONTROL	**Number**						
Backfill & compaction-embankment	**ESC-1**		$ 6.00	CY			
Check dams, 4" minus rock	**ESC-2**	SWDM 5.4.6.3	$ 80.00	Each	5	1	400
Crushed surfacing 1 1/4" minus	**ESC-3**	WSDOT 9-03.9(3)	$ 95.00	CY			
Ditching	**ESC-4**		$ 9.00	CY			
Excavation-bulk	**ESC-5**		$ 2.00	CY			
Fence, silt	**ESC-6**	SWDM 5.4.3.1	$ 1.50	LF	1330	1	1995
Fence, Temporary (NGPE)	**ESC-7**		$ 1.50	LF			
Hydroseeding	**ESC-8**	SWDM 5.4.2.4	$ 0.80	SY	1500	1	1200
Jute Mesh	**ESC-9**	SWDM 5.4.2.2	$ 3.50	SY			
Mulch, by hand, straw, 3" deep	**ESC-10**	SWDM 5.4.2.1	$ 2.50	SY			
Mulch, by machine, straw, 2" deep	**ESC-11**	SWDM 5.4.2.1	$ 2.00	SY			
Piping, temporary, CPP, 6"	**ESC-12**		$ 12.00	LF			
Piping, temporary, CPP, 8"	**ESC-13**		$ 14.00	LF			
Piping, temporary, CPP, 12"	**ESC-14**		$ 18.00	LF			
Plastic covering, 6mm thick, sandbagged	**ESC-15**	SWDM 5.4.2.3	$ 4.00	SY			
Rip Rap, machine placed; slopes	**ESC-16**	WSDOT 9-13.1(2)	$ 45.00	CY			
Rock Construction Entrance, 50'x15'x1'	**ESC-17**	SWDM 5.4.4.1	$ 1,800.00	Each			
Rock Construction Entrance, 100'x15'x1'	**ESC-18**	SWDM 5.4.4.1	$ 3,200.00	Each	2	1	6400
Sediment pond riser assembly	**ESC-19**	SWDM 5.4.5.2	$ 2,200.00	Each			
Sediment trap, 5' high berm	**ESC-20**	SWDM 5.4.5.1	$ 19.00	LF			
Sed. trap, 5' high, riprapped spillway berm section	**ESC-21**	SWDM 5.4.5.1	$ 70.00	LF			
Seeding, by hand	**ESC-22**	SWDM 5.4.2.4	$ 1.00	SY			
Sodding, 1" deep, level ground	**ESC-23**	SWDM 5.4.2.5	$ 8.00	SY			
Sodding, 1" deep, sloped ground	**ESC-24**	SWDM 5.4.2.5	$ 10.00	SY			
TESC Supervisor	**ESC-25**		$ 110.00	HR			
Water truck, dust control	**ESC-26**	SWDM 5.4.7	$ 140.00	HR			
WRITE-IN-ITEMS ** (see page 9)**							
				Each			

ESC SUBTOTAL:	$ 9,995.00
30% CONTINGENCY & MOBILIZATION:	$ 2,998.50
ESC TOTAL:	$ 12,993.50
COLUMN:	**A**

Site Improvement Bond Quantity Worksheet

Web date: 04/03/2015

				Existing Right-of-Way		Future Public Right of Way & Drainage Facilities		Private Improvements		
		Unit Price	Unit	Quant.	Cost	Quant.	Cost	Quant.	Cost	
GENERAL ITEMS	**No.**									
Backfill & Compaction- embankment	GI - 1	$ 6.00	CY							
Backfill & Compaction- trench	GI - 2	$ 9.00	CY							
Clear/Remove Brush, by hand	GI - 3	$ 1.00	SY							
Clearing/Grubbing/Tree Removal	GI - 4	$10,000.00	Acre					4.2	42,000.00	
Excavation - bulk	GI - 5	$ 2.00	CY					10900	21,800.00	
Excavation - Trench	GI - 6	$ 5.00	CY					2000	10,000.00	
Fencing, cedar, 6' high	GI - 7	$ 20.00	LF							
Fencing, chain link, vinyl coated, 6' high	GI - 8	$ 20.00	LF					790	15,800.00	
Fencing, chain link, gate, vinyl coated, 20	GI - 9	$ 1,400.00	Each							
Fencing, split rail, 3' high	GI - 10	$ 15.00	LF							
Fill & compact - common barrow	GI - 11	$ 25.00	CY					2000	50,000.00	
Fill & compact - gravel base	GI - 12	$ 27.00	CY							
Fill & compact - screened topsoil	GI - 13	$ 39.00	CY							
Gabion, 12" deep, stone filled mesh	GI - 14	$ 65.00	SY							
Gabion, 18" deep, stone filled mesh	GI - 15	$ 90.00	SY							
Gabion, 36" deep, stone filled mesh	GI - 16	$ 150.00	SY							
Grading, fine, by hand	GI - 17	$ 2.50	SY							
Grading, fine, with grader	GI - 18	$ 2.00	SY							
Monuments, 3' long	GI - 19	$ 250.00	Each							
Sensitive Areas Sign	GI - 20	$ 7.00	Each							
Sodding, 1" deep, sloped ground	GI - 21	$ 8.00	SY							
Surveying, line & grade	GI - 22	$ 850.00	Day							
Surveying, lot location/lines	GI - 23	$ 1,800.00	Acre							
Traffic control crew (2 flaggers)	GI - 24	$ 120.00	HR							
Trail, 4" chipped wood	GI - 25	$ 8.00	SY							
Trail, 4" crushed cinder	GI - 26	$ 9.00	SY							
Trail, 4" top course	GI - 27	$ 12.00	SY							
Wall, retaining, concrete	GI - 28	$ 55.00	SF					6000	330,000.00	
Wall, rockery	GI - 29	$ 15.00	SF							
		SUBTOTAL							469,600.00	

*KCC 27A authorizes only one bond reduction.

App F - Bond Qtty.xlsx

Unit prices updated: 03/02/2015
Version: 03/02/2015
Report Date: 7/28/2015

Site Improvement Bond Quantity Worksheet

				Existing Right-of-way		Future Public Right of Way & Drainage Facilities		Private Improvements		
		Unit Price	Unit	Quant.	Cost	Quant.	Cost	Quant.	Cost	
ROAD IMPROVEMENT	**No.**									
AC Grinding, 4' wide machine < 1000sy	RI - 1	$ 30.00	SY							
AC Grinding, 4' wide machine 1000-2000s	RI - 2	$ 16.00	SY							
AC Grinding, 4' wide machine > 2000sy	RI - 3	$ 10.00	SY							
AC Removal/Disposal	RI - 4	$ 35.00	SY					2100	73,500.00	
Barricade, type III (Permanent)	RI - 6	$ 56.00	LF							
Curb & Gutter, rolled	RI - 7	$ 17.00	LF					2600	44,200.00	
Curb & Gutter, vertical	RI - 8	$ 12.50	LF					1600	20,000.00	
Curb and Gutter, demolition and disposal	RI - 9	$ 18.00	LF							
Curb, extruded asphalt	RI - 10	$ 5.50	LF							
Curb, extruded concrete	RI - 11	$ 7.00	LF							
Sawcut, asphalt, 3" depth	RI - 12	$ 1.85	LF							
Sawcut, concrete, per 1" depth	RI - 13	$ 3.00	LF							
Sealant, asphalt	RI - 14	$ 2.00	LF							
Shoulder, AC, (see AC road unit price)	RI - 15	$ -	SY							
Shoulder, gravel, 4" thick	RI - 16	$ 15.00	SY							
Sidewalk, 4" thick	RI - 17	$ 38.00	SY					310	11,780.00	
Sidewalk, 4" thick, demolition and disposa	RI - 18	$ 32.00	SY							
Sidewalk, 5" thick	RI - 19	$ 41.00	SY							
Sidewalk, 5" thick, demolition and disposa	RI - 20	$ 40.00	SY							
Sign, handicap	RI - 21	$ 85.00	Each							
Striping, per stall	RI - 22	$ 7.00	Each					30	210.00	
Striping, thermoplastic, (for crosswalk)	RI - 23	$ 3.00	SF							
Striping, 4" reflectorized line	RI - 24	$ 0.50	LF					2000	1,000.00	
			SUBTOTAL						150,690.00	

*KCC 27A authorizes only one bond reduction.

App F - Bond Qtty.xlsx

Unit prices updated: 03/02/2015
Version: 03/02/2015
Report Date: 7/28/2015

Site Improvement Bond Quantity Worksheet

Web date: 04/03/2015

				Existing Right-of-way		Future Public Right of Way & Drainage Facilities		Private Improvements		
		Unit Price	Unit	Quant.	Cost	Quant.	Cost	Quant.	Cost	
ROAD SURFACING	**No.**	(4" Rock = 2.5 base & 1.5" top course) 9 1/2" Rock= 8" base & 1.5" top course)								
Additional 2.5" Crushed Surfacing	RS - 1	$ 3.60	SY					2100	7,560.00	
HMA 1/2" Overlay, 1.5"	RS - 2	$ 14.00	SY							
HMA 1/2" Overlay 2"	RS - 3	$ 18.00	SY							
HMA Road, 2", 4" rock, First 2500 SY	RS - 4	$ 28.00	SY							
HMA Road, 2", 4" rock, Qty. over 2500 SY	RS - 5	$ 21.00	SY							
HMA Road, 3", 9 1/2" Rock, First 2500 SY	RS - 6	$ 35.00	SY							
HMA Road, 3", 9 1/2" Rock, Qty Over 250	RS - 7	$ 42.00	SY					6700	281,400.00	
Not Used	RS - 8									
Not Used	RS - 9									
HMA Road, 6" Depth, First 2500 SY	RS - 10	$ 33.10	SY							
HMA Road, 6" Depth, Qty. Over 2500 SY	RS - 11	$ 30.00	SY							
HMA 3/4" or 1", 4" Depth	RS - 12	$ 20.00	SY							
Gravel Road, 4" rock, First 2500 SY	RS - 13	$ 15.00	SY							
Gravel Road, 4" rock, Qty. over 2500 SY	RS - 14	$ 10.00	SY							
PCC Road (Add Under Write-Ins w/Desig	RS - 15									
Thickened Edge	RS - 17	$ 8.60	LF					50	430.00	

SUBTOTAL 289,390.00

*KCC 27A authorizes only one bond reduction.

Unit prices updated: 03/02/2015
Version: 03/02/2015
Report Date: 7/28/2015

Site Improvement Bond Quantity Worksheet

Web date: 04/03/2015

				Existing Right-of-way		Future Public Right of Way & Drainage Facilities		Private Improvements		
		Unit Price	Unit	Quant.	Cost	Quant.	Cost	Quant.	Cost	
DRAINAGE (CPP = Corrugated Plastic Pipe, N12 or Equivalent) For Culvert prices, Average of 4' cover was assumed. Assume perforated PVC is same price as solid pipe.										
Access Road, R/D	D - 1	$ 21.00	SY							
Bollards - fixed	D - 2	$ 240.74	Each					20	4,814.80	
Bollards - removable	D - 3	$ 452.34	Each							
* (CBs include frame and lid)										
CB Type I	D - 4	$ 1,500.00	Each					16	24,000.00	
CB Type IL	D - 5	$ 1,750.00	Each							
CB Type II, 48" diameter	D - 6	$ 2,300.00	Each					7	16,100.00	
for additional depth over 4'	D - 7	$ 480.00	FT							
CB Type II, 54" diameter	D - 8	$ 2,500.00	Each							
for additional depth over 4'	D - 9	$ 495.00	FT							
CB Type II, 60" diameter	D - 10	$ 2,800.00	Each							
for additional depth over 4'	D - 11	$ 600.00	FT							
CB Type II, 72" diameter	D - 12	$ 3,600.00	Each							
for additional depth over 4'	D - 13	$ 850.00	FT							
Through-curb Inlet Framework (Add)	D - 14	$ 400.00	Each							
Cleanout, PVC, 4"	D - 15	$ 150.00	Each							
Cleanout, PVC, 6"	D - 16	$ 170.00	Each					40	6,800.00	
Cleanout, PVC, 8"	D - 17	$ 200.00	Each							
Culvert, PVC, 4"	D - 18	$ 10.00	LF							
Culvert, PVC, 6"	D - 19	$ 13.00	LF							
Culvert, PVC, 8"	D - 20	$ 15.00	LF							
Culvert, PVC, 12"	D - 21	$ 23.00	LF							
Culvert, CMP, 8"	D - 22	$ 19.00	LF							
Culvert, CMP, 12"	D - 23	$ 29.00	LF							
Culvert, CMP, 15"	D - 24	$ 35.00	LF							
Culvert, CMP, 18"	D - 25	$ 41.00	LF							
Culvert, CMP, 24"	D - 26	$ 56.00	LF							
Culvert, CMP, 30"	D - 27	$ 78.00	LF							
Culvert, CMP, 36"	D - 28	$ 130.00	LF							
Culvert, CMP, 48"	D - 29	$ 190.00	LF							
Culvert, CMP, 60"	D - 30	$ 270.00	LF							
Culvert, CMP, 72"	D - 31	$ 350.00	LF							

SUBTOTAL 51,714.80

Unit prices updated: 03/02/2015
Version: 03/02/2015
Report Date: 7/28/2015

*KCC 27A authorizes only one bond reduction.

Site Improvement Bond Quantity Worksheet

Web date: 04/03/2015

DRAINAGE CONTINUED				**Existing Right-of-way**		**Future Public Right of Way & Drainage Facilities**		**Private Improvements**		
	No.	Unit Price	Unit	Quant.	Cost	Quant.	Cost	Quant.	Cost	
Culvert, Concrete, 8"	D - 32	$ 25.00	LF							
Culvert, Concrete, 12"	D - 33	$ 36.00	LF							
Culvert, Concrete, 15"	D - 34	$ 42.00	LF							
Culvert, Concrete, 18"	D - 35	$ 48.00	LF							
Culvert, Concrete, 24"	D - 36	$ 78.00	LF							
Culvert, Concrete, 30"	D - 37	$ 125.00	LF							
Culvert, Concrete, 36"	D - 38	$ 150.00	LF							
Culvert, Concrete, 42"	D - 39	$ 175.00	LF							
Culvert, Concrete, 48"	D - 40	$ 205.00	LF							
Culvert, CPP, 6"	D - 41	$ 14.00	LF					1040	14560	
Culvert, CPP, 8"	D - 42	$ 16.00	LF					42	672	
Culvert, CPP, 12"	D - 43	$ 24.00	LF					1500	36000	
Culvert, CPP, 15"	D - 44	$ 35.00	LF					100	3500	
Culvert, CPP, 18"	D - 45	$ 41.00	LF							
Culvert, CPP, 24"	D - 46	$ 56.00	LF							
Culvert, CPP, 30"	D - 47	$ 78.00	LF							
Culvert, CPP, 36"	D - 48	$ 130.00	LF							
Ditching	D - 49	$ 9.50	CY							
Flow Dispersal Trench (1,436 base+)	D - 50	$ 28.00	LF							
French Drain (3' depth)	D - 51	$ 26.00	LF							
Geotextile, laid in trench, polypropylene	D - 52	$ 3.00	SY							
Mid-tank Access Riser, 48" dia, 6' deep	D - 54	$ 2,000.00	Each							
Pond Overflow Spillway	D - 55	$ 16.00	SY							
Restrictor/Oil Separator, 12"	D - 56	$ 1,150.00	Each							
Restrictor/Oil Separator, 15"	D - 57	$ 1,350.00	Each							
Restrictor/Oil Separator, 18"	D - 58	$ 1,700.00	Each					1	1700	
Riprap, placed	D - 59	$ 42.00	CY							
Tank End Reducer (36" diameter)	D - 60	$ 1,200.00	Each							
Trash Rack, 12"	D - 61	$ 350.00	Each							
Trash Rack, 15"	D - 62	$ 410.00	Each							
Trash Rack, 18"	D - 63	$ 480.00	Each							
Trash Rack, 21"	D - 64	$ 550.00	Each							

SUBTOTAL 56432

*KCC 27A authorizes only one bond reduction.

Unit prices updated: 03/02/2015
Version: 03/02/2015
Report Date: 7/28/2015

Site Improvement Bond Quantity Worksheet

Web date: 04/03/2015

				Existing Right-of-way		Future Public Right of Way & Drainage Facilities		Private Improvements		
		Unit Price	Unit	Quant.	Price	Quant.	Cost	Quant.	Cost	
PARKING LOT SURFACING					Not To Be Used For Roads Or Shoulders					
	No.									
2" AC, 2" top course rock & 4" borrow	PL - 1	$ 21.00	SY	NA		NA				
2" AC, 1.5" top course & 2.5" base cours	PL - 2	$ 28.00	SY	NA		NA				
4" select borrow	PL - 3	$ 5.00	SY	NA		NA				
1.5" top course rock & 2.5" base course	PL - 4	$ 14.00	SY	NA		NA				
UTILITY POLES & STREET LIGHTING					Utility pole relocation costs must be accompanied by **Franchise Utility's Cost Estimate**					
Utility Pole(s) Relocation	UP-1	Lump Sum								
Street Light Poles w/Luminaires	UP-2		Each							
WRITE-IN-ITEMS										
(Such as detention/water quality vaults.)	No.									
	WI - 1		Each							
	WI - 2		SY							
	WI - 3		CY							
	WI - 4		LF							
	WI - 5		FT							
	WI - 6									
	WI - 7									
	WI - 8									
	WI - 9									
	WI - 10									

SUBTOTAL			
SUBTOTAL (SUM ALL PAGES):			1,017,826.80
30% CONTINGENCY & MOBILIZATION:			305,348.04
GRANDTOTAL:			1,323,174.84
COLUMN:	**B**	**C**	**D**

*KCC 27A authorizes only one bond reduction.

App F - Bond Qtty.xlsx

Unit prices updated: 03/02/2015
Version: 03/02/2015
Report Date: 7/28/2015

Site Improvement Bond Quantity Worksheet

Web date: 04/03/2015

Original bond computations prepared by:

Name:	Mark Davis	**Date:**	7/28/2015
PE Registration Number:		**Tel. #:**	425-741-3800
Firm Name:	Reid Middleton, Inc		
Address:	728 134th St SW, Everett, WA 98204	**Project No:**	

FINANCIAL GUARANTEE REQUIREMENTS

		PERFORMANCE BOND* AMOUNT	MINIMUM BOND* AMOUNT REQUIRED FOR RECORDING OR TEMPORARY OCCUPANCY AT SUBSTANTIAL COMPLETION ***	PUBLIC ROAD & DRAINAGE MAINTENANCE/DEFECT BOND*
Stabilization/Erosion Sediment Control (ESC)	(A)	$ 12,993.5		
Existing Right-of-Way Improvements	(B)	$ -		
Future Public Right of Way & Drainage Facilities	(C)	$ -		
Private Improvements	(D)	$ 1,323,174.8		
Calculated Quantity Completed				
Total Right-of Way and/or Site Restoration Bond*/** (First $7,500 of bond* shall be cash.)	(A+B)	$ 12,993.5		
Performance Bond* Amount (A+B+C+D) = TOTAL	(T)	$ 1,336,168.3 Minimum is $2000.	T x 0.30 $ 400,850.5 Minimum is $2000.	
Maintenance/Defect Bond* Total				(B+C) x 0.25 = $ - Minimum is $2000.

NAME OF PERSON PREPARING BOND* REDUCTION: Mark Davis, PE Date:

*** NOTE:** The word "bond" as used in this document means a financial guarantee acceptable to King County.

**** NOTE:** KCC 27A authorizes right of way and site restoration bonds to be combined when both are required. The restoration requirement shall include the total cost for all TESC as a minimum, not a maximum. In addition, corrective work, both on- and off-site needs to be included. Quantities shall reflect worse case scenarios not just minimum requirements. For example, if a salmonid stream may be damaged, some estimated costs for restoration needs to be reflected in this amount. The 30% contingency and mobilization costs are computed in this quantity.

***** NOTE:** Per KCC 27A, total bond amounts remaining after reduction shall not be less than 30% of the original amount (T) or as revised by major design changes.

REQUIRED BOND* AMOUNTS ARE SUBJECT TO REVIEW AND MODIFICATION BY KING COUNTY

Check out the DDES Web site at www.kingcounty.gov/permits

APPENDIX G

DRAINAGE COVENANT

RECORDING REQUESTED BY AND
WHEN RECORDED MAIL TO:

DECLARATION OF COVENANT
PROHIBITING USE OF LEACHABLE METALS

Grantor: Washington State Patrol

Grantee: King County

Legal Description:

POR NW 1/4 OF NE 1/4 - BEG NW COR SD SUBD TH S 02-02-54 E 1039.18 FT TH N 89-58-57 E 1295 FT TH NLY ALG E LN SD SUBD 1030 FT TH WLY ALG N LN SD SUBD TO POB

Additional Legal(s) on:

Assessor's Tax Parcel ID#: 282309-9023

IN CONSIDERATION of the approved King County commercial permit for application No. COMM20-0008 relating to real property legally described above, the undersigned as Grantor(s), declares(declare) that the above described property is hereby established as having a prohibition on the use of leachable metals on those portions of the property exposed to the weather for the purpose of limiting metals in stormwater flows and is subject to the following restrictions.

The Grantor(s) hereby covenants(covenant) and agrees(agree) as follows: no leachable metal surfaces exposed to the weather will be allowed on the property. Leachable metal surfaces means a surface area that consists of or is coated with a non-ferrous metal that is soluble in water. Common leachable metal surfaces include, but are not limited to, galvanized steel roofing, gutters, flashing, downspouts, guardrails, light posts, and copper roofing. King County or its municipal successors shall

have a nonexclusive perpetual access easement on the Property in order to ingress and egress over the Property for the sole purposes of inspecting and monitoring that no leachable metal is present on the Property.

This easement/restriction is binding upon the Grantor(s), its heirs, successors, and assigns unless or until a new drainage or site plan is reviewed and approved by the Department of Development and Environmental Services or its successor.

IN WITNESS WHEREOF, this Declaration of Covenant is executed this _____ day of _____, 20_____.

_____
GRANTOR, owner of the Property

_____
GRANTOR, owner of the Property

STATE OF WASHINGTON)
COUNTY OF KING)ss.

On this day personally appeared before me:

_____, to me known to be the individual(s) described in and who executed the within and foregoing instrument and acknowledged that they signed the same as their free and voluntary act and deed, for the uses and purposes therein stated.

Given under my hand and official seal this _____ day of _____, 20_____.

_____

_____
Printed name
Notary Public in and for the State of Washington, residing at

_____

My appointment expires _____

RECORDING REQUESTED BY AND
WHEN RECORDED MAIL TO:

DECLARATION OF COVENANT

FOR MAINTENANCE AND INSPECTION OF FLOW CONTROL BMPS

Grantor: Washington State Patrol

Grantee: King County

Legal Description: POR NW 1/4 OF NE 1/4 - BEG NW COR SD SUBD TH S 02-02-54 E 1039.18 FT TH N 89-58-57 E 1295 FT TH NLY ALG E LN SD SUBD 1030 FT TH WLY ALG N LN SD SUBD TO POB

Additional Legal(s) on:

Assessor's Tax Parcel ID#: 282309-9023

IN CONSIDERATION of the approved King County (check one of the following) ☐ residential building permit, ☒ commercial building permit, ☐ clearing and grading permit, ☐ subdivision permit, or ☐ short subdivision permit for Application No. COMM20-0008 relating to the real property ("Property") described above, the Grantor(s), the owner(s) in fee of that Property, hereby covenants(covenant) with King County, a political subdivision of the state of Washington, and its municipal successors in interest and assigns ("King County" and "the County", or "its municipal successor"), that he/she(they) will observe, consent to, and abide by the conditions and obligations set forth and described in Paragraphs 1 through 8 below with regard to the Property. Grantor(s) hereby grants(grant), covenants(covenant), and agrees(agree) as follows:

1. Grantor(s) or his/her(their) successors in interest and assigns ("Owners") shall retain, uphold, and protect the stormwater management devices, features, pathways, limits, and restrictions, known as flow control best management practices ("BMPs"), shown on the approved Flow Control BMP Site Plan for the Property attached hereto and incorporated herein as Exhibit A.

2. The Owners shall at their own cost, operate, maintain, and keep in good repair, the Property's BMPs as described in the approved Design and Maintenance Details for each BMP attached hereto and incorporated herein as Exhibit B.

3. King County shall provide at least 30 days written notice to the Owners that entry on the Property is planned for the inspection of the BMPs. After the 30 days, the Owners shall allow King County to enter for the sole purpose of inspecting the BMPs. In lieu of inspection by the County, the Owners may elect to engage a licensed civil engineer registered in the state of Washington who has expertise in drainage to inspect the BMPs and provide a written report describing their condition. If the engineer option is chosen, the Owners shall provide written notice to the Director of the Water and Land Resources Division or its municipal successor in interest ("WLR") within fifteen days of receiving the County's notice of inspection. Within 30 days of giving this notice, the Owners, or the engineer on behalf of the Owners, shall provide the engineer's report to WLR. If the report is not provided in a timely manner as specified above, the County may inspect the BMPs without further notice.

4. If King County determines from its inspection, or from an engineer's report provided in accordance with Paragraph 3, that maintenance, repair, restoration, and/or mitigation work is required for the BMPs, WLR shall notify the Owners of the specific maintenance, repair, restoration, and/or mitigation work (Work) required under Title 9 of the King County Code ("KCC"). WLR shall also set a reasonable deadline for completing the Work or providing an engineer's report that verifies completion of the Work. After the deadline has passed, the Owners shall allow the County access to re-inspect the BMPs unless an engineer's report has been provided verifying completion of the Work. If the work is not completed properly within the time frame set by WLR, King County may initiate an enforcement action. Failure to

properly maintain the BMPs is a violation of KCC Chapter 9.04 and may subject the Owners to enforcement under the KCC, including fines and penalties.

5. Apart from performing routine landscape maintenance, the Owners are hereby required to obtain written approval from WLR before performing any alterations or modifications to the BMPs.

6. Any notice or approval required to be given by one party to the other under the provisions of this Declaration of Covenant shall be effective upon personal delivery to the other party, or after three (3) days from the date that the notice or approval is mailed with delivery confirmation to the current address on record with each Party. The parties shall notify each other of any change to their addresses.

7. This Declaration of Covenant is intended to promote the efficient and effective management of surface water drainage on the Property, and it shall inure to the benefit of all the citizens of King County and its municipal successors and assigns. This Declaration of Covenant shall run with the land and be binding upon Grantor(s), and Grantor's(s') successors in interest and assigns.

8. This Declaration of Covenant may be terminated by execution of a written agreement by the Owners and King County that is recorded by King County in its real property records.

IN WITNESS WHEREOF, this Declaration of Covenant for the Maintenance and Inspection of Flow Control BMPs is executed this _____ day of _____, 20_____.

_____
GRANTOR, owner of the Property

_____
GRANTOR, owner of the Property

STATE OF WASHINGTON)
COUNTY OF KING)ss.

On this day personally appeared before me:

_____, to me known to be the individual(s) described in and who executed the within and foregoing instrument and acknowledged that they signed the same as their free and voluntary act and deed, for the uses and purposes therein stated.

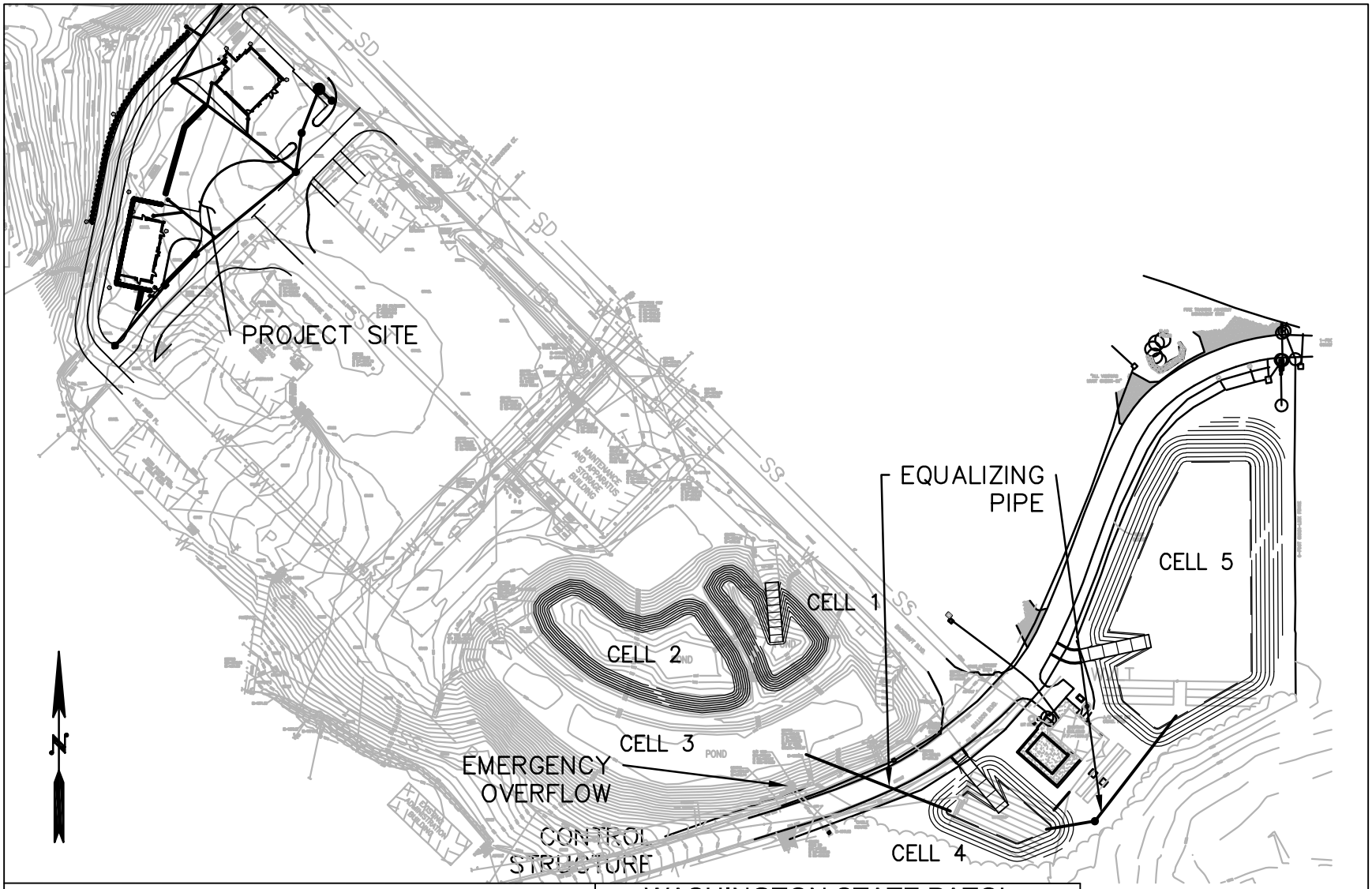
Given under my hand and official seal this _____ day of _____, 20_____.

_____

_____
Printed name
Notary Public in and for the State of Washington, residing at

_____

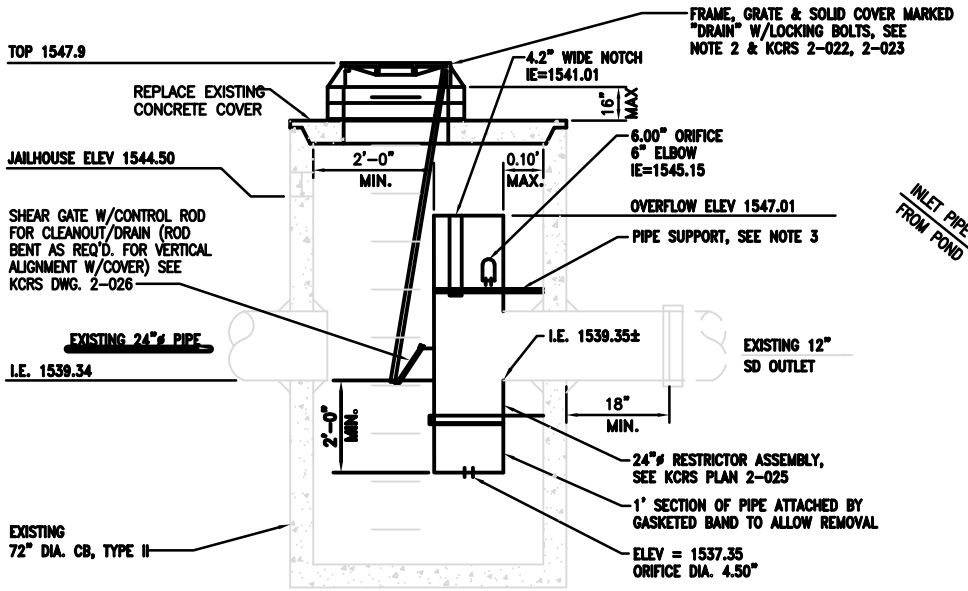
My appointment expires _____



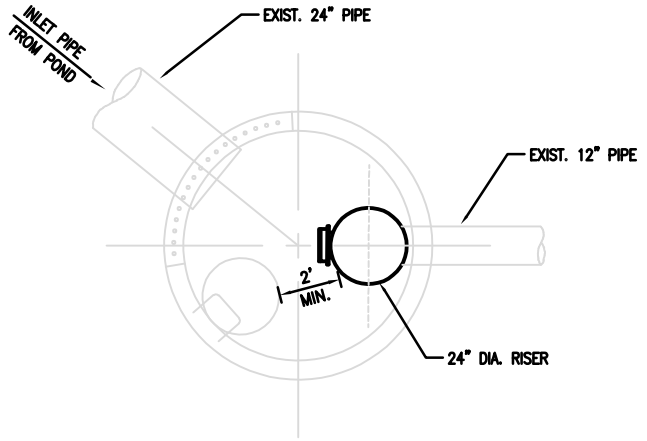
ReidMiddleton
728 134th Street SW Suite 200
Everett, Washington 98204
Ph: 425 741-3800

WASHINGTON STATE PATOL
FTA BURN BLDG PROJECT
EXHIBIT A - FLOW CONTROL

FILE NO. 21.2018.019 | DATE 03-31-2021



SECTION VIEW



PLAN VIEW

NOTES:

1. ALL ORIFICES SHALL BE SHARP EDGED AND SHOP DRILLED.
2. METAL PARTS: CORROSION RESISTANT. NON-GALVANIZED PARTS PREFERRED.
3. PROVIDE AT LEAST ONE 3"x.090 GA SUPPORT BRACKET ANCHORED TO CONCRETE WALL. (MAXIMUM 3'-0" VERTICAL SPACING).
4. LOCATE ELBOW RESTRICTOR(S) AS NECESSARY TO 2' MIN. CLEARANCE. AS SHOWN.

CONTROL STRUCTURE DETAIL

Reid Middleton
728 134th Street SW Suite 200
Everett, Washington 98204
Ph: 425 741-3800

WASHINGTON STATE PATOL
FTA BURN BLDG PROJECT
EXHIBIT B - DETAILS

FILE NO. 21.2018.019 | DATE 03-31-2021

NO. 1 – DETENTION PONDS

Maintenance Component	Defect or Problem	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
Site	Trash and debris	Any trash and debris which exceed 1 cubic foot per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size office garbage can). In general, there should be no visual evidence of dumping.	Trash and debris cleared from site.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Grass/groundcover	Grass or groundcover exceeds 18 inches in height.	Grass or groundcover mowed to a height no greater than 6 inches.
Top or Side Slopes of Dam, Berm or Embankment	Rodent holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents removed or destroyed and dam or berm repaired.
	Tree growth	Tree growth threatens integrity of slopes, does not allow maintenance access, or interferes with maintenance activity. If trees are not a threat or not interfering with access or maintenance, they do not need to be removed.	Trees do not hinder facility performance or maintenance activities.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted slope.	Slopes stabilized using appropriate erosion control measures. If erosion is occurring on compacted slope, a licensed civil engineer should be consulted to resolve source of erosion.
	Settlement	Any part of a dam, berm or embankment that has settled 4 inches lower than the design elevation.	Top or side slope restored to design dimensions. If settlement is significant, a licensed civil engineer should be consulted to determine the cause of the settlement.
Storage Area	Sediment accumulation	Accumulated sediment that exceeds 10% of the designed pond depth.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
	Liner damaged (If Applicable)	Liner is visible or pond does not hold water as designed.	Liner repaired or replaced.
Inlet/Outlet Pipe.	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.
Emergency Overflow/Spillway	Tree growth	Tree growth impedes flow or threatens stability of spillway.	Trees removed.
	Rock missing	Only one layer of rock exists above native soil in area five square feet or larger or any exposure of native soil on the spillway.	Spillway restored to design standards.

NO. 4 – CONTROL STRUCTURE/FLOW RESTRICTOR

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Structure	Trash and debris	Trash or debris of more than ½ cubic foot which is located immediately in front of the structure opening or is blocking capacity of the structure by more than 10%.	No Trash or debris blocking or potentially blocking entrance to structure.
		Trash or debris in the structure that exceeds $^1/_3$ the depth from the bottom of basin to invert the lowest pipe into or out of the basin.	No trash or debris in the structure.
		Deposits of garbage exceeding 1 cubic foot in volume.	No condition present which would attract or support the breeding of insects or rodents.
	Sediment	Sediment exceeds 60% of the depth from the bottom of the structure to the invert of the lowest pipe into or out of the structure or the bottom of the FROP-T section or is within 6 inches of the invert of the lowest pipe into or out of the structure or the bottom of the FROP-T section.	Sump of structure contains no sediment.
	Damage to frame and/or top slab	Corner of frame extends more than ¾ inch past curb face into the street (If applicable).	Frame is even with curb.
		Top slab has holes larger than 2 square inches or cracks wider than ¼ inch.	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than ¾ inch of the frame from the top slab.	Frame is sitting flush on top slab.
	Cracks in walls or bottom	Cracks wider than ½ inch and longer than 3 feet, any evidence of soil particles entering structure through cracks, or maintenance person judges that structure is unsound.	Structure is sealed and structurally sound.
		Cracks wider than ½ inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering structure through cracks.	No cracks more than $^1/_4$ inch wide at the joint of inlet/outlet pipe.
	Settlement/ misalignment	Structure has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards.
	Damaged pipe joints	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering the structure at the joint of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of inlet/outlet pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Ladder rungs missing or unsafe	Ladder is unsafe due to missing rungs, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
FROP-T Section	Damage	T section is not securely attached to structure wall and outlet pipe structure should support at least 1,000 lbs of up or down pressure.	T section securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
		Connections to outlet pipe are not watertight or show signs of deteriorated grout.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes—other than designed holes—in the structure.	Structure has no holes other than designed holes.

NO. 4 – CONTROL STRUCTURE/FLOW RESTRICTOR

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Cleanout Gate	Damaged or missing	Cleanout gate is missing.	Replace cleanout gate.
		Cleanout gate is not watertight.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
Orifice Plate	Damaged or missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
	Deformed or damaged lip	Lip of overflow pipe is bent or deformed.	Overflow pipe does not allow overflow at an elevation lower than design
Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.
Metal Grates (If Applicable)	Unsafe grate opening	Grate with opening wider than $^{7}/_{8}$ inch.	Grate opening meets design standards.
	Trash and debris	Trash and debris that is blocking more than 20% of grate surface.	Grate free of trash and debris. footnote to guidelines for disposal
	Damaged or missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.
Manhole Cover/Lid	Cover/lid not in place	Cover/lid is missing or only partially in place. **Any open structure requires urgent maintenance**.	Cover/lid protects opening to structure.
	Locking mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to Remove	One maintenance person cannot remove cover/lid after applying 80 lbs. of lift.	Cover/lid can be removed and reinstalled by one maintenance person.

APPENDIX H

STORMWATER FACILITY SUMMARY SHEET

STORMWATER FACILITY SUMMARY SHEET

(provide one Stormwater Facility Summary Sheet per Natural Discharge Location)

DPER Permit No. COMM20-0008
Date 07/13/21
NPDES Permit No. _____

OVERVIEW:

Project Name WSP FTA Burn Building

Project Location 50810 SE Grouse Ridge Rd
North Bend, WA 98045

Parcel No. 282309-9023
Retired Parcel No. _____

Downstream Drainage Basins:

Major Basin Name Snoqualmie River

Immediate Basin Name _____

Project includes Landscape Management Plan? (include copy with TIR as Appendix) yes ☐ no ☒

Declarations of Covenant	Recording No.
Leachable Metals	
Impervious Surface Limit	
Flow Control BMPs	
Clearing Limit	
Drainage Facility	
Landscape Management Plan	

GENERAL FACILITY INFORMATION:

Detention		Infiltration		Water Quality		Flow Control Performance Std
Type	*# of*	*Type*	*# of*	*Type*	*# of facilities*	
Ponds	1	Ponds		Ponds	1	☐ Basic
Vaults		Tanks		Vaults		☒ Conservation
Tanks		Trenches		Tanks		☐ Flood Problem

If no flow control facility, check one:

- ☐ Project qualifies for KCSWDM Exemption (KCSWDM 1.2.3):
  - ☐ Basic Exemption
  - ☐ Impervious Surface Exemption for Transportation Redevelopment projects
  - ☐ Cost Exemption for Parcel Redevelopment projects
  - ☐ Direct Discharge Exemption
  - ☐ Other _____
- ☐ Project qualifies for 0.1 cfs Exception per KCSWDM 1.2.3
- ☐ No flow control required per approved KCSWDM Adjustment No. _____
- ☐ Flow control provided in regional/shared facility per approved approved KCSWDM Adjustment No. _____
  Shared Facility Name/Location: _____
- ☐ No flow control required (other, provide justification):
  _____

TREATMENT SUMMARY FOR TOTAL IMPERVIOUS SURFACES

(Applies to Commercial parcels only)	Area	% of Total
Total Acreage **(ac)**	18.51	-----
Total Impervious Acreage **(ac)**	9.81	46%
Total impervious surface served by flow control facility(ies) **(sq ft)**		
Impervious surface served by flow control facility(ies) designed 1990 or later **(sq ft)**		
Impervious surface served by pervious surface absorption **(sq ft)**		
Impervious surface served by approved water quality facility(ies) **(sq ft)**	9.81	46%

PROVIDE FACILITY DETAILS AND FACILITY SKETCH FOR EACH FACILITY ON REVERSE. USE ADDITIONAL SHEETS AS NEEDED FOR ADDITIONAL FACILITIES

STORMWATER FACILITY SUMMARY SHEET

DPER Permit No. COMM20-0008

(provide one Stormwater Facility Summary Sheet per *Natural Discharge Location)*

Project Name	WSP FTA Burn Building
Project Location	50810 SE Grouse Ridge Rd North Bend, WA 98045

Downstream Drainage Basins:
Major Basin Name Snoqualmie River
Immediate Basin Name _____

FLOW CONTROL FACILITY: Basin:

Facility Name/Number Ex. Pond (Cells 1-3)
Facility Location Onsite
☐ New Facility
☒ Existing Facility

UIC? ☐ yes ☒ no **UIC Site ID:**

Live Storage Volume 355,100 CF ☐ cu.ft. ☐ ac.ft.
Live Storage Depth (ft) 7
Volume Factor of Safety _____

Project Impervious Acres Served 9.81
% of Total Project Impervious Acres Served 46%
No. of Lots Served _____

Control Structure location: Ex. pond
Type of Control Structure:
☐ Riser in vault
☒ Riser in Type II CB
☐ Weir in Type II CB

No. of Orifices/Restrictions 2
Size of Orifice/Restriction (in.) (numbered starting with lowest orifice): (inches in decimal format)
No.1 4.5
No.2 6"
No.3 _____
No.4 _____

Dam Safety Regulations (WA State Dept of Ecology):

Reservoir Volume above natural grade		☐ cu.ft. ☐ ac.ft.
Depth of Reservoir above natural grade		(ft)

WATER QUALITY FACILITIES

Indicate no. of water quality facilities/BMPs for each type:

_____ Flow dispersion
_____ Filter strip
_____ Biofiltration swale ☐ *regular,* ☐ *wet or* ☐ *continuous inflow*
_____ Wetvault ☐ *combined w/detention*
1 Wetpond ☐ *basic* ☐ *large* ☒ *combined w/detention*
_____ Pre-settling pond
_____ Stormwater wetland
_____ Sand filter ☐ *basic* ☐ *large* ☐ *regular* ☐ *linear* ☐ *vault*
Sand bed depth (inches) _____
● Is facility lined? ☐ yes ☐ no If so, what marker is used above liner? _____

Design Information

Water Quality design flow (cfs)
Water Quality treated volume (sandfilter) (cu.ft.)
Water Quality storage volume (wetpool) (cu.ft.) 159,500
☐ **Landscape management plan** ☐ **Farm management plan**

_____ High flow bypass structure (e.g., flow-splitter catch basin)
_____ Oil/water separator ☐ *baffle* ☐ *coalescing plate*
_____ Storm filter
_____ Pre-settling structure (Manufacturer:_____)
_____ Catch basin inserts (Manufacturer:_____)
_____ Source controls _____

Facility Summary Sheet Sketch: All detention, infiltration and water quality facilities must include a detailed sketch (11"x17" reduced size plan sheets preferred).

STORMWATER FACILITY SUMMARY SHEET

(provide one Stormwater Facility Summary Sheet per Natural Discharge Location)

DPER Permit No. COMM20-0008
Date 07/13/21
NPDES Permit No. _____

OVERVIEW:

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Project Location 50810 SE Grouse Ridge Rd
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Retired Parcel No. _____

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Declarations of Covenant	Recording No.
Leachable Metals	
Impervious Surface Limit	
Flow Control BMPs	
Clearing Limit	
Drainage Facility	
Landscape Management Plan	

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Detention		Infiltration		Water Quality		Flow Control Performance Std
Type	*# of*	*Type*	*# of*	*Type*	*# of facilities*	
Ponds	2	Ponds		Ponds	1	☐ Basic
Vaults		Tanks		Vaults		☒ Conservation
Tanks		Trenches		Tanks		☐ Flood Problem

If no flow control facility, check one:

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  - ☐ Other _____
- ☐ Project qualifies for 0.1 cfs Exception per KCSWDM 1.2.3
- ☐ No flow control required per approved KCSWDM Adjustment No. _____
- ☐ Flow control provided in regional/shared facility per approved approved KCSWDM Adjustment No. _____
  Shared Facility Name/Location: _____
- ☐ No flow control required (other, provide justification):
  _____

TREATMENT SUMMARY FOR TOTAL IMPERVIOUS SURFACES

(Applies to Commercial parcels only)	Area	% of Total
Total Acreage **(ac)**	14.98	-----
Total Impervious Acreage **(ac)**	11.68	54%
Total impervious surface served by flow control facility(ies) **(sq ft)**		
Impervious surface served by flow control facility(ies) designed 1990 or later **(sq ft)**		
Impervious surface served by pervious surface absorption **(sq ft)**		
Impervious surface served by approved water quality facility(ies) **(sq ft)**	11.68	54%

PROVIDE FACILITY DETAILS AND FACILITY SKETCH FOR EACH FACILITY ON REVERSE. USE ADDITIONAL SHEETS AS NEEDED FOR ADDITIONAL FACILITIES

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DPER Permit No. COMM20-0008

(provide one Stormwater Facility Summary Sheet per *Natural Discharge Location)*

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Major Basin Name Snoqualmie River
Immediate Basin Name _____

FLOW CONTROL FACILITY: Basin:

Facility Name/Number Cells 4 and 5 ☒ New Facility ☐ Existing Facility
Facility Location Onsite
UIC? ☐ yes ☒ no **UIC Site ID:**

Live Storage Volume	267,645 CF	☐ cu.ft. ☐ ac.ft.	Live Storage Depth (ft)	7	Volume Factor of Safety

Project Impervious Acres Served 11.68
% of Total Project Impervious Acres Served 54%
No. of Lots Served

Control Structure location: Ex. Pond
Type of Control Structure:
☐ Riser in vault
☒ Riser in Type II CB
☐ Weir in Type II CB

No. of Orifices/Restrictions 2
Size of Orifice/Restriction (in.) (numbered starting with lowest orifice): (inches in decimal format)
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No.2 6"
No.3
No.4

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_____ Pre-settling pond
_____ Stormwater wetland
_____ Sand filter ☐ *basic* ☐ *large* ☐ *regular* ☐ *linear* ☐ *vault* Sand bed depth (inches) _____
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