Stormwater Plan

SOUTH HILL SUPPORT CAMPUS IMPROVEMENTS

Puyallup, WA

Prepared for

Puyallup School District
1501 39th Ave SW
Puyallup, WA. 98371

Prepared by

JMJ TEAM
905 Main St
Sumner, WA 98390
206.596.2020
Justin Jones, PE

October 24, 2023

JMJTEAM

PROJECT ENGINEER'S CERTIFICATION

I hereby certify that this Stormwater Plan for the South Hill Support Campus Improvements – Phase 1 in Puyallup has been prepared by me or under my supervision and meets minimum standards of Washington State Department of Ecology and normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me.

Justin Jones, PE

JUSTIN M. JONES
STATE OF WASHINGTON
41829
REGISTERED
PROFESSIONAL ENGINEER

10-24-2023

TABLE OF CONTENTS

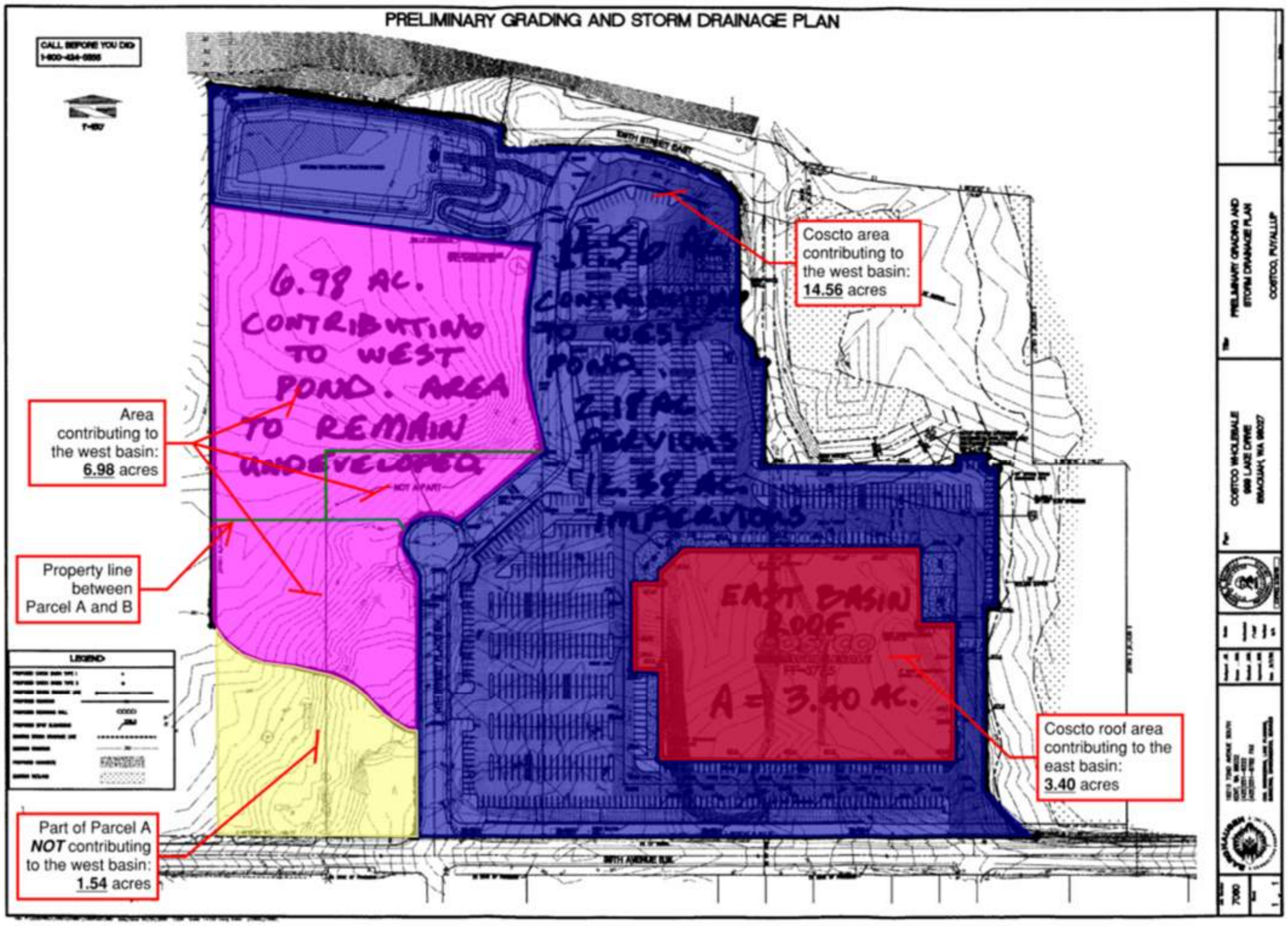
PROJECT OVERVIEW AND MAPS

The South Hill Support Campus Improvements project is located in Puyallup, WA with 17th St. SW to the west, 14th St. Pl SW to the east, 39th Ave SW to the south and WA-512 to the north.

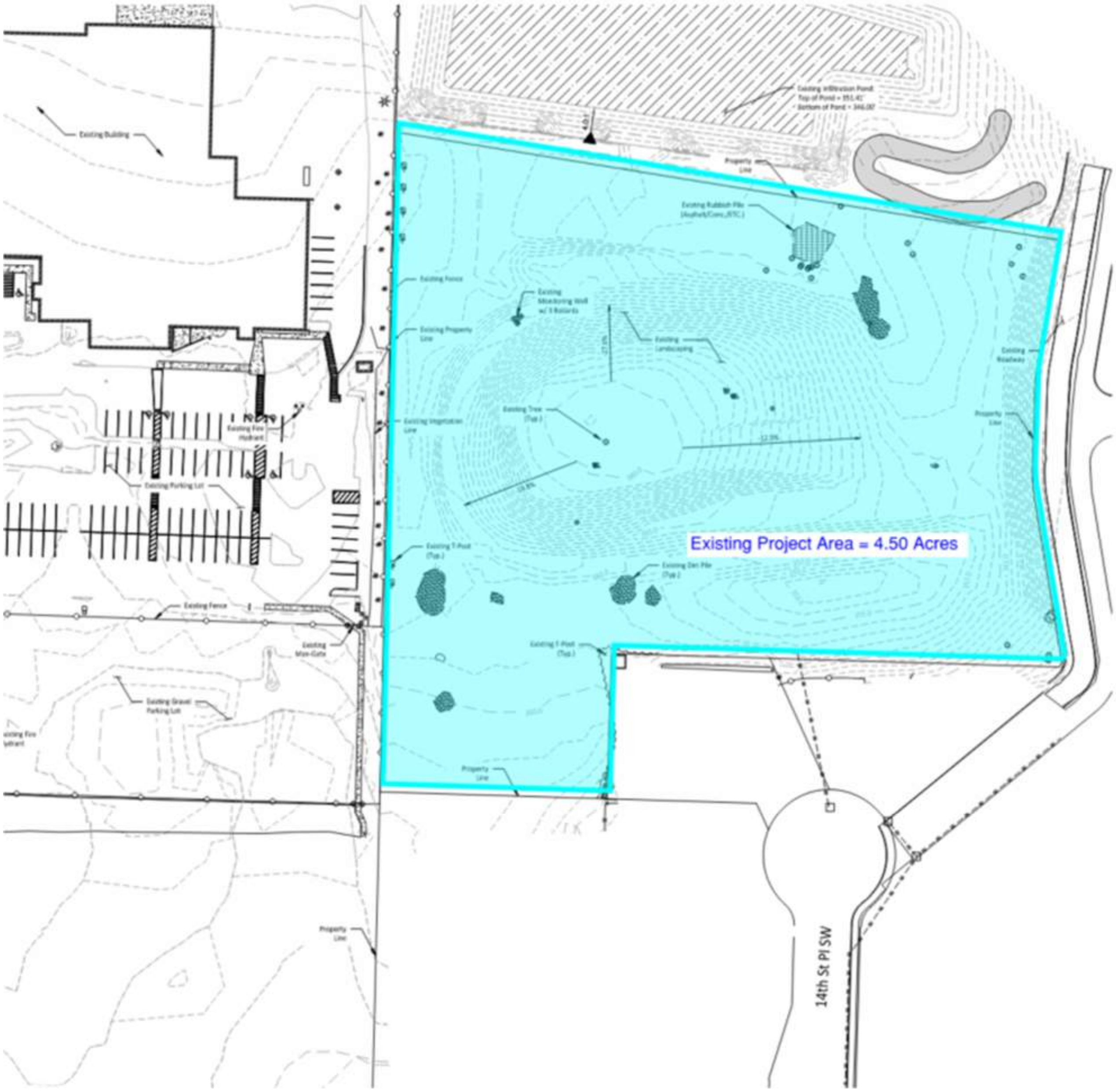
The project includes re-grading of the newly acquired parcel, adding an asphalt parking lot that connects to the existing site. The parking lot will be broken out into two designated areas with the north portion of the lot reserved for SPED bus parking and the south portion reserved for standard car parking. The SPED parking lot will be accessed along the north of the existing building to the west. The passenger vehicle parking lot with be accessed via a new driveway into the existing parking lot located south of the existing building.

EXISTING CONDITIONS SUMMARY

The project area is 4.5 acres which will be added to the existing South Hill Support Campus site which has an onsite infiltration pond system. The existing conditions for the project area consist of grass vegetation and a mound located in the center of the project area that was left over from the development of the adjoining parcel to the east (Costco). Stormwater runoff of the project area infiltrates into the ground and sheet flows to the adjacent infiltration pond that is owned by Costco. The Costco infiltration pond was designed to accommodate existing conditions flows from the project area. Below is a snip of Costco infiltration pond basin sizing.



EXISTING STORMWATER BASIN MAP



PROPOSED CONDITIONS SUMMARY

The South Hill Support Campus Improvement project proposes the addition of an asphalt parking lot, stormwater improvements, and landscaping for the parking of small size buses and employee parking. The project will also construct an infiltration overflow system to convey stormwater overflow to the Costco pond from the project site and the property adjoining the southern boundary of the project site which is also owned by Costco.

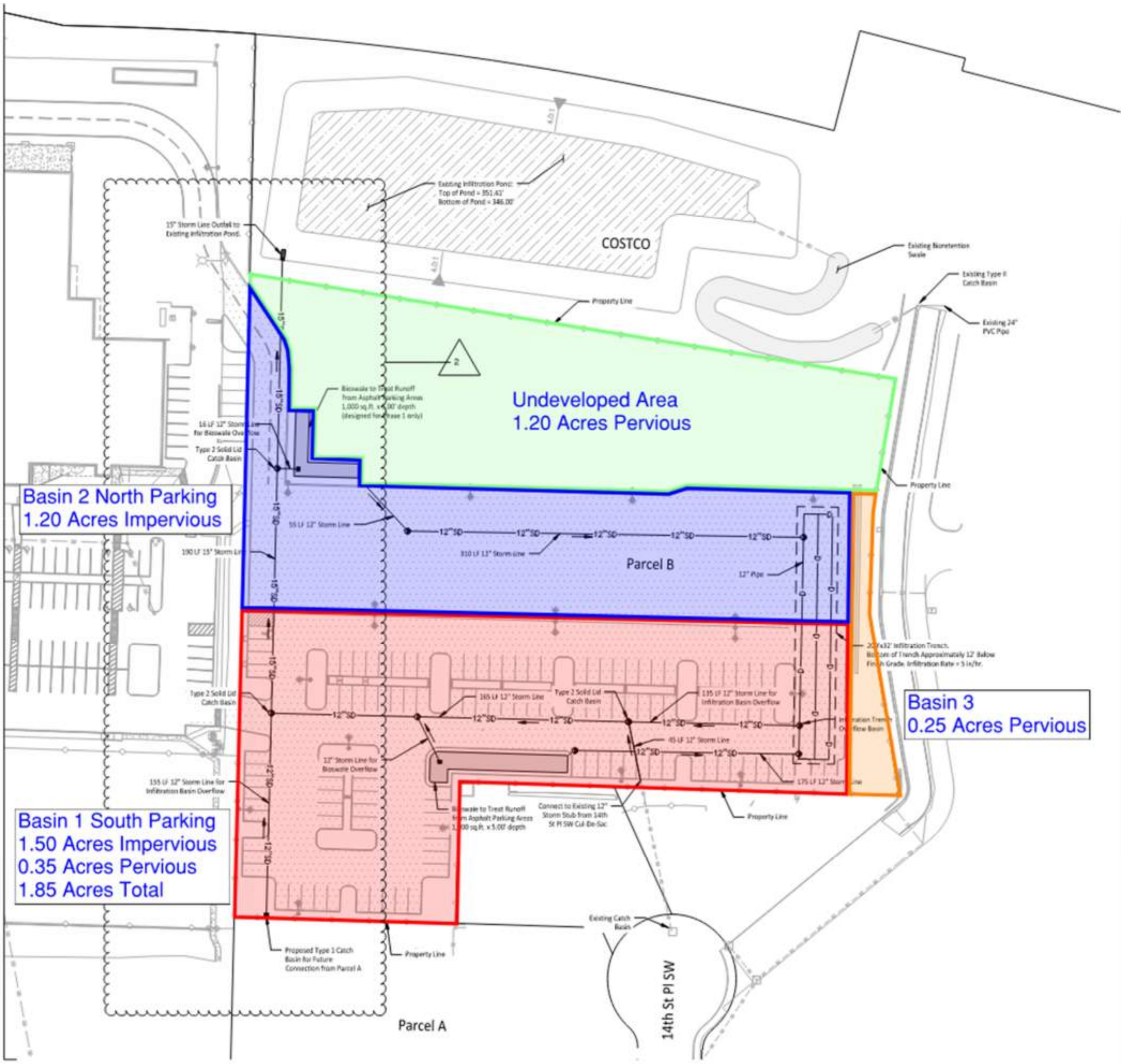
Stormwater management was evaluated for all new hardscape surfaces. Infiltration was selected as the most appropriate stormwater management practice for the new asphalt parking lot. Due to the existing grades of the site, the asphalt parking lot will be broken out into two sections where the SPED and standard stalls meet. The standard parking lot will sheet flow to a bioretention swale in the SE corner of the new parcel. From the bioretention swale, the storm runoff will be conveyed to an infiltration gallery to the east where it will infiltrate up to the 100-year storm event. An overflow system is planned to be installed and connect to the existing Costco infiltration pond on the adjacent property to the north. This overflow system will only discharge stormwater during storm events larger than the 100-year storm event. The SPED parking lot will be graded toward to the NW of the existing site and stormwater will be collected and flow to a bioretention swale north of the parking lot. Like the standard parking lot, storm runoff will be conveyed from the bioretention swale to an infiltration gallery to the east and infiltrate up to the 100-year storm event. An overflow system is planned to be installed and connect to the existing Costco infiltration pond on the adjacent property to the north. This overflow system will only discharge stormwater during storm events larger than the 100-year storm event. The northern portion of the project site will remain undeveloped and will continue to drain to the north away from the proposed improvements and therefore not included in the proposed stormwater calculations.

The South Hill Support Campus Improvements project adds more than 5,000 SF of new impervious surface which subjects the project to minimum requirements 1-9.

BASIN SUMMARY

Basin	Pervious Area (ac)	Impervious Area (ac)	Total Area (ac)
Predeveloped			
Existing Site	4.50	0.00	4.50
Developed			
Basin 1 South Parking Lot	1.50	0.35	1.85
Basin 2 North Parking Lot	0.00	1.20	1.20
Basin 3 Slope	0.25	0.00	0.25
Undeveloped Area	1.20	0.00	1.20
Total	2.95	1.55	4.50

PROPOSED STORMWATER BASIN MAP



SOIL INVESTIGATION

Site evaluation was conducted by AESI in October of 2021 and included advancing eight exploration borings, one of which completed as a groundwater monitoring well. During the duration of the test, no groundwater was observed. Moderate depth infiltration will be utilized for this site and was estimated to be 5.0 in/hr. See image below of the geotechnical report. The infiltration basin is between borings EB-2 and EB-5 where the Vashon advance outwash are 13-feet below existing grade.

> Moderate depth infiltration opportunities are present in the coarser-grained Vashon advance outwash sediments. The depth to the top of the Vashon advance outwash ranged from 12.5 (EB-2) to 22.5 (EB-1W). Infiltration testing was conducted on the LSC Warehouse and LSC Kessler sites in the Vashon advance outwash and the field infiltration rates ranged from 28 to 42 inches per hour. For planning considerations, the recommended long-term design infiltration rates for the adjacent facilities were 5 inches per hour. Locating and constructing infiltration trenches with a variable base depth can be challenging and additional subsurface exploration and infiltration testing will be required for facilities planned in the Vashon advance outwash.

Exploration Boring

associated earth sciences incorporated

Project Number	Exploration Number	Sheet
20210394E001	EB-5	1 of 1

Project Name: PSD- South Hill Site
Location: Puyallup, WA
Driller/Equipment: Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop: 140# / 30
Ground Surface Elevation (ft): ~359
Datum: NAVD88
Date Start/Finish: 10/22/21,10/22/21
Hole Diameter (in): 3.75 i.d.

Depth (ft)	Samples	DESCRIPTION	Blows/6"	Blows/Foot
		Fill		
	S-1	Moist, grayish brown, silty, fine SAND; dark organic banding; unsorted (SM).	2, 5, 9	14
		Vashon Recessional Lacustrine		
		Lower 6 inches: Moist, light brown with iron oxide staining, silty, fine SAND; faintly stratified otherwise massive (SM).		
5	S-2	Moist, brownish gray with iron oxide staining, silty, fine SAND ranging to fine sandy, SILT, trace gravel; occasional organics observed; faintly stratified otherwise massive (SM).	5, 4, 5	9
		Vashon Ice Contact / Melt-out Till		
10	S-3	Moist, brownish gray, silty fine SAND ranges to fine sandy, SILT, some broken gravel, trace medium to coarse sand; till-like (SM-ML).	5, 11, 11	22
		Vashon Advance Outwash		
		Driller reports gravel.		
15	S-4	Moist, brownish gray, fine to medium sandy, GRAVEL, some silt, some coarse sand; contains broken gravel; unsorted (GP-GM).	12, 22, 22	44
20	S-5	No recovery; due to gravel.	29, 44, 50/5"	50/5"
		Bottom of exploration boring at 21.4 feet No groundwater encountered.		

November 30, 2021

Exploration Boring

associated earth sciences incorporated

Project Number	Exploration Number	Sheet
20210394E001	EB-2	1 of 2

Project Name: PSD- South Hill Site
Location: Puyallup, WA
Driller/Equipment: Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop: 140# / 30
Ground Surface Elevation (ft): ~357
Datum: NAVD88
Date Start/Finish: 10/21/21,10/21/21
Hole Diameter (in): 3.75 i.d.

Depth (ft)	Samples	DESCRIPTION	Blows/6"	Blows/Foot
		Topsoil - 6 inches		
		Vashon Recessional Lacustrine		
5	S-1	Moist, light brown, silty, fine SAND; faint stratification; massive (SM).	4, 4, 4	8
		Vashon Ice Contact / Melt-out Till		
		Gravel at 9 feet.		
10	S-2	Moist, brownish gray, silty, fine SAND, some medium sand, some broken gravel; layer (0.5 inches thick) of dark organics observed; unsorted; blowcounts overstated (SM).	22, 18, 20	38
		Vashon Advance Outwash		
15	S-3	Moist, brownish gray, silty, fine SAND, some medium to coarse sand, some broken gravel; coarsens with depth; cleaner sand towards bottom of sampler; unsorted (SM).	16, 28, 31	59

SUMMARY OF MINIMUM REQUIREMENTS

The City of Puyallup utilizes the 2019 Washington Department of Ecology Stormwater Manual (manual) for stormwater design. Volume 1 of this manual describes the Minimum Requirements for stormwater management for a redevelopment site. Using the flow chart below, Minimum Requirements 1-9 apply to the South Hill Support Campus Improvement – Phase 1 site.

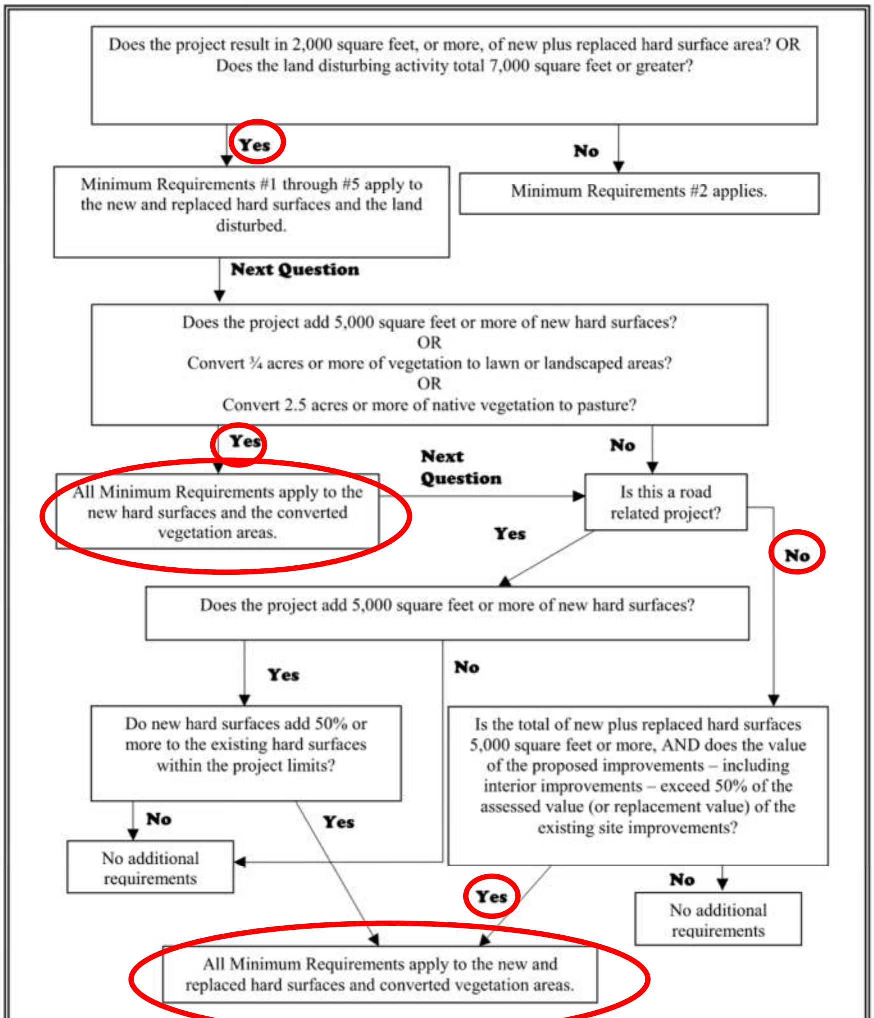


Figure 2.4.2 – Flow Chart for Determining Requirements for Redevelopment

Volume I – Minimum Technical Requirements – December 2014
2-6

MINIMUM REQUIREMENT 1: PREPARATION OF STORMWATER SITE PLANS

Stormwater Site Plan drawings are submitted with this Permit.

MINIMUM REQUIREMENT 2: CONSTRUCTION STORMWATER POLLUTION PREVENTION

A Temporary Erosion and Sediment Control Plan is included with this Civil Permit. Construction Stormwater Pollution Prevention measures may include: storm drain inlet protection; construction entrance; silt fence and vegetative filtration. See "Temporary Erosion & Sediment Control Plan" in Appendix A for details.

MINIMUM REQUIREMENT 3: SOURCE CONTROL OF POLLUTION

Source control BMPs will be implemented to minimize stormwater contamination and comply with the 2019 Department of Ecology Stormwater Manual as adopted by the City of Puyallup. BMP's for the project may include:

- *Inspect and clean treatment BMPs, conveyance systems, and catch basins as needed, and determine necessary O & M Improvements.*
- *Clean catch basins when the depth of deposits reaches 60-percent of the sump depth as measured from the bottom of basin to the invert of the lowest pipe into or out of the basin.*
- *Clean woody debris in a catch basin as frequently as needed to ensure proper operation of the catch basin.*

MINIMUM REQUIREMENT 4: PRESERVATION OF NATURAL DRAINAGE SYSTEMS AND OUTFALLS

Natural drainage for the site is infiltration and overland flow to the neighboring properties. Stormwater from the site will sheet flow to a bioretention swale for treatment and then infiltrate into the native soils on site with an overflow system to the existing Costco pond. The basin does not have a stormwater outfall and the entire basin area infiltrates.

MINIMUM REQUIREMENT 5: ONSITE STORMWATER MANAGEMENT

Minimum Requirement #5 states projects shall utilize either On-Site Stormwater Management BMP's from List #1 or demonstrate compliance with the LID Performance Standard. The South Hill Support Campus Improvement – Phase 1 is selecting to meet the LID Performance Standard as 100% of the stormwater flows will be infiltrated onsite.

> ***Low Impact Development Performance Standard***
>
> **Stormwater discharges shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 8% of the 2-year peak flow to 50% of the 2-year peak flow. Refer to the Standard Flow Control Requirement section in Minimum Requirement #7 for information about the assignment of the pre-developed condition. Project sites that must also meet minimum requirement #7 – flow control - must match flow durations between 8% of the 2-year flow through the full 50-year flow.**

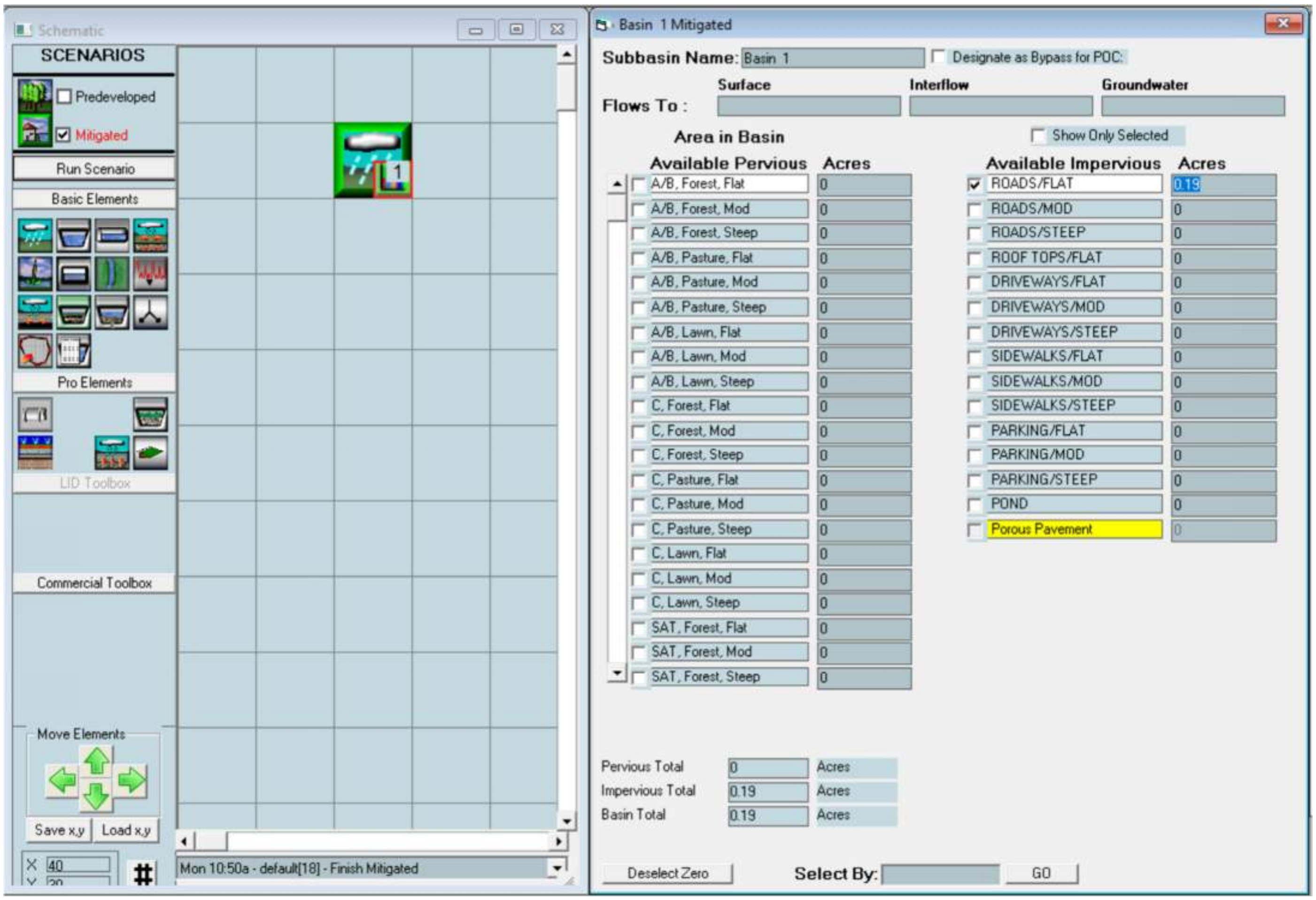
The project proposes the construction of a 15-inch overflow bypass pipe, which will convey runoff from approximately 8,000 SF of impervious area from the adjacent 14th St Pl SW roadway surface. This pipe will also be utilized as an overflow pipe for any flows generated both the development site and from a future Costco development parcel that exceed the 100-year runoff volume (the future Costco development site will be infiltrating stormwater up to the 100-year storm event). Mannings Equation for Pipe Flow, along with WWHM modelling for anticipated flows generated by the 8,000 SF roadway area were utilized to analyze the conveyance capacity of the proposed 15-inch pipe, shown below.

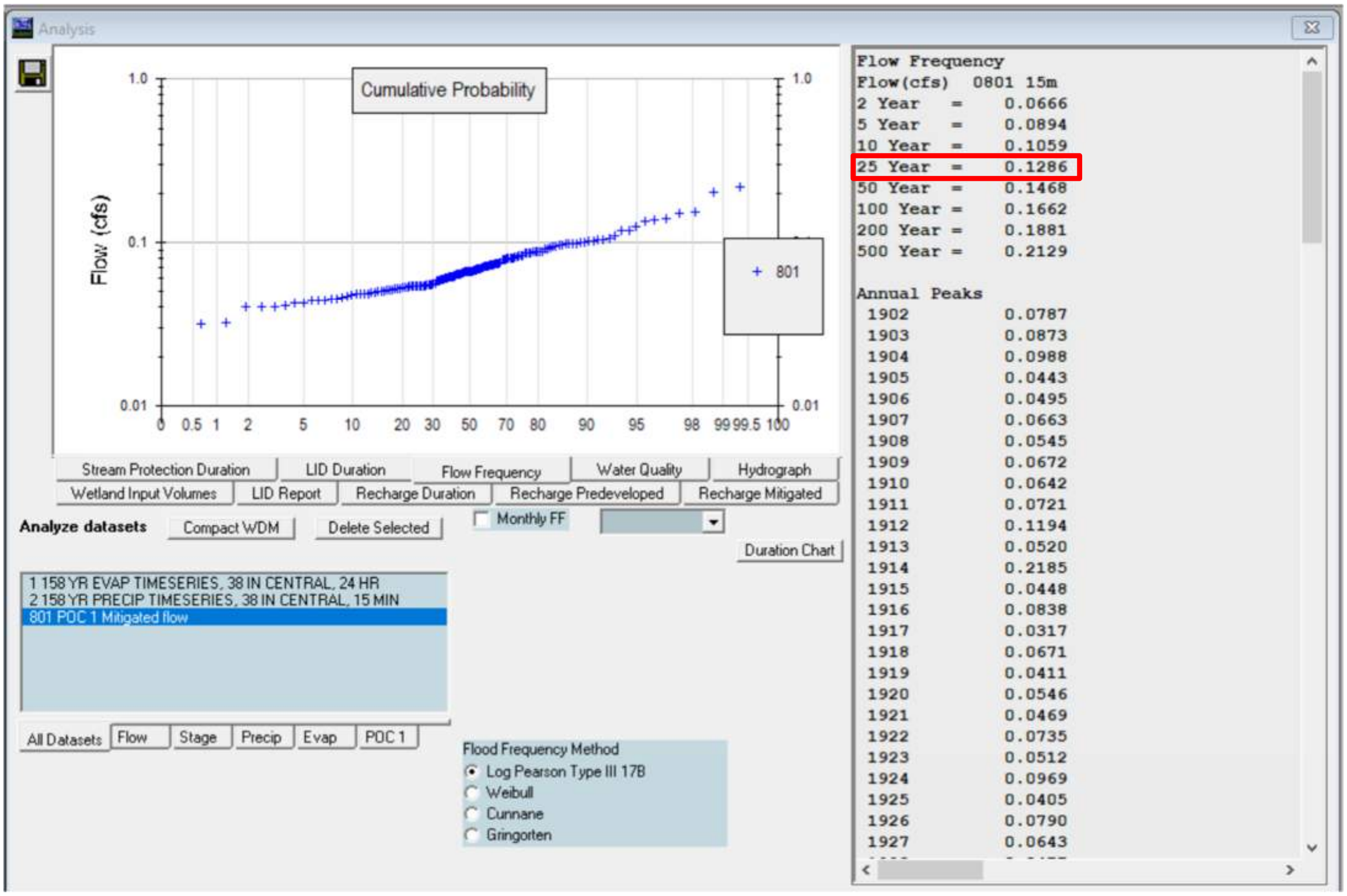
Assumptions for Manning's Equation for Pipe Flow:

- 15-inch diameter pipe
- Minimum pipe slope of 1.0%
- PVC Pipe Material with an N value of 0.013

Pipe Conveyance Capacity (at 100% Full) = **6.46 CFS**

Flow Generated by 8,000 SF of Impervious Roadway Area during the 25 Year Storm (City of Puyallup Design Storm):





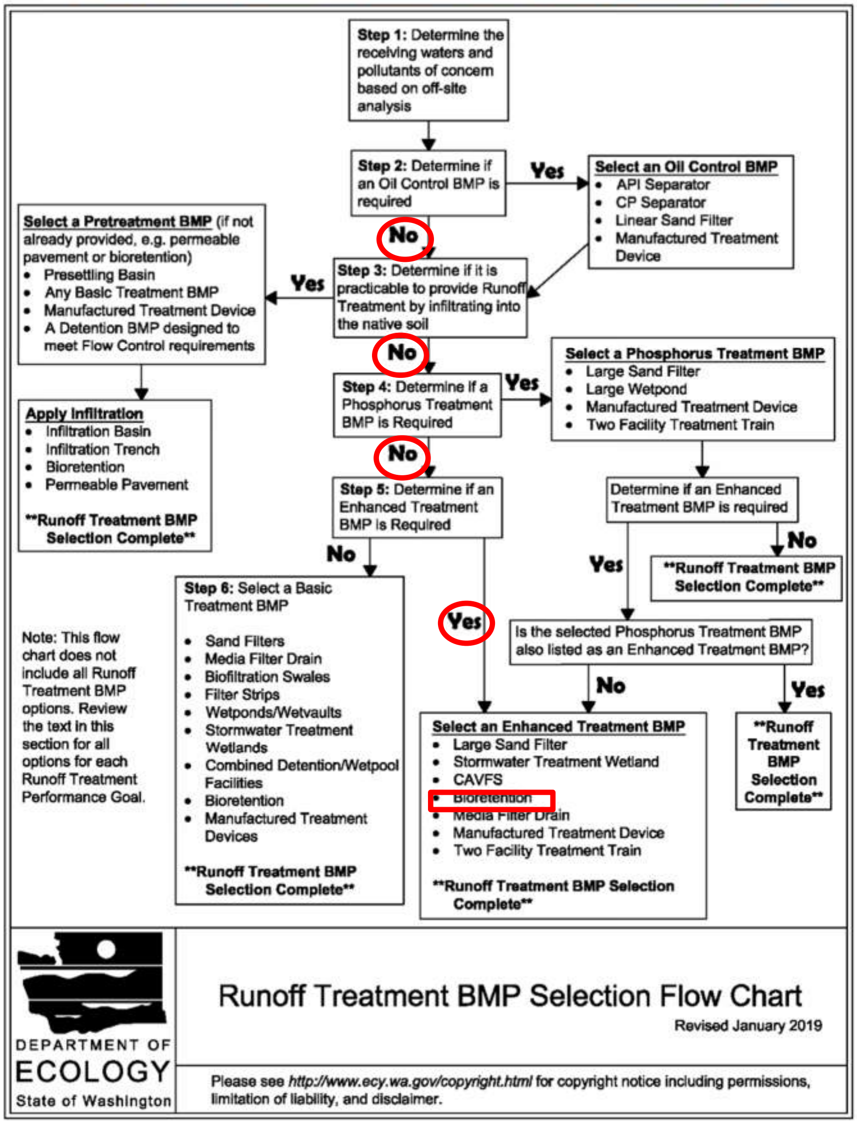
During a 25-year storm event, the 15-inch conveyance pipe would be receiving a flow of 0.1286 CFS from 14th St Pl SW, and 0.000 CFS flows from the proposed development site and the future Costco development site. This equates to the pipe being approximately 2.0% full during the 25-year storm event.

During a 100-year storm event, the pipe would receive 0.1662 CFS from 14th St Pl SW and 0.000 CFS from the proposed development site and the future Costco, which equates to the pipe being approximately 2.6% full during the 100-year storm event. Since the future Costco development site is also required to infiltrate up to the 100-year storm with its proposed development, only flows exceeding the 100-year storm would be conveyed to the overflow pipe. During a 100-year storm event or greater, the 15-inch overflow pipe would have capacity to convey an additional 6.2938 CFS of stormwater runoff.

MINIMUM REQUIREMENT 6: RUNOFF TREATMENT

The 2019 Department of Ecology Stormwater Management Manual states that any project with a pollution generating threshold discharge area greater than 5,000 SF shall be required to utilize runoff treatment BMPs. Table III-1.1 provides guidance on selecting a runoff treatment BMP for redevelopment projects, see below:

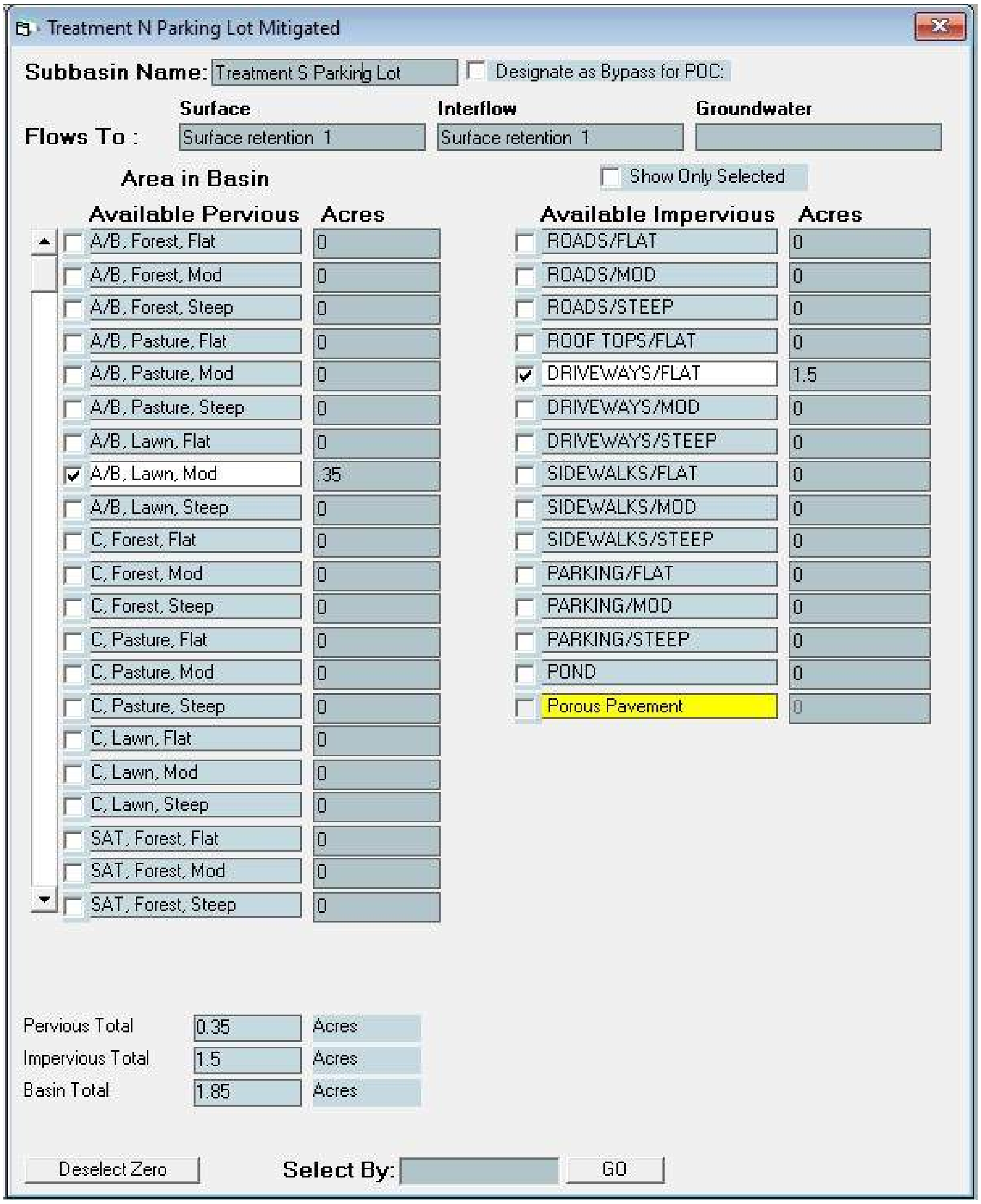
Figure III-1.1: Runoff Treatment BMP Selection Flow Chart



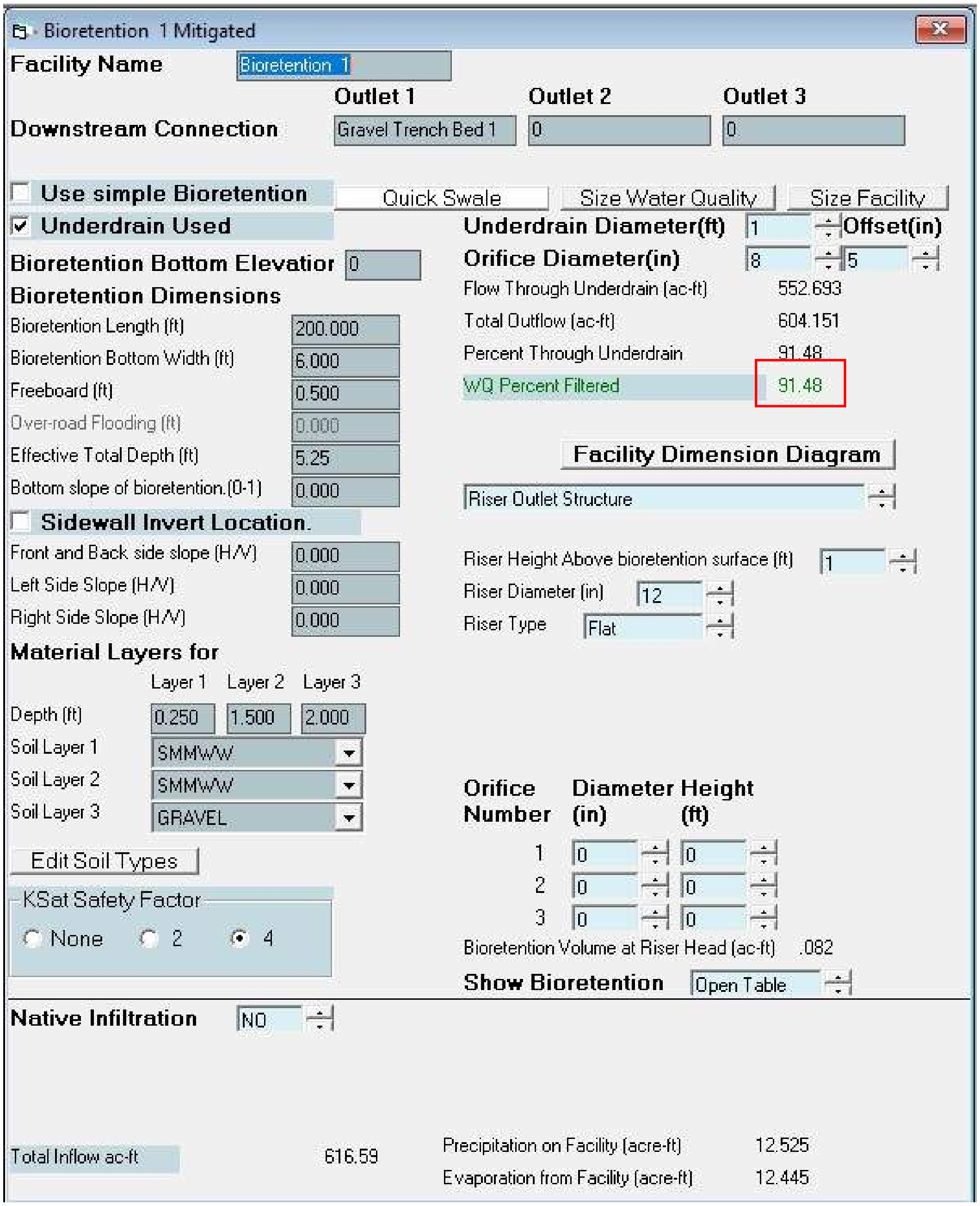
The project proposes the construction of two bioretention swales to provide enhanced treatment for all runoff from pollution generating impervious and pervious surface areas on site. The bioretention cells will drain through an underdrain to the infiltration facility. Enhanced treatment has been met by filtering over 91% of stormwater flows.

The Southern Parking Lot Bioretention Swale sizing is shown below:

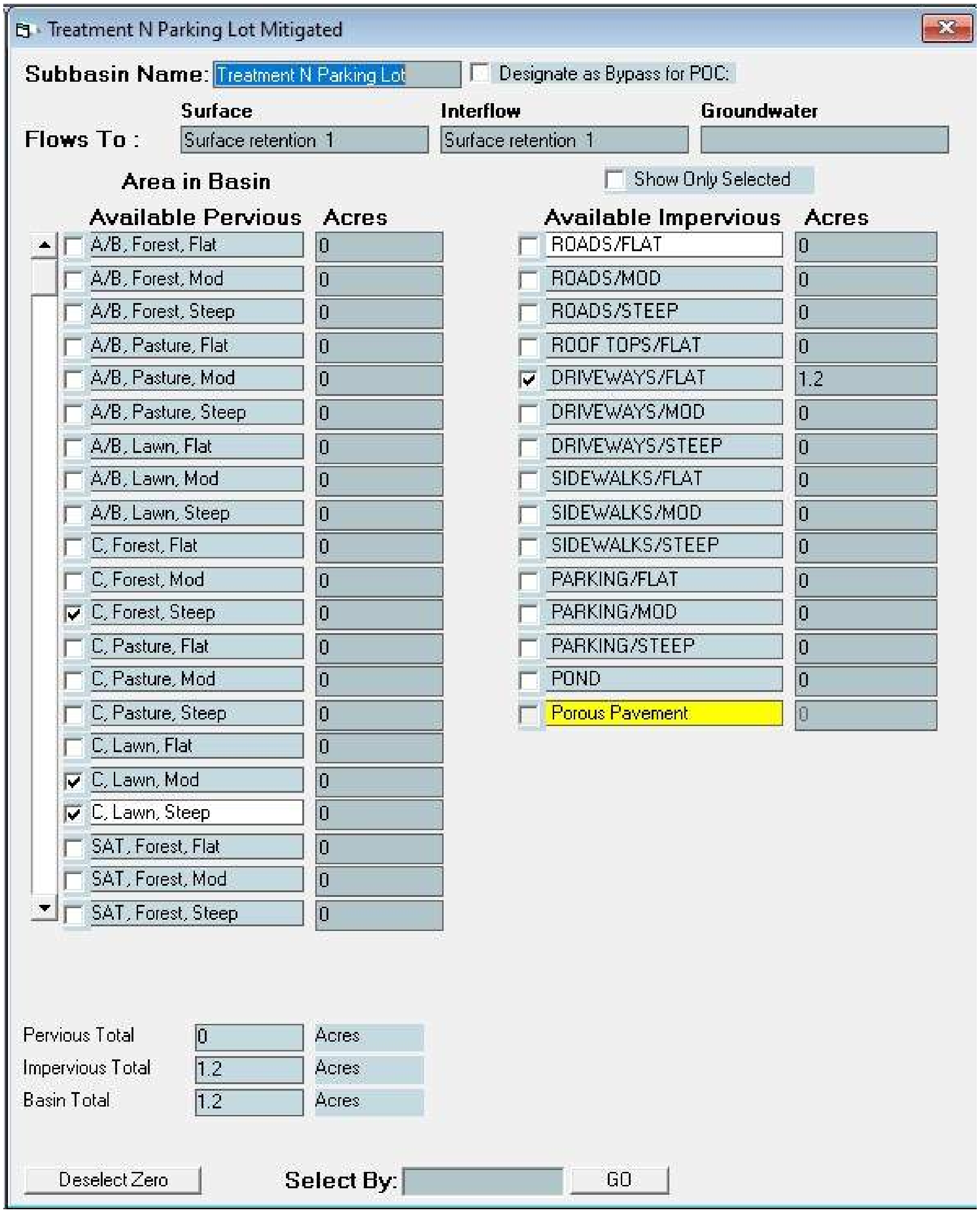
South Parking Lot Basin Area



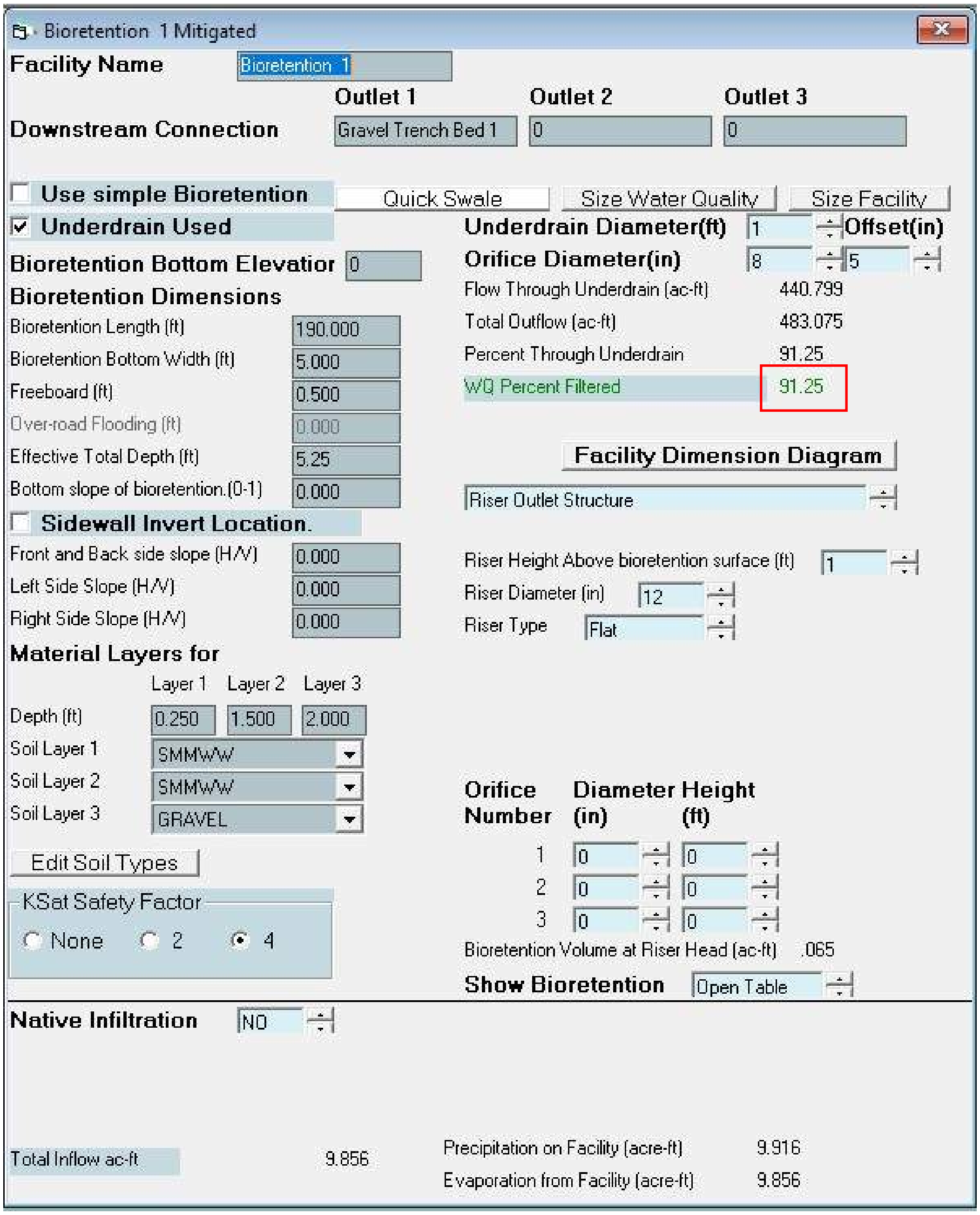
South Parking Lot Bioretention Cell



North Parking Lot Basin Area



North Parking Lot Bioretention Cell



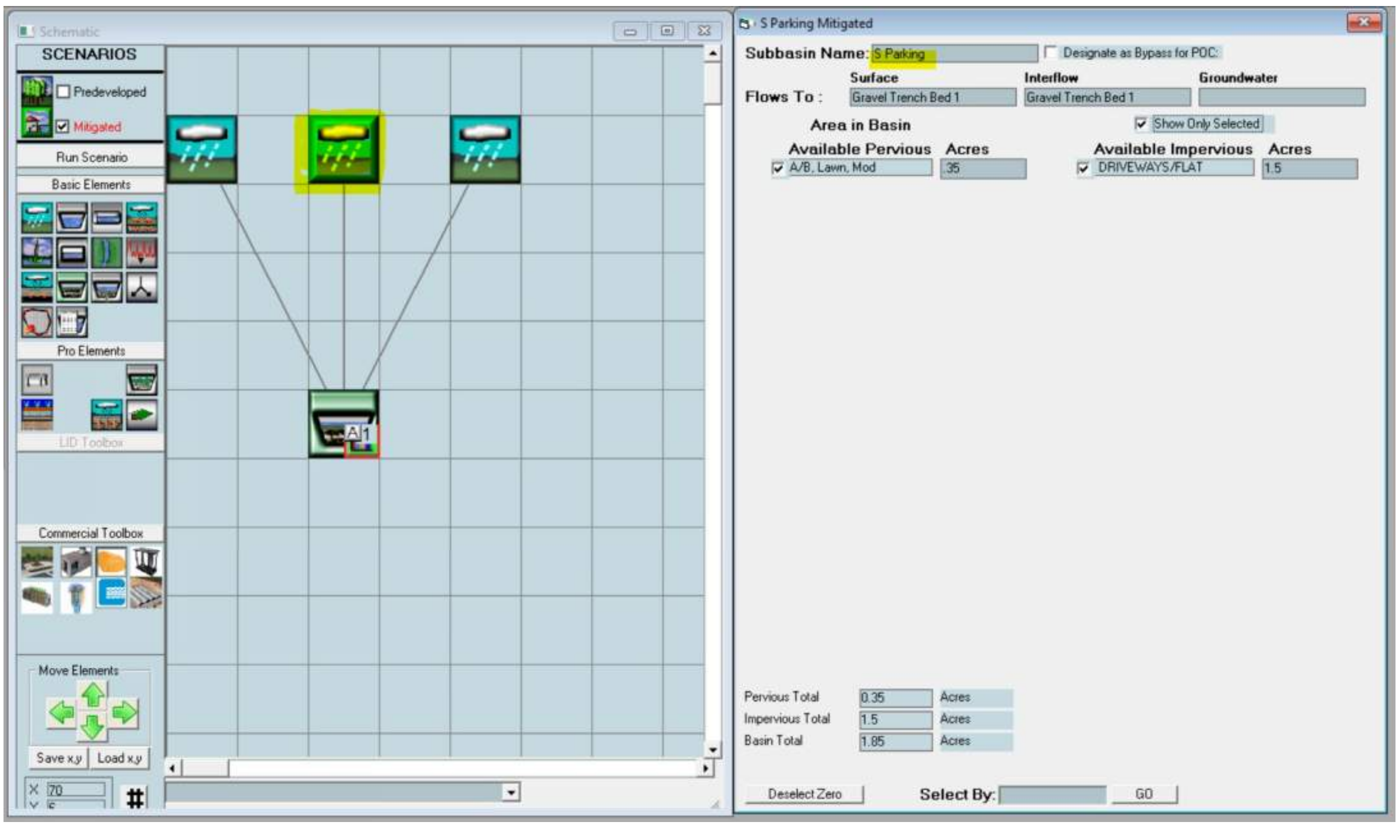
MINIMUM REQUIREMENT 7: FLOW CONTROL

The South Hill Support Campus Improvement – Phase 1 project site uses infiltration to meet the requirement of Minimum Requirement 7 Flow Control.

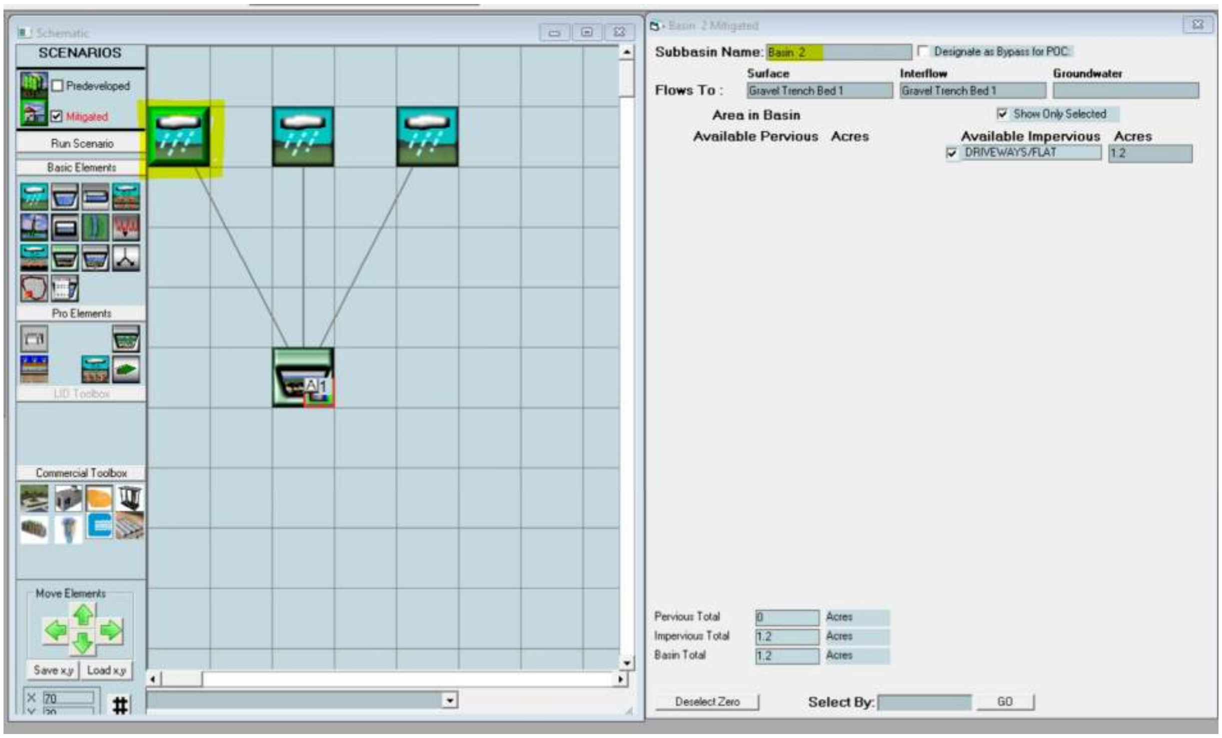
Runoff from the three proposed basin areas will be conveyed to a infiltration gallery where it will infiltrate 100-percent into native soils on site up to the 100-year storm event. An infiltration rate of 5 inches per hour has been used as determined in the geotechnical investigation. The criterial of the developed condition for the South Hill Support Campus Improvement project meets 8% of the 2-year peak flow and 50-year peak flow thresholds to the existing flows is satisfied by 100% of the stormwater being infiltrated.

Below are the WWHM screenshots of the three proposed basins and the infiltration basin results.

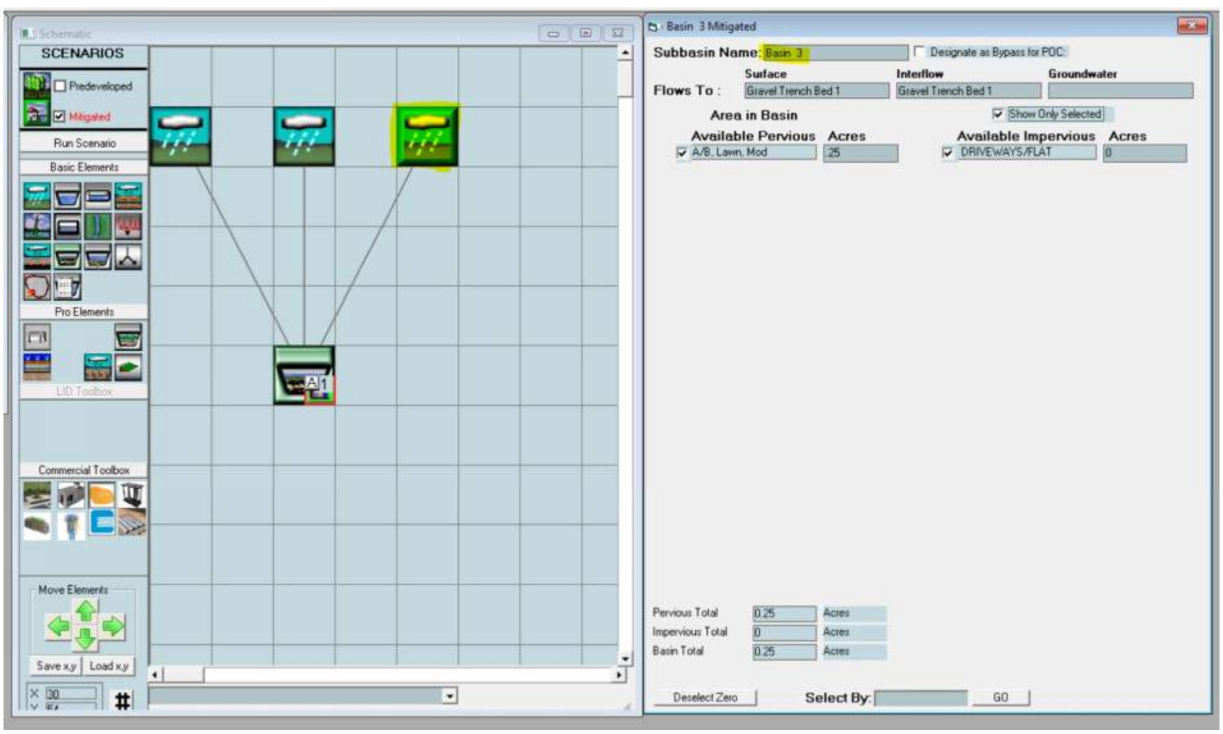
Basin 1 South Parking Lot



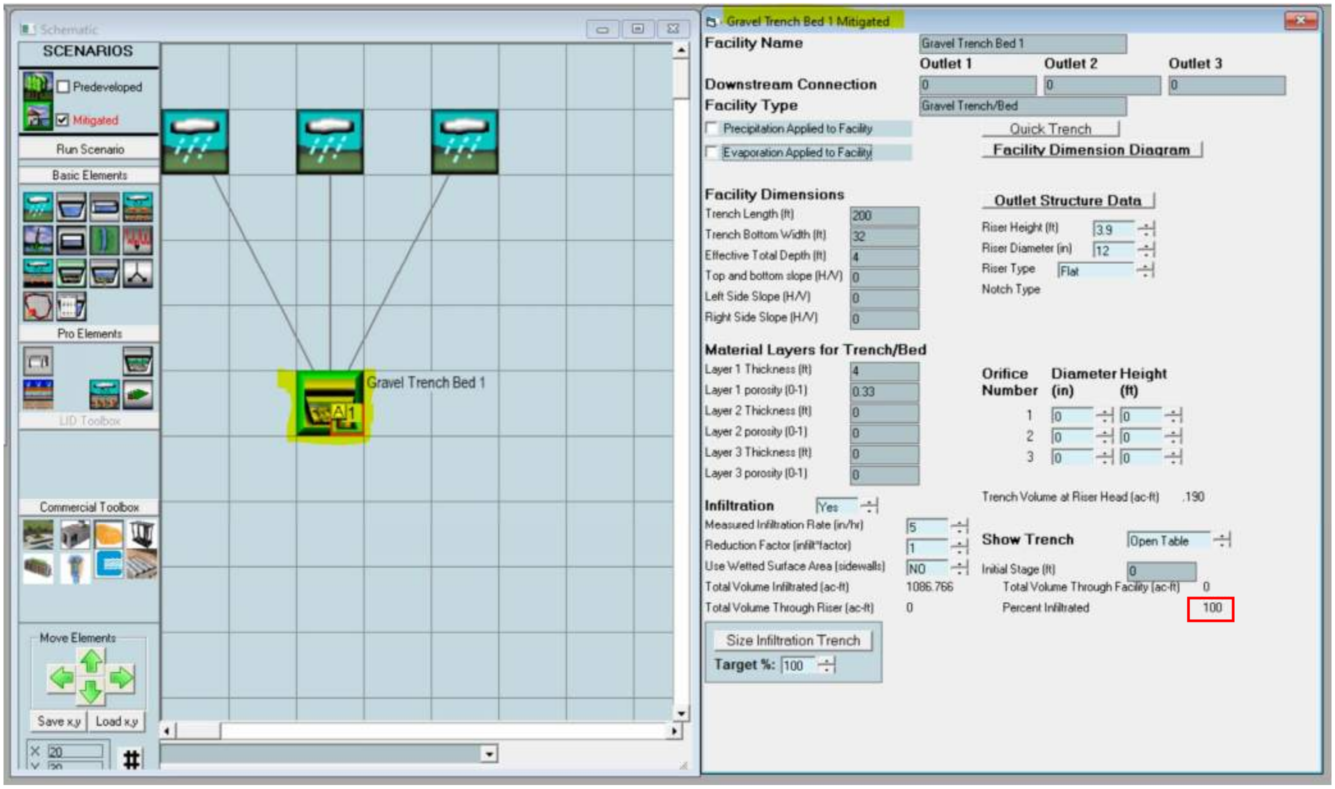
Basin 2 North Parking Lot



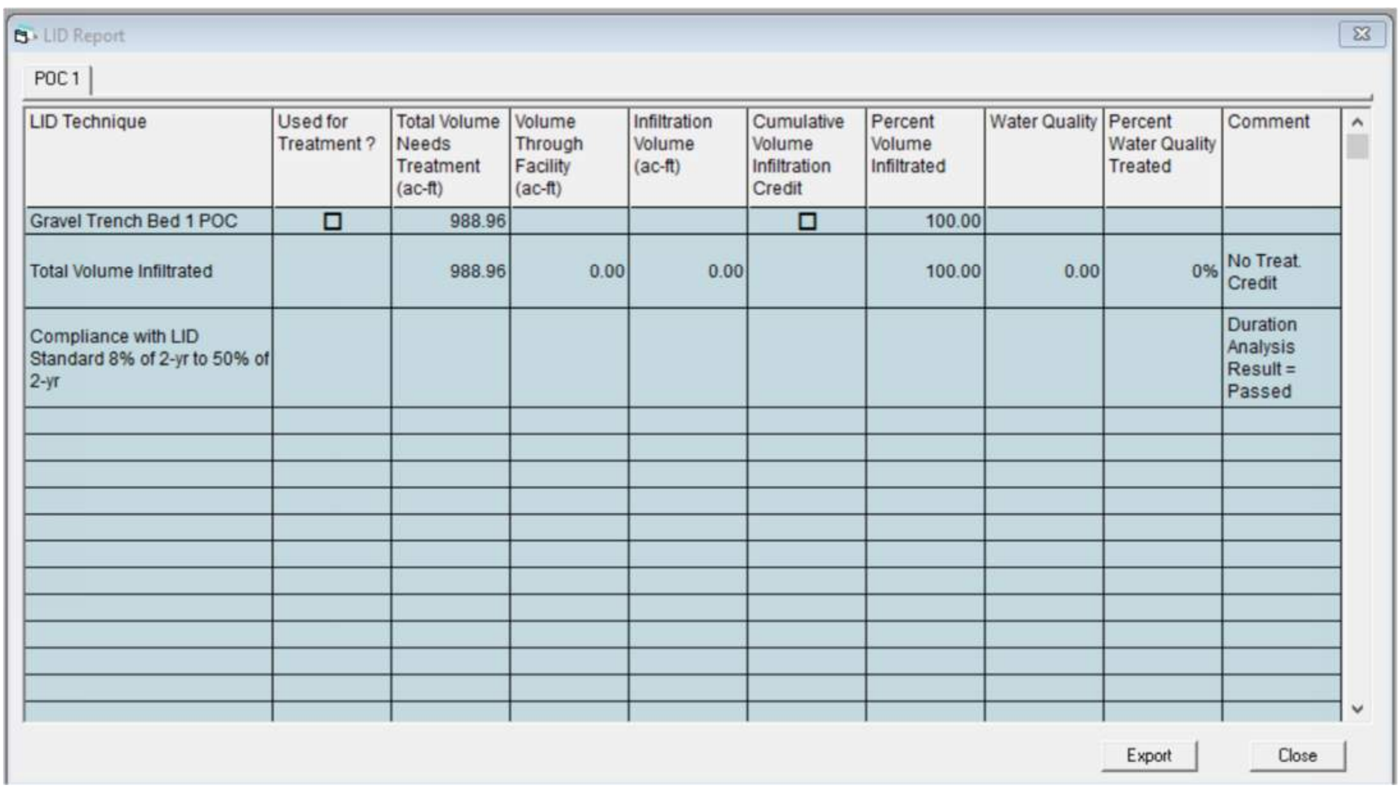
Basin 3 Slope



Infiltration Gallery



The LID Performance Standard Report for flow control is shown below:



LID Report

POC 1

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Gravel Trench Bed 1 POC	☐	988.96			☐	100.00			
Total Volume Infiltrated		988.96	0.00	0.00		100.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Export Close

MINIMUM REQUIREMENT 8: WETLAND PROTECTION

This project does not impact any wetland on or off site and therefore wetland protection is not required.

MINIMUM REQUIREMENT 9: OPERATION AND MAINTENANCE

The project will include the development of an O&M Manual.

APPENDIX A

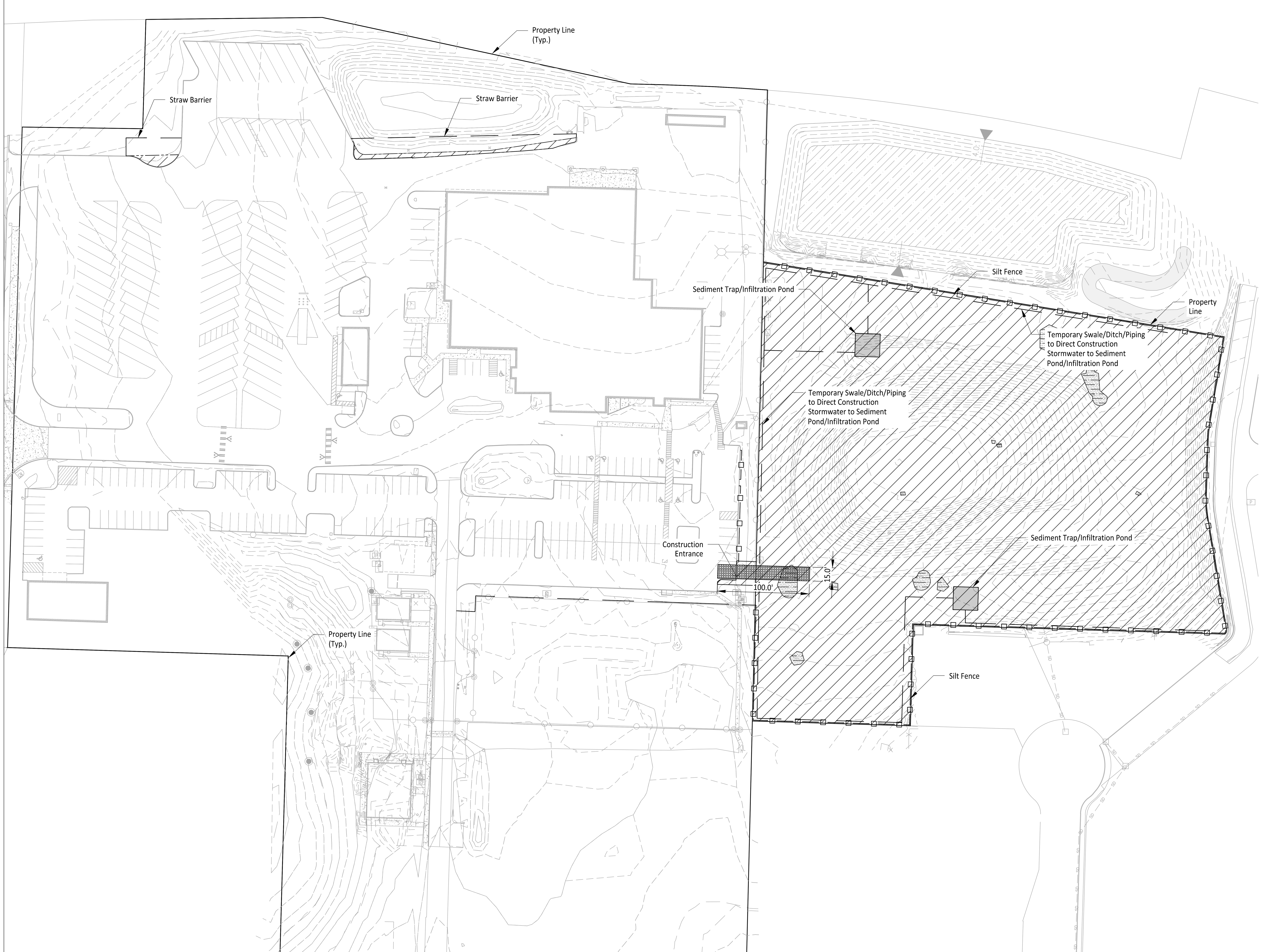
LEGEND

Construction Entrance

Landscape to be Removed

Gravel to be Removed

Silt Fencing



0 60 120 FT

1" = 60'

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PUYALLUP SCHOOL DISTRICT
A Tradition of Excellence

Project Title

SOUTH HILL SUPPORT CAMPUS IMPROVEMENTS

1501 39th AVE SW
PUYALLUP, WA 98371

Project Numbers
2022-002

Issue & Revision Dates

23 JUNE, 2022	SCHEMATIC DESIGN
11 AUGUST, 2022	DESIGN DEVELOPMENT
27 JULY, 2022	CONDITIONAL USE PERMIT
21 DECEMBER, 2022	CUP REVISION 1
23 JUNE, 2023	CUP REVISION 2
02 OCTOBER, 2023	CUP REVISION 3

CONDITIONAL USE PERMIT
NOT FOR CONSTRUCTION

JUSTIN M. JONES
STATE OF WASHINGTON
41829
REGISTERED
PROFESSIONAL ENGINEER
10/02/2023

Sheet Title

TESC Plan

Drawn By Checked By

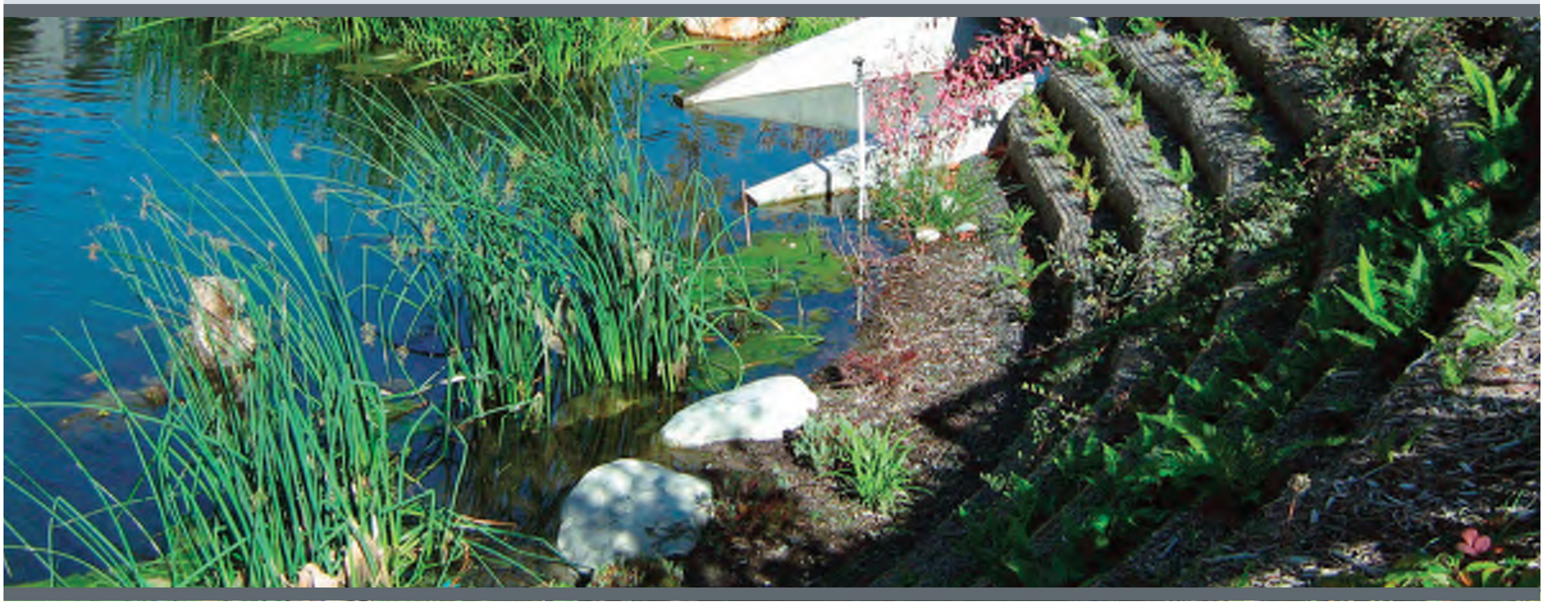
Sheet Number

C1-301

Sheet Number Of

APPENDIX B

associated earth sciences incorporated



Subsurface Exploration, Geologic Hazard, Infiltration Feasibility, and Preliminary Geotechnical Engineering Report

PSD - SOUTH HILL SITE

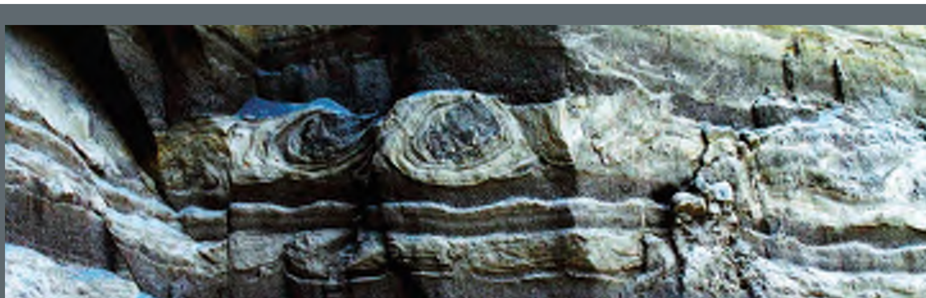
Puyallup, Washington

Prepared For:

PUYALLUP SCHOOL DISTRICT

Project No. 20210394E001

November 29, 2021



Associated Earth Sciences, Inc.
911 5th Avenue
Kirkland, WA 98033
P (425) 827 7701

November 29, 2021
Project No. 20210394E001

Puyallup School District
323 12th Street NW
Puyallup, Washington 98371

Attention: Mr. Brady Martin

Subject: Subsurface Exploration, Geologic Hazard, Infiltration Feasibility, and Preliminary Geotechnical Engineering Report
PSD - South Hill Site
14th Street Place SW
Puyallup, Washington

Dear Mr. Martin:

We are pleased to present the enclosed copy of the referenced report. This report summarizes the results of tasks including subsurface exploration, geologic hazard analysis, infiltration feasibility assessment, and geotechnical engineering, and offers preliminary recommendations for design of the project.

We have enjoyed working with you on this study and are confident that the preliminary recommendations presented in this report will aid in the successful completion of your project. Please contact me if you have any questions or if we can be of additional help to you.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

____
Kurt D. Merriman, P.E.
Senior Principal Engineer

KDM/ld - 20210394E001-002

SUBSURFACE EXPLORATION, GEOLOGIC HAZARD, INFILTRATION FEASIBILITY, AND PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

PSD - SOUTH HILL SITE

Puyallup, Washington

Prepared for:
Puyallup School District
323 12th Street NW
Puyallup, Washington 98371

Prepared by:
Associated Earth Sciences, Inc.
911 5th Avenue
Kirkland, Washington 98033
425-827-7701

November 29, 2021
Project No. 20210394E001

I. PROJECT AND SITE CONDITIONS

1.0 INTRODUCTION

This report presents the results of Associated Earth Sciences, Inc.'s (AESI's) subsurface exploration, geologic hazard analysis, preliminary geotechnical engineering, and stormwater infiltration feasibility study for the proposed project in Puyallup, Washington. Our recommendations are preliminary in that the project is in the early design phase. The site location is shown on the "Vicinity Map," Figure 1. The approximate locations of explorations completed for this study are shown on the "Existing Site and Exploration Plan," Figure 2. Interpretive exploration logs of subsurface explorations completed for this study are included in Appendix A.

1.1 Purpose and Scope

The purpose of this study is to provide subsurface soil and groundwater data to be utilized in the preliminary design of the proposed South Hill Site project. Our study included reviewing selected available geologic literature, advancing eight exploration borings (EB-1W through EB-8), and performing a geologic study of subsurface sediment and groundwater conditions. Geotechnical engineering studies were completed to develop recommendations for site preparation, flexible and rigid pavement sections, structural fill, erosion control, and to provide infiltration feasibility recommendations. This report summarizes our current fieldwork and offers preliminary design recommendations based on our present understanding of the project.

1.2 Authorization

Authorization to proceed with this study was given to AESI by means of District Purchase Order CP3655 dated October 15, 2021. Our study was accomplished in general accordance with our proposal dated October 8, 2021. This report has been prepared for the exclusive use of the Puyallup School District (PSD) and its agents for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering and engineering geology practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made.

2.0 PROJECT AND SITE DESCRIPTION

The site known as Parcel B is located along 14th Street Place SW just north of 39th Avenue NW in Puyallup, Washington as shown on Figure 2, "Existing Site and Exploration Plan." Roughly rectangular in shape, the site encompasses about 4.8 acres. The site is bounded to the north by a stormwater pond associated with the Costco store to the east of the site, to the south by commercial property and undeveloped Parcel A, to the west by PSD property, and to the east by 14th Street Place SW.

AESI previously completed a "Subsurface Exploration and Geotechnical Engineering Report" dated May 30, 2018 for the Logistics Center Warehouse (LSC) Addition immediately to the west of the subject site. We also completed a "Subsurface Exploration, Infiltration Testing, and Design Infiltration Rate Determination" dated June 21, 2018 for the LSC Addition. AESI performed geotechnical monitoring during construction of the addition and a stormwater infiltration trench.

AESI previously completed a "Subsurface Exploration and Geotechnical Engineering Report" dated June 17, 2019 for the LSC-Kessler Center southwest of the subject site. We also completed a "Subsurface Exploration, Infiltration Testing, and Design Infiltration Rate Determination" dated December 18, 2019 for the LSC-Kessler Center. AESI performed geotechnical monitoring during construction of the addition, bioretention facility, and infiltration trenches.

Topography on the site is dominated by a large mound composed of fill soils reportedly associated with construction of the Costco store across the street according to the PSD. Surface elevations surrounding the mound range from about 355 feet in the northwestern corner, to about 372 feet in the southeastern corner. The top of the mound is about elevation 380 feet. An approximate 10-foot-high slope is present on the eastern site boundary. Vegetation across the site generally consists of tall grasses and occasional Scotch broom. No surface water features were observed at the time of our site visit.

Based on discussions with TCF Architecture and review of conceptual plans, we understand that development of Parcel B will involve using the fill mound to level the site and create a new paved parking area for district school buses relocated from the downtown maintenance facility site. We understand that project plans will include infiltration of stormwater. Project plans are still in the conceptual stages but based on discussions with the project civil engineer, stormwater will be captured and then conveyed to infiltration trenches for disposal. Favorable infiltration conditions were encountered on the adjacent property where the LSC Warehouse Addition (AESI, May 2018) and also on the nearby LSC- Kessler Center are located (AESI, June 2019). We further understand that future improvements being considered include a direct connection from the new bus parking area to 14th Street Place NW.

3.0 SITE EXPLORATION

Our field explorations were conducted in October 2021 and included advancing eight exploration borings, one of which was completed as a groundwater monitoring well (EB-1W). The existing site conditions, and the approximate locations of subsurface explorations referenced in this study, are presented on the "Existing Site and Exploration Plan" (Figure 2). The various types of sediments, as well as the depths where the characteristics of the sediments changed, are indicated on the exploration logs presented in Appendix A. The depths indicated on the logs where conditions changed may represent gradational variations between sediment types. If changes occurred between sample intervals in our exploration borings, they were interpreted. Our explorations were approximately located in the field by measuring from known site features depicted on the aerial photograph used as a basis for Figure 2.

The conclusions and recommendations presented in this report are based on the explorations completed for this study. The number, locations, and depths of the explorations were completed within site and budgetary constraints. Because of the nature of exploratory work below ground, extrapolation of subsurface conditions between field explorations is necessary. It should be noted that differing subsurface conditions may be present due to the random nature of deposition and the alteration of topography by past grading and/or filling. The nature and extent of variations between the field explorations may not become fully evident until construction. If variations are observed at that time, it may be necessary to re-evaluate specific recommendations in this report and make appropriate changes.

3.1 Exploration Borings

For this study, eight exploration borings were performed by Advance Drill Technologies, Inc., an independent firm working under subcontract to AESI. The borings were completed by advancing both a 3.25- and 4.25-inch, inside-diameter hollow-stem auger using a track-mounted drill. During the drilling process, samples were generally obtained at 2½- to 5-foot-depth intervals. After completion of drilling, each borehole was backfilled with bentonite chips, and the surface was patched with concrete or sod.

Disturbed, but representative samples were obtained by using the Standard Penetration Test (SPT) procedure in accordance with *ASTM International* (ASTM) D-1586. This test and sampling method consists of driving a standard 2-inch, outside-diameter, split-barrel sampler a distance of 18 inches into the soil with a 140-pound hammer free-falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded, and the number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance ("N") or blow count. If a total of 50 is recorded within one 6-inch interval, the blow count is recorded as the number of blows for the corresponding number of inches of penetration. The resistance, or N-value, provides a measure of the relative density of granular soils or the relative consistency of cohesive soils; these values are plotted on the attached exploration boring logs.

The borings were continuously observed and logged by a geologist from our firm. The samples obtained from the split-barrel sampler were classified in the field and representative portions placed in watertight containers. The samples were then transported to our laboratory for further visual classification and testing. The exploration logs presented in Appendix A are based on the field observations, drilling action, and laboratory test results.

3.2 Monitoring Well

A groundwater monitoring well was installed by Advance Drill Technologies, Inc. in conjunction with our exploration borings in exploration boring EB-1W. The well consists of a 2-inch-diameter polyvinyl chloride (PVC) Schedule-40 well casing with threaded connections, the lower 10 feet of which is finely-slotted (0.020-inch machine slot) well screen to allow water inflow. The annular space around the well screen was backfilled with clean sand, and the upper portion of annulus was sealed with bentonite chips and concrete. An above-grade steel monument was placed over the top of the wellhead for protection. The as-built configuration is illustrated on the boring log in Appendix A. The well was dry at the time of drilling. After installation, an AESI representative developed the well by adding water and documenting that the well remained dry.

4.0 SUBSURFACE CONDITIONS

4.1 Regional Geology and Soils Mapping

The *2006 Draft Geologic Map of the Puyallup 7.5-Minute Quadrangle* (1:24,000 scale) indicates that the project site is underlain by Vashon-age Steilacoom gravel outburst deposits. These sediments normally consist of loose to medium dense, well-sorted gravels with sands, and variable amounts of silts and cobbles. The total thickness typically ranges from several feet to several tens of feet. Steilacoom gravel is often underlain by dense to very dense, glacial lodgement till, and the geologic map shows lodgement till covering a large portion of the upland to the west of the site. We did not encounter coarse-grained sand and gravel sediments.

Review of regional soils mapping available via the Natural Resources Conservation Service (NRCS) *Web Soil Survey* web application indicates that the subject site is underlain by Indianola loamy sand which is formed from the weathering of sandy outwash. Finer-grained Kitsap loam soils formed from the weathering of lacustrine sediments are mapped nearby. Our interpretation of the soils encountered in our explorations is in somewhat agreement with the regional soils mapping in that we encountered fine-grained glaciolacustrine sediments in several explorations below the fill mound.

4.2 Site Stratigraphy

Subsurface conditions at the project site were inferred from the field explorations accomplished for this study, visual reconnaissance of the site, and review of selected applicable geologic literature. Our subsurface explorations confirmed the presence of Vashon-age deposits in the proposed project area. However, the Steilacoom gravel unit shown on the regional geology map was not encountered. Instead, we observed Vashon-age recessional lacustrine deposits, Vashon-age ice-contact sediments, and Vashon-age advance outwash deposits. In our experience, this deviation from mapped geology is not unusual, because the geology in the project vicinity varies over short distances.

Topsoil

Organic-rich brown topsoil was observed at the ground surface in all borings completed where native sediments were present at ground surface elevation (EB-2, EB-6, EB-7, and EB-8). The observed thicknesses of topsoil ranged between 4 and 6 inches at the boring locations and are shown on the exploration logs. Fill over relic topsoil was also observed in EB-1W at a depth of approximately 7 feet below existing ground surface elevation. Existing topsoil should be stripped from structural areas and exported or reused in landscape applications if specifically permitted by project specifications.

Fill

Fill soils (those not naturally placed), were observed in borings EB-1W, EB-3, EB-4, EB-5, and EB-6. The observed fill thicknesses ranged between 1 foot (EB-5) and 29 feet (EB-3). Figure 2 includes the observed fill depths at each of the exploration locations. The fill generally consisted of loose to medium dense, moist, light brown to brown, fine to medium sand with variable silt content and variable gravel content. Organics (wood pieces) and faint organic odors were observed in the fill at the locations of borings EB-3 and EB-4. Existing fill may require remedial preparation below new pavement areas. Excavated existing fill material is potentially suitable for reuse in structural fill applications if such reuse is specifically allowed by project plans and specifications, if excessively organic and any other deleterious materials are removed, and if moisture content is adjusted (by aeration or cement amendment) to allow compaction to the specified level and to a firm and unyielding condition. Existing fill is not suitable for infiltration of stormwater and will be difficult to reuse during wet weather.

Vashon Recessional Lacustrine Sediments

Immediately below the surficial topsoil and/or fill, in all borings except EB-3, we observed a thick deposit of massive to stratified, silty, fine sands and fine, sandy silts. We interpret this deposit to be Vashon recessional lacustrine sediments that were deposited in a lake or other low-energy setting during the retreat of the Vashon ice sheet. These sediments have a low permeability due to a high percentage of fines, and are not typically suitable for concentrated stormwater infiltration. The recessional lacustrine deposit extended to depths of 22.5 feet (EB-1W), 9 feet (EB-2), 39 feet (EB-4), 7.5 feet (EB-5), 12.5 (EB-7), and 18.5 (EB-8). We did not observe the bottom of the lacustrine deposit in EB-6.

Vashon Ice-Contact (Melt-Out Till) Sediments

In exploration borings EB-2, EB-4, EB-5, EB-7, and EB-8 we observed a thin layer of sediments interpreted as ice-contact deposits below the Vashon recessional lacustrine sediments and above the Vashon advance outwash. The sediments were generally an unsorted mixture of silty fine sand to sandy silt with variable amounts of coarser sands and gravel, and ranged from medium dense to dense/hard. This material was differentiated from the underlying Vashon advance outwash observed onsite based on fines content (siltier) and composition (unsorted, diamict). This material is not recommended for use as an infiltration receptor due to its variable density and generally high silt content. Vashon ice-contact sediments are suitable for reuse in structural fill applications if allowed by project specifications and if the moisture content is adjusted to allow compaction to a firm and unyielding condition at the specified level.

Vashon Advance Outwash

In exploration borings EB-1W, EB-2, EB-3, EB-5, and EB-7 we observed dense sand and gravel with variable silt content that we interpret to be Vashon advance outwash. Advance outwash deposits were encountered at depths of 22.5 feet (EB-1W), 12.5 feet (EB-2), 29 feet (EB-3), 13 feet (EB-5), and 17.5 feet (EB-7). The advance outwash continued beyond the termination of each boring where it was observed. The Vashon advance outwash consists of sediments that were deposited by meltwater streams that emanated from the advancing Vashon glacier, and were subsequently consolidated by the massive weight of the glacial ice. Where permeable and unsaturated, these sediments are suitable for stormwater infiltration.

4.3 Hydrology

AESI has studied groundwater conditions for the adjacent LSC Warehouse and LSC Kessler PSD projects for infiltration design. There is historical information on shallow and deep groundwater conditions in the site vicinity. Site groundwater consists of two general water-bearing zones: (1) perched water in the recessional lacustrine deposits and advance outwash deposits, and (2) deeper groundwater in the regional Vashon advance aquifer. The recessional lacustrine sediments are expected to be intermittently wet at the base of the unit if the ice-contact/ melt-out till layer is present.

Most of the exploration borings did not encounter groundwater at the time of drilling, consistent with the expected lowered groundwater conditions present in the fall season. Perched groundwater was observed in exploration boring EB-1W at the time of drilling (October 2021) in the advance outwash at a depth of approximately 45 feet below ground surface, perched above a siltier layer with the advance outwash formation.

Perched water occurs when surface water infiltrates down through relatively permeable soils, such as existing fill, recessional deposits, or coarser-grained advance outwash strata and becomes trapped or "perched" atop a comparatively low-permeability barrier such as the melt-out till deposits. When water becomes perched, it may travel laterally and may follow flow paths related to permeable zones that may not correspond to ground surface topography.

EB-1W was completed as a groundwater monitoring well at approximately 90 feet deep to monitor groundwater fluctuations throughout the year. The well was dry at the time of installation and 1 week after installation. Water level monitoring is ongoing within well EB-1W. The monitoring program is intended to document that there is adequate vertical separation from the base of potential stormwater infiltration systems and the aquifer contained at depth in the Vashon advance outwash deposits.

It should be noted that the presence and quantity of groundwater will largely depend on the soil grain-size distribution, topography, seasonal precipitation, site use, on- and off-site land usage, and other factors. Explorations for the current study were conducted in October 2021. However, there is historical groundwater level monitoring data the LCS site during 2018 to 2020.

4.4 Laboratory Testing

As a part of our geotechnical study, we completed six grain-size analyses, two Modified Proctor tests, and two organic content determinations in accordance with ASTM procedures. Copies of the laboratory testing reports are included in Appendix B.

II. GEOLOGIC HAZARDS AND MITIGATIONS

We reviewed the Washington State Department of Natural Resources (DNR) Geologic Information Portal[1], Pierce County Public GIS,[2] and City of Puyallup Public GIS[3]. Steep slopes associated with the fill stockpile that would be classified as a landslide hazard per the City of Puyallup code were identified on the site but are exempt from City code requirements. In addition, we infer that the fine-grained lacustrine deposits and deeper glacial deposits underlying the site represent a negligible hazard with respect to seismically induced liquefaction. Earthquake activity is a widespread hazard throughout Western Washington, but the risk of associated shaking and ground rupture does not appear to be any higher at this site than elsewhere in the region. Geologic hazards are described in further detail below.

5.0 LANDSLIDE HAZARDS AND MITIGATIONS

The topography of the site is undulating to relatively flat with a fill mound that has an approximate height of 20 to 25 feet and slopes steeper than 40 percent. The *Puyallup Municipal Code* Section 21.06 states that a landslide hazard area is any area with a slope of 40 percent or steeper and with a vertical relief of 10 or more feet except areas composed of bedrock. Per the code definition, the fill mound would be classified as a landslide hazard area; however, based on recent AESI discussions with City staff, we understand that the City does not consider the mound a landslide hazard because it is a man-made feature comprised of uncontrolled fill, thus no mitigation is warranted. An approximate 10-foot-tall slope is present along the east side of the site descending from 14th Street Place SW. We interpret the slope to be associated with the construction of 14th Street Place SW and is likely comprised of fill. This slope will not be impacted by the planned site improvements and will remain unchanged.

6.0 SEISMIC HAZARDS AND MITIGATIONS

The following discussion is a more general assessment of seismic hazards that is intended to be useful to the project design team in terms of understanding seismic issues, and to the structural engineer for preliminary design.

All of Western Washington is at risk of strong seismic events resulting from movement of the tectonic plates associated with the Cascadia Subduction Zone (CSZ), where the offshore Juan de

[1] https://www.dnr.wa.gov/geologyportal
[2] PublicGIS (pierce.wa.us)
[3] Public Data Viewer (arcgis.com)

Fuca plate subducts beneath the continental North American plate. The site lies within a zone of strong potential shaking from subduction zone earthquakes associated with the CSZ. The CSZ can produce earthquakes up to magnitude 9.0, and the recurrence interval is estimated to be on the order of 500 years. Geologists infer the most recent subduction zone earthquake occurred in 1700 (Goldfinger et al., 2012[4]). Three main types of earthquakes are typically associated with subduction zone environments: crustal, intraplate, and interplate earthquakes. Seismic records in the Puget Sound region document a distinct zone of shallow crustal seismicity (e.g., the Seattle Fault Zone). These shallow fault zones may include surficial expressions of previous seismic events, such as fault scarps, displaced shorelines, and shallow bedrock exposures. The shallow fault zones typically extend from the surface to depths ranging from 16 to 19 miles. A deeper zone of seismicity is associated with the subducting Juan de Fuca plate. Subduction zone seismic events produce intraplate earthquakes at depths ranging from 25 to 45 miles beneath the Puget Lowland including the 1949, 7.2-magnitude event; the 1965, 6.5-magnitude event; and the 2001, 6.8-magnitude event) and interplate earthquakes at shallow depths near the Washington coast including the 1700 earthquake, which had a magnitude of approximately 9.0. The 1949 earthquake appears to have been the largest in this region during recorded history and was centered in the Olympia area. Evaluation of earthquake return rates indicates that an earthquake of the magnitude between 5.5 and 6.0 is likely within a given 20-year period.

Generally, there are four types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture, 2) seismically induced landslides, 3) liquefaction, 4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below.

6.1 Surficial Ground Rupture

The nearest known fault traces to the subject property are possible southern branches of the Tacoma Fault Zone, referred to as Lineaments "C" and "D" (Sherrod et al., 2003[5]) approximately 7 miles northwest and northeast of the site. The geophysical datasets indicate that the vertical displacement of this fault increases to the west. Evidence of uplift or subsidence is recorded in marshes along inlets of southern Puget Sound near Lynch Cove, Burley, North Bay, and Wollochet Bay. This movement suggests a seismic event associated with the Tacoma Fault approximately 1,100 years ago, with up to 3 meters of displacement. Data pertaining to the Tacoma Fault is limited, with studies still ongoing. The recurrence interval of movement along this fault system is still unknown, although it is hypothesized to be in excess of 1,000 years. Due to the suspected

[4] Goldfinger, C., Nelson, C.H., Morey, A.E., Johnson, J.E., Patton, J.R., Karabanov, E., Gutierrez-Pastor, J., Eriksson, A.T., Gracia, E., Dunhill, G., Enkin, R.J, Dallimore, A., and Vallier, T., 2012, *Turbidite Event History—Methods and Implications for Holocene Paleoseismicity of the Cascadia Subduction Zone*: U.S. Geological Survey Professional Paper 1661–F, 170 .

[5] Sherrod, B.L. Nelson, A.R., Kelsey, H.M., Brocher, T.M., Blakely, R.J., Weaver, C.S., Rountree, N.K., Rhea, S.B., and Jackson, B.S., 2003, *The Catfish Lake Scarp, Allyn, Washington: Preliminary Field Data and Implications for Earthquake Hazards Posed by the Tacoma Fault*, U.S. Geological Survey (USGS) Open File Report 03-0455.

long recurrence interval, and the distance from mapped fault traces, the potential risk to the project from surficial ground rupture is considered to be low during the expected life of the project. We are available to discuss mapped faulting further on request.

6.2 Seismically Induced Landslides

As stated above, slopes associated with the fill mound present at the site meet the City code definition of a landslide hazard; however, because they are man-made features comprised of uncontrolled fill and will be removed, the code does not apply. The existing 10-foot-tall steep slope on the east side of the site that descends from 14th Street Place SW will not be impacted by the proposed site development. No detailed quantitative assessment of slope stability was completed as part of this study.

6.3 Liquefaction

Liquefaction is a process through which unconsolidated soil loses strength as a result of vibrations, such as those which occur during a seismic event. During normal conditions, the weight of the soil is supported by both grain-to-grain contacts and by the fluid pressure within the pore spaces of the soil below the water table. Extreme vibratory shaking can disrupt the grain-to-grain contact, increase the pore pressure, and result in a temporary decrease in soil shear strength. The soil is said to be liquefied when nearly all of the weight of the soil is supported by pore pressure alone. Liquefaction can result in deformation of the sediment and settlement of overlying structures. Areas most susceptible to liquefaction include those areas underlain by very soft to stiff, non-cohesive silt and very loose to medium dense, non-silty to silty sands with low relative densities, accompanied by a shallow water table.

The project is not expected to have substantial risk of damage due to liquefaction because substantial deposits of loose saturated granular sediments were not observed. A detailed liquefaction hazard analysis was not performed as part of this study, and none is warranted based on existing subsurface data, in our opinion.

6.4 Ground Motion/Seismic Site Class (2018 *International Building Code*)

Any structural designs associated with the proposed project should follow 2018 *International Building Code* (IBC) standards. We recommend that the project be designed in accordance with Site Class "D" in accordance with the 2018 IBC, and the publication *American Society of Civil Engineers* (ASCE) 7 referenced therein, the most recent version of which is ASCE 7-16.

7.0 EROSION HAZARDS AND MITIGATIONS

According to the *City of Puyallup Municipal Code* a site is classified as having an erosion hazard if identified by the U.S. Department of Agriculture's Natural Resources Conservation Service (USDA NRCS) or identified by a special study as having a "moderate to severe," "severe," or "very severe" erosion potential. According to the USDA NRCS, the site soils are classified as part of the Indianola Series on 0 to 5 percent slopes. These soils are identified as having a slight susceptibility to erosion and therefore would not be classified as an erosion hazard. As mentioned previously, there are steeper man-made slopes present on the site associated with the fill mound and grading for 14th Street Place SW.

Due to the variable silt content in the shallow subsurface soils, project plans should include implementation of temporary erosion controls in accordance with local standards of practice. In our opinion, implementation of the following recommendations should be adequate to address the Washington State Department of Ecology (Ecology) and City of Puyallup requirements for management of erosion hazards.

The Ecology Construction Storm Water General Permit requires weekly Temporary Erosion and Sedimentation Control (TESC) inspections, turbidity monitoring and pH monitoring for all sites 1 or more acres in size that discharge stormwater to surface waters of the state. Because we anticipate that the proposed project will require disturbance of more than 1 acre, we anticipate that these inspection and reporting requirements will be triggered. The following recommendations are related to general erosion potential and mitigation.

Best management practices (BMPs) should include but not be limited to:

1. Construction activity should be scheduled or phased as much as possible to reduce the amount of earthwork activity that is performed during the winter months.

2. The winter performance of a site is dependent on a well-conceived plan for control of site erosion and stormwater runoff. The site plan should include ground-cover measures, access roads, and staging areas. The contractor should be prepared to implement and maintain the required measures to reduce the amount of exposed ground.

3. TESC measures for a given area to be graded or otherwise worked should be installed soon after ground clearing. The recommended sequence of construction within a given area after clearing would be to install TESC elements and perimeter flow control prior to starting grading.

4. During the wetter months of the year, or when large storm events are predicted during the summer months, each work area should be stabilized so that if showers occur, the

work area can receive the rainfall without excessive erosion or sediment transport. The required measures for an area to be "buttoned-up" will depend on the time of year and the duration the area will be left unworked. During the winter months, areas that are to be left unworked for more than 2 days should be mulched or covered with plastic. During the summer months, stabilization will usually consist of seal-rolling the subgrade. Such measures will aid in the contractor's ability to get back into a work area after a storm event. The stabilization process also includes establishing temporary stormwater conveyance channels through work areas to route runoff to the approved treatment/ discharge facilities.

5. All disturbed areas should be revegetated as soon as possible. If it is outside of the growing season, the disturbed areas should be covered with mulch, as recommended in the erosion control plan. Straw mulch provides a cost-effective cover measure and can be made wind-resistant with the application of a tackifier after it is placed.

6. Surface runoff and discharge should be controlled during and following development. Uncontrolled discharge may promote erosion and sediment transport. Under no circumstances should concentrated discharges be allowed to flow over the top of steep slopes.

7. Soils that are to be reused around the site should be stored in such a manner as to reduce erosion from the stockpile. Protective measures may include, but are not limited to, covering with plastic sheeting, the use of low stockpiles in flat areas, or the use of silt fences around pile perimeters.

It is our opinion that with the proper implementation of the TESC plans and by field-adjusting appropriate mitigation elements (BMPs) during construction, the potential adverse impacts from erosion hazards on the project may be mitigated.

III. PRELIMINARY DESIGN RECOMMENDATIONS

8.0 INTRODUCTION

Our explorations indicate that, from a geotechnical engineering standpoint, the property is suitable for the proposed development provided the recommendations contained herein are properly followed. The subject site is underlain in places by a layer of existing fill that is variable in thickness and density. Existing fill or loose soils may warrant remedial preparation where occurring below paving. AESI should be allowed to review the final project plans once they have been developed to update our recommendations, as necessary.

8.1 Site Preparation

Areas of planned paving should be prepared by stripping existing vegetation and topsoil, and excavating to planned paving subgrade elevation. The resulting subgrade should then be evaluated visually, compacted, and proof-rolled. Exposed soils are expected to consist of existing fill or recessional lacustrine sediments depending on the location and finished subgrade elevation. Areas with organic or deleterious material, or areas that yield during proof-rolling should receive additional preparation tailored to proof-rolling results and field conditions at the time of construction.

8.2 Site Drainage and Surface Water Control

The site should be graded to prevent water from ponding in construction areas and/or flowing into excavations. Exposed grades should be crowned, sloped, and smooth drum-rolled at the end of each day to facilitate drainage. Accumulated water must be removed from subgrades and work areas immediately prior to performing further work in the area. Equipment access may be limited, and the amount of soil rendered unfit for use as structural fill may be greatly increased if drainage efforts are not accomplished in a timely sequence. If an effective drainage system is not utilized, project delays and increased costs could be incurred due to the greater quantities of wet and unsuitable fill, or poor access and unstable conditions.

We do not anticipate the need for extensive dewatering in advance of excavations. However, the contractor should be prepared to intercept any groundwater seepage entering the excavations and route it to a suitable discharge location. Groundwater was not encountered in any of our explorations at shallow depths. Explorations were completed during the end of the seasonal dry weather and wetter conditions may be present at the time of construction. Perched groundwater should be expected during the wetter, winter months.

8.3 Subgrade Protection

If construction will proceed during the winter, we recommend the use of a working surface of sand and gravel, crushed rock, or quarry spalls to protect exposed soils, particularly in areas supporting concentrated equipment traffic. In winter construction staging areas and areas that will be subjected to repeated heavy loads, a minimum thickness of 12 inches of quarry spalls or 18 inches of pit run sand and gravel is recommended. If subgrade conditions are soft and silty, a geotextile separation fabric, such as Mirafi 500X or approved equivalent, should be used between the subgrade and the new fill. Construction of working surfaces from advancing fill pads could be used to avoid directly exposing the subgrade soils to vehicular traffic.

8.4 Proof-Rolling and Subgrade Compaction

Following the recommended clearing, site stripping, planned excavation, and any overexcavation required to remove existing fill, the stripped subgrade should be proof-rolled with heavy, rubber-tired construction equipment, such as a fully-loaded tandem-axle dump truck. Proof-rolling should be performed prior to structural fill placement or pavement section construction. The proof-roll should be monitored by the geotechnical engineer so that any soft or yielding subgrade soils can be identified. Any soft/loose, yielding soils should be removed to a stable subgrade. The subgrade should then be scarified, adjusted in moisture content, and recompacted to the required density. Proof-rolling should only be attempted if soil moisture contents are at or near optimum moisture content. Proof-rolling of wet subgrades could result in further degradation. Low areas and excavations may then be raised to the planned finished grade with compacted structural fill. Subgrade preparation and selection, placement, and compaction of structural fill should be performed under engineering-controlled conditions in accordance with the project specifications.

8.5 Overexcavation/Stabilization

Construction during extended wet weather periods could create the need to overexcavate exposed soils if they become disturbed and cannot be recompacted due to elevated moisture content and/or weather conditions. Even during dry weather periods, soft/wet soils, which may need to be overexcavated, may be encountered in some portions of the site. If overexcavation is necessary, it should be confirmed through continuous observation and testing by AESI. Soils that have become unstable may require remedial measures in the form of one or more of the following:

1. Drying and recompaction. Selective drying may be accomplished by scarifying or windrowing surficial material during extended periods of dry and warm weather.

2. Removal of affected soils to expose a suitable bearing subgrade and replacement with compacted structural fill.

3. Mechanical stabilization with a coarse crushed aggregate compacted into the subgrade, possibly in conjunction with a geotextile.

4. Soil/cement admixture stabilization.

8.6 Wet Weather Conditions

If construction proceeds during an extended wet weather construction period and the moisture-sensitive site soils become wet, they will become unstable. Therefore, the bids for site grading operations should be based upon the time of year that construction will proceed. It is expected that in wet conditions additional soils may need to be removed and/or other stabilization methods used, such as a coarse crushed rock working mat to develop a stable condition if silty subgrade soils are disturbed in the presence of excess moisture. The severity of construction disturbance will be dependent, in part, on the precautions that are taken by the contractor to protect the moisture- and disturbance-sensitive site soils. If overexcavation is necessary, it should be confirmed through continuous observation and testing by a representative of our firm.

8.7 Temporary and Permanent Slopes

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction. For estimating purposes, however, we anticipate that temporary, unsupported cut slopes in the existing fill or loose to medium dense native deposits can be made at a maximum slope of 1.5H:1V (Horizontal:Vertical) or flatter. Temporary slopes in dense to very dense sediments may be planned at 1H:1V. As is typical with earthwork operations, some sloughing and raveling may occur, and cut slopes may have to be adjusted in the field. If groundwater seepage is encountered in cut slopes, or if surface water is not routed away from temporary cut slope faces, flatter slopes will be required. In addition, WISHA/OSHA regulations should be followed at all times. Permanent cut and structural fill slopes that are not intended to be exposed to surface water should be designed at inclinations of 2H:1V or flatter. All permanent cut or fill slopes should be compacted to at least 95 percent of the modified Proctor maximum dry density, as determined by ASTM D-1557, and the slopes should be protected from erosion by sheet plastic until vegetation cover can be established during favorable weather.

8.8 Frozen Subgrades

If earthwork takes place during freezing conditions, all exposed subgrades should be allowed to thaw and then be recompacted prior to placing subsequent lifts of structural fill or paving components. Alternatively, the frozen material could be stripped from the subgrade to reveal unfrozen soil prior to placing subsequent lifts of fill or paving components. The frozen soil should not be reused as structural fill until allowed to thaw and adjusted to the proper moisture content, which may not be possible during winter months.

9.0 STRUCTURAL FILL

All references to structural fill in this report refer to subgrade preparation, fill type and placement, and compaction of materials, as discussed in this section. If a percentage of compaction is specified under another section of this report, the value given in that section should be used.

9.1 Subgrade Compaction

After stripping, planned excavation, and any required overexcavation have been performed to the satisfaction of the geotechnical engineer, the exposed ground in areas to receive fill should be recompacted to a firm and unyielding condition as determined by the geotechnical engineer. If the subgrade contains silty soils and too much moisture, adequate recompaction may be difficult or impossible to obtain and should probably not be attempted. In lieu of recompaction, the area to receive fill should be blanketed with washed rock or quarry spalls to act as a capillary break between the new fill and the wet subgrade. Where the exposed ground remains soft and further overexcavation is impractical, placement of an engineering stabilization fabric may be necessary to prevent contamination of the free-draining layer by silt migration from below. After recompaction of the exposed ground is approved, or a free-draining rock course is laid, structural fill may be placed to attain desired grades.

9.2 Structural Fill Placement

Structural fill is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 8-inch loose lifts, with each lift being compacted to 95 percent of the modified Proctor maximum density using ASTM D-1557 as the standard. For on-site utility trench backfill**,** we recommend the structural fill standard described above. In the case of roadway and utility trench filling within City rights-of-way, the backfill should be placed and compacted in accordance with current City of Puyallup codes and standards. The top of the compacted fill should extend horizontally outward a minimum distance of 3 feet beyond the locations of the roadway edges before sloping down at an angle of 2H:1V.

The contractor should note that any proposed fill soils must be evaluated by AESI prior to their use in fills. This would require that we have a sample of the material 72 hours in advance to perform a Proctor test and determine its field compaction standard.

Soils in which the amount of fine-grained material (smaller than the No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve size) should be considered moisture-sensitive. Use of moisture-sensitive soil in structural fills should be limited to favorable dry weather conditions. The native and existing fill soils present onsite contained variably high amounts of silt and are considered moisture-sensitive. Therefore, we anticipate that the use of on-site soils as structural fill may require moisture-conditioning to achieve proper compaction. For non-structural applications, the on-site material is generally considered suitable, as long as it is free of vegetation, topsoil, and any other deleterious materials. In addition, construction equipment traversing the site when the soils are wet can cause considerable disturbance.

9.3 Reuse of Site Soils for Structural Fill

We understand that the existing on-site fill stockpile is being considered for reuse as structural fill to achieve desired site grades. Based on our observations during drilling and laboratory testing results, it is our opinion that the fill has the potential for reuse, provided the recommendations contained herein are properly followed. The fill stockpile has an approximate thickness of 25 to 29 feet, at the highest elevations. During drilling of borings EB-3 and EB-4 located within the fill stockpile, we observed the soil samples collected every 5 feet with SPT methods and cuttings brought up by the auger. The soils generally were a mixture of gravelly, silty sand with variable organic content. Upon completion of the borings within the fill, we collected bulk samples from the soil cuttings that were transported to our Kirkland laboratory for further testing. Modified Proctor (ASTM D-1557), grain-size and organic content analysis tests were completed. Our testing results indicated that the fill soils have a field moisture ranging from 14 to 21 percent. Based on our Modified Proctor analysis of the existing fill from the stockpile, optimum moisture for compaction ranges from 7 to 9 percent. Our grain-size analysis indicates that the fill soils contain a fines portion, ranging from 23 to 24 percent. Our organic matter analysis indicates that the soils contain less than 2 percent organics.

In our opinion, reuse of the fill stockpile will be difficult due to high natural moisture content and high fines content even in dry weather. The high moisture content soils will require moisture-conditioning before placement and compaction. That could involve adding cement or aeration to dry them out in favorable weather conditions, usually between late June to early September. The high fines content of the fill soils will make them more difficult to place and compact in months having wet weather. Overall, the organic components of the bulk samples fell below 2 percent; however, during drilling we did observe larger organic matter. If larger organic material is present it will need to be removed prior to fill placement.

9.4 Wet Weather Structural Fill

If fill is placed during wet weather or if proper compaction cannot be obtained, a select import material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil with the amount of fine-grained material limited to 5 percent by weight when measured on the minus No. 4 sieve fraction with at least 25 percent retained on the No. 4 sieve.

9.5 Compaction Testing

A representative from our firm should observe the stripped subgrade and be present during placement of structural fill to observe the work and perform a representative number of in-place density tests. In this way, the adequacy of the earthwork may be evaluated as filling progresses, and any problem areas may be corrected at that time. It is important to understand that taking random compaction tests on a part-time basis will not assure uniformity or acceptable performance of a fill. As such, we are available to aid in developing a suitable monitoring and testing program.

10.0 PAVEMENT AND SIDEWALK RECOMMENDATIONS

The recommended pavement sections in this report section are for on-site driveway and parking areas, and are not applicable to right-of-way improvements. If any new paving of public streets is required, we should be allowed to offer situation-specific recommendations.

Pavement and sidewalk areas should be prepared in accordance with the "Site Preparation" section of this report. Soft or yielding areas should be overexcavated to provide a suitable subgrade and backfilled with structural fill.

10.1 Conventional Pavement Sections

We understand that conventional (impermeable) flexible (asphalt concrete) pavements might be used in new bus parking areas and driveways, whereas conventional rigid (cement concrete) pavements might be used for sidewalks and/or certain other locations. The following comments and recommendations are given for conventional pavement design and construction purposes.

Soil Design Values: Soil conditions can be defined by a California Bearing Ratio (CBR), which quantitatively predicts the effects of wheel loads imposed on a saturated subgrade. Although our scope of work did not include a CBR test on the surficial site soils, we infer from our observations and limited textural testing that a CBR value on the order of 5 to 8 would likely be appropriate for pavement design purposes. This value corresponds to a subgrade modulus of about 100 to 200 pounds per cubic inch (pci).

Traffic Design Values: Traffic conditions can be defined by a Traffic Index (TI), which quantifies the combined effects of projected car and bus traffic. Although no specific traffic data was available at the time of our analysis, we estimate that a TI of 3.0 to 4.0 would likely be appropriate for the car parking areas. A higher TI of about 5.0 to 6.0 appears appropriate for driveways and other areas that are subjected to school buses, delivery trucks, or similar vehicles.

Flexible Pavement Sections: A flexible pavement section typically comprises an asphalt concrete pavement (ACP) over a crushed aggregate base (CAB) over a granular subbase (GSB). Our recommended minimum thicknesses for flexible pavement sections, which are based on the aforementioned design values and a 20-year lifespan, are shown below.

Car Parking Lots	
Asphalt Concrete Pavement (ACP):	2½ inches
Crushed Aggregate Base Course (CAB):	3 inches
Granular Subbase Course (GSB):	6 inches

Bus Parking and Access Driveways	
Asphalt Concrete Pavement (ACP):	4 inches
Crushed Aggregate Base Course (CAB):	4 inches
Granular Subbase Course (GSB):	10 inches

Rigid Pavement Sections: A rigid pavement section typically comprises a cement concrete pavement (CCP) over a CAB over a GSB. We recommend the following minimum thicknesses for a rigid pavement section that is subjected to school buses and occasional delivery trucks. Pavements and slabs that are subjected to frequent truck traffic or to other heavy structural loads would require a special design.

Bus Parking and Access Driveways	
Cement Concrete Pavement (CCP):	8 inches
Crushed Aggregate Base Course (CAB):	2 inches
Granular Subbase Course (GSB):	8 inches

Granular Subbase: A GSB helps to provide more-uniform structural support for a pavement section. For the subject site, we recommend using an imported, well-graded sand and gravel, such as “Ballast” per Washington State Department of Transportation (WSDOT) 9-03.9(1) or “Gravel Borrow” per WSDOT 9-03.14. It would also be acceptable to use a crushed recycled concrete, provided that it meets the same general textural criteria as the aforementioned WSDOT materials. In all cases, the GSB should be vibratory-compacted to at least 95 percent based on the modified Proctor maximum dry density (per ASTM D-1557).

Crushed Aggregate Base: We recommend that all CAB material conform to the criteria for “Crushed Surfacing Base Course” or “Crushed Surfacing Top Course” per WSDOT 9-03.9(3).

All CAB material should be compacted to at least 95 percent based on the modified Proctor maximum dry density (per ASTM D-1557).

Asphalt Concrete Pavement: We recommend that the ACP aggregate gradation conform to the control points for a ½-inch mix (per WSDOT 9-03.8(6)) and that the binder conform to Performance Grade 58-22 criteria (per WSDOT 9-02.1(4)). We also recommend that the ACP be compacted to a target average density of 92 percent, with no individual locations compacted to less than 90 percent nor more than 96 percent, based on the Rice theoretical maximum density for that material (per ASTM D-2041).

Cement Concrete Pavement: We recommend that the CCP consist of Portland cement concrete with a minimum compressive strength of 4,000 pounds per square inch (psi) and a minimum rupture modulus of 500. We also recommend that the concrete be reinforced with a welded wire mesh, such as W2-6x6, positioned at a one-third depth within the CCP layer.

Pavement Life and Maintenance: It should be realized that conventional asphaltic pavements are not maintenance-free. The foregoing pavement sections represent our minimum recommendations for an average level of performance during a 20-year design life; therefore, an average level of maintenance will likely be required. Furthermore, a 20-year pavement life typically assumes that an overlay will be placed after about 10 years. Thicker asphalt, base, and subbase courses would offer better long-term performance, but would cost more initially; thinner courses would be more susceptible to "alligator" cracking and other failure modes. As such, pavement design can be considered a compromise between a high initial cost and low maintenance costs versus a low initial cost and higher maintenance costs.

11.0 INFILTRATION FEASIBILITY

We understand that project plans will include infiltration of stormwater. Project plans are still in the conceptual stages but based on discussions with the project civil engineer, stormwater will be captured and then conveyed to infiltration trenches for disposal.

We reviewed subsurface information from our current geotechnical evaluation of the site and our previous geotechnical evaluations associated with the adjacent LSC Warehouse (AESI, May 2018) and LSC-Kessler Center (AESI, June 2019). Site soils consist of a variable thickness layer of silt and silty fine sand (Vashon recessional lacustrine sediments), an intermittent perching layer of ice-contact melt-out till sediments, overlying coarse-grained sand and gravel (Vashon advance outwash sediments).

Shallow infiltration opportunities are limited by the fine-grained Vashon recessional lacustrine sediments. Limited infiltration testing was conducted on the LSC Kessler site in the Vashon recessional lacustrine sediments and the field infiltration rates ranged from 1.4 to 2.6 inches per hour. After accounting for correction factors, planning-level design infiltration rates would be on the order of 0.25 to 0.5 inches per hour for shallow facilities situated in the Vashon recessional lacustrine sediments.

Moderate depth infiltration opportunities are present in the coarser-grained Vashon advance outwash sediments. The depth to the top of the Vashon advance outwash ranged from 12.5 (EB-2) to 22.5 (EB-1W). Infiltration testing was conducted on the LSC Warehouse and LSC Kessler sites in the Vashon advance outwash and the field infiltration rates ranged from 28 to 42 inches per hour. For planning considerations, the recommended long-term design infiltration rates for the adjacent facilities were 5 inches per hour. Locating and constructing infiltration trenches with a variable base depth can be challenging and additional subsurface exploration and infiltration testing will be required for facilities planned in the Vashon advance outwash.

Puyallup Municipal Code, Chapter 21.10.040, adopts as their stormwater management manual the 2014 Washington State Department of Ecology *Stormwater Management Manual for Western Washington* (Ecology Manual). The Ecology Manual requires site-specific exploration and testing for infiltration design to assess site suitability criteria for drawdown time (infiltration rate) and separation from perching layers.

Design-specific infiltration facility geotechnical recommendations should be made once a design is available and will include additional facility-specific explorations, field infiltration testing, design infiltration rate, estimation of seasonal groundwater high, and considerations for site and subgrade preparation, overflow path, and protection of the facility. These activities are not included in our current scope of work. We are available to assist in planning for facility location and depth.

12.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

We are available to provide additional geotechnical/hydrogeologic consultation as the project design develops and possibly changes from that upon which this report is based. We recommend that AESI perform a geotechnical review of the plans prior to final design completion. In this way, we can confirm that our recommendations have been correctly interpreted and implemented in the design. The City of Puyallup may require a plan review by the geotechnical engineer as a condition of permitting.

We recommend that AESI be retained to provide geotechnical special inspections during construction, and preparation of a final summary letter when construction is complete. The City of Puyallup may require such geotechnical special inspections. The integrity of the earthwork depends on proper site preparation and construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent.

We have enjoyed working with you on this study and are confident these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

Aaron R. Turnley, G.I.T.
Senior Staff Geologist

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Senior Principal Engineer

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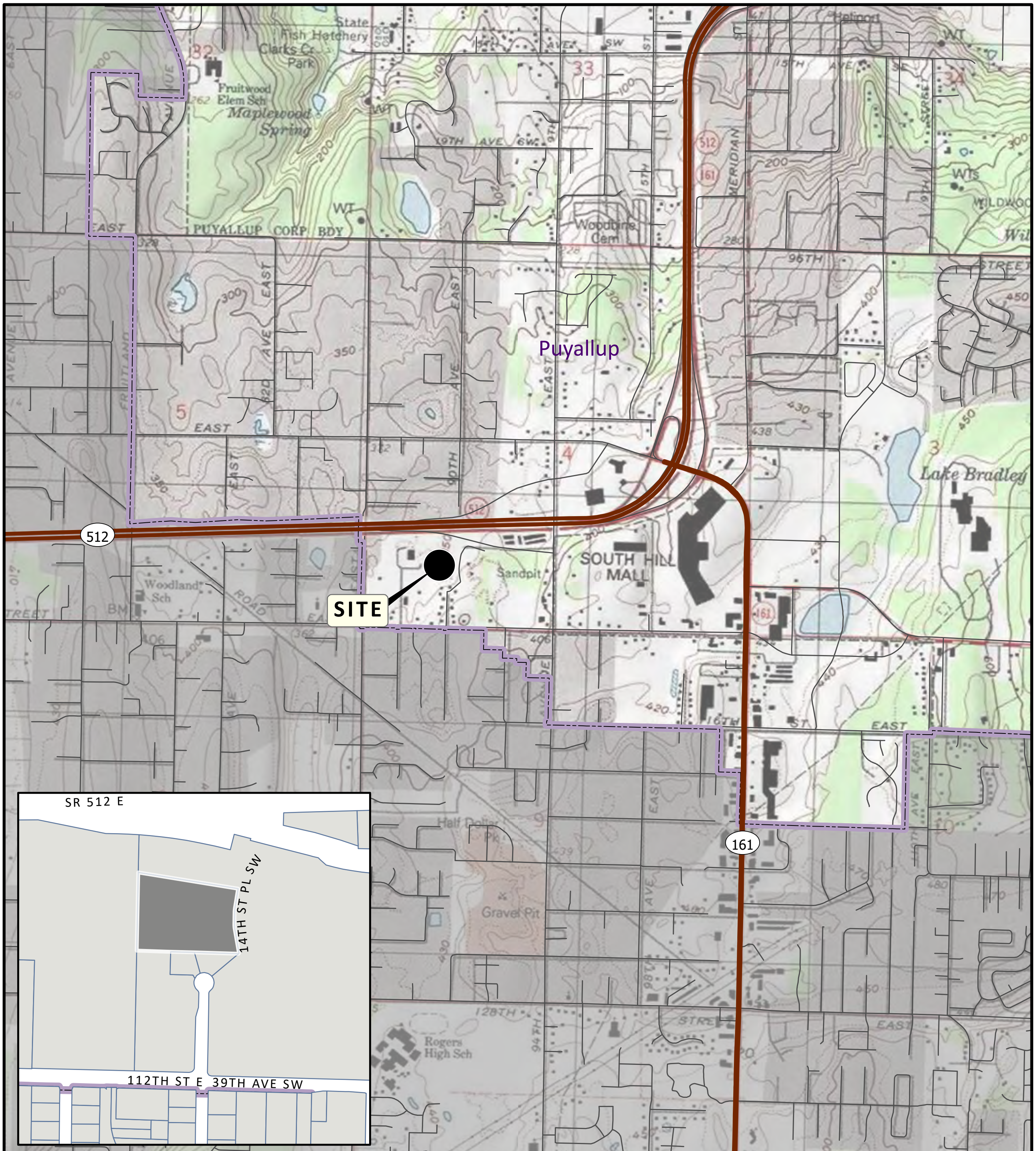
Associate Geotechnical Engineer

Attachments:	Figure 1.	Vicinity Map
	Figure 2.	Existing Site and Exploration Plan
	Appendix A.	Exploration Logs
	Appendix B.	Laboratory Test Results



DATA SOURCES / REFERENCES:
USGS: 7.5' SERIES TOPOGRAPHIC MAPS, ESRI/I-CUBED/NGS 2013
PIERCE CO: STREETS, CITY LIMITS, PARCELS, PARKS 2/21

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

N

0 2000
Feet

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION

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VICINITY MAP

PUYALLUP SD - SOUTH HILL SITE
PUYALLUP, WASHINGTON

PROJ NO.	DATE:	FIGURE:
20210394E001	11/21	1

LEGEND

- SITE
- EXPLORATION BORING, DEPTH OF FILL
- MONITORING WELL, DEPTH OF FILL
- PARCEL
- CONTOUR 10 FT
- CONTOUR 2 FT

DATA SOURCES / REFERENCES:
LIDAR: WATERHSED SCIENCES, INC. FOR PIERCE COUNTY DELIVERY 2 FLOWN 12/10, GRID CELL SIZE IS 3'.
CONTOURS FROM LIDAR
PIERCE CO: STREETS, CITIES, 2/21, PARCELS 8/21
AERIAL: WORLD IMAGERY, ESRI, DIGITAL GLOBE 3/3/21

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION

associated earth sciences incorporated

EXISTING SITE AND EXPLORATION PLAN

PUYALLUP SD - SOUTH HILL SITE
PUYALLUP, WASHINGTON

PROJ NO.	DATE:	FIGURE:
20210394E001	11/21	2

\\kirfile2\GIS\GIS_Projects\aaY2021\210394 PSD South Hill\APRX\20210394E001 F2 ES_PSDSouthHill.aprx | 20210394E001 F2 ES_PSDSouthHill | 11/29/2021

APPENDIX A

Exploration Logs

Geologic & Monitoring Well Construction Log

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Project Number	Well Number	Sheet
20210394E001	EB-1W	1 of 4

Project Name	PSD- South Hill Site	Location	Puyallup, WA
Elevation (Top of Well Casing)	362.31	Surface Elevation (ft)	~360
Water Level Elevation	45 Dry (10/27/2021)	Date Start/Finish	10/20/21,10/21/21
Drilling/Equipment	Advance / D-50 Track Mount H.S.A.	Hole Diameter (in)	4.25 i.d.
Hammer Weight/Drop	140# / 30	Well Tag #	BMM 300

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
0		Above Grade monument Concrete 0 to 1 foot				**Fill**
1		Bentonite chips/grout 1 to 75 feet				
2.5				12 17 12		Moist, grayish brown, silty, fine SAND, some broken gravel; unsorted (SM).
5				6 6 9		Upper 6 inches: Moist, grayish brown, silty, fine SAND, some coarse sand; unsorted (SM). Lower 12 inches: Moist, gray, silty, fine SAND; massive; alternating layers of dark brown organics and light brown sand (SM).
						Topsoil ?
7.5				5 5 7		Moist, dark brown to reddish brown, silty, fine SAND, trace medium to coarse sand, trace gravel; organics observed; unsorted (SM).
						Vashon Recessional Lacustrine
10		2-inch I.D. PVC casing 0 to 79.6 feet		3 2 3		Moist, reddish brown with iron oxide staining, silty, fine SAND, trace medium to coarse sand, trace gravel; pockets of clean sand; unsorted (SM).
12.5				4 4 4		Moist, light brown with iron oxide staining, fine sandy, SILT, trace medium to coarse sand; massive (ML).
15				4 4 5		Moist, light brown, fine SAND, some silt; faintly stratified; massive (SM-SP).
20				3 4 6		Very moist, light brown, fine sandy, SILT, some medium sand; massive (ML).
						Vashon Advance Outwash

Sampler Type (ST):

2" OD Split Spoon Sampler (SPT)	No Recovery	M - Moisture	**Logged by:** ART
3" OD Split Spoon Sampler (D & M)	Ring Sample	▽ Water Level ()	**Approved by:** JHS
Grab Sample	Shelby Tube Sample	▼ Water Level at time of drilling (ATD)	

Geologic & Monitoring Well Construction Log

associated earth sciences incorporated

Project Number	Well Number	Sheet
20210394E001	EB-1W	2 of 4

Project Name: PSD- South Hill Site
Elevation (Top of Well Casing): 362.31
Water Level Elevation: 45 Dry (10/27/2021)
Drilling/Equipment: Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop: 140# / 30

Location: Puyallup, WA
Surface Elevation (ft): ~360
Date Start/Finish: 10/20/21,10/21/21
Hole Diameter (in): 4.25 i.d.
Well Tag #: BMM 300

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				7 17 36		Moist, brownish gray, silty, fine to medium SAND, some coarse sand, some broken gravel; organic; layer (3 inches thick) of dark brown sandy silt with rootlets; unsorted (SM).
30				17 35 36		Moist, brownish gray, fine to medium sandy, GRAVEL, some silt, some coarse sand; broken gravels; unsorted (GP-GM).
						Driller notes gravel at 32 feet. Drill action changes.
35				27 50/6"		Moist, brownish gray, gravelly, fine to medium SAND, some silt, some broken gravel, trace medium to coarse sand; unsorted (SP-SM).
						Gravelly drilling.
40				44 50/5"		Moist, brownish gray, fine to medium sandy, GRAVEL, some silt; contains rare red sand grains; unsorted; poor recovery (GP-GM).
45	▼			37 50/5"		Wet, brownish gray, silty, fine to medium SAND, some coarse sand, some gravel; unsorted (SM).

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
Water Level ()
Water Level at time of drilling (ATD)

Logged by: ART
Approved by: JHS

Geologic & Monitoring Well Construction Log

associated earth sciences incorporated

Project Number	Well Number	Sheet
20210394E001	EB-1W	3 of 4

Project Name: PSD- South Hill Site
Elevation (Top of Well Casing): 362.31
Water Level Elevation: 45 Dry (10/27/2021)
Drilling/Equipment: Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop: 140# / 30

Location: Puyallup, WA
Surface Elevation (ft): ~360
Date Start/Finish: 10/20/21,10/21/21
Hole Diameter (in): 4.25 i.d.
Well Tag #: BMM 300

Depth (ft)	Water Level	WELL CONSTRUCTION	ST	Blows/ 6"	Graphic Symbol	DESCRIPTION
				43 50/6"		Moist, brownish gray, fine to medium SAND, some silt, some broken gravel; unsorted (SP-SM).
55				50/4"		Moist, brownish gray, fine to medium SAND, trace to some silt contains rare red sand grains; unsorted; poor recovery due to random large gravel (SP).
60				50/2"		No recovery.
65				36 42 50/3"		Very moist, brownish gray, medium to coarse SAND, some fine sand, some silt, trace gravel; unsorted (SP-SM).
70				50/1"		Very moist, brownish gray, silty, fine to medium SAND; poor recovery due to gravel (SM).

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
Water Level ()
Water Level at time of drilling (ATD)

Logged by: ART
Approved by: JHS

Geologic & Monitoring Well Construction Log

associated earth sciences incorporated

Project Number	Well Number	Sheet
20210394E001	EB-1W	4 of 4

Project Name: PSD- South Hill Site
Elevation (Top of Well Casing): 362.31
Water Level Elevation: 45 Dry (10/27/2021)
Drilling/Equipment: Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop: 140# / 30

Location: Puyallup, WA
Surface Elevation (ft): ~360
Date Start/Finish: 10/20/21,10/21/21
Hole Diameter (in): 4.25 i.d.
Well Tag #: BMM 300

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				32 50/5"		Very moist, brownish gray, fine to coarse SAND, some silt, trace gravel; unsorted (SP-SM).
		Sand pack 75 to ~90 feet				
80				46 50/4"		As above; more gravel; coarsens with depth.
85		2-inch I.D. PVC well screen 0.020-inch slot width 79.6 to 89.6 feet		50/4"		Moist, brownish gray, fine to medium SAND, some silt, trace broken gravel; unsorted; poor recovery (SP-SM).
90				50/5"		Moist, grayish brown, silty, fine SAND, some broken gravel; unsorted; poor recovery (SM).
						Boring terminated at 90.5 feet Well completed at 89.6 feet on 10/21/21. Perched water at 45 at the time of drilling. Well was dry at time of insallation and on 10/27/21.
95						

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level ()
- Water Level at time of drilling (ATD)

Logged by: ART
Approved by: JHS

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Exploration Boring

Project Number	Exploration Number	Sheet
20210394E001	EB-2	1 of 2

Project Name	PSD- South Hill Site	Ground Surface Elevation (ft)	~357
Location	Puyallup, WA	Datum	NAVD88
Driller/Equipment	Advance / D-50 Track Mount H.S.A.	Date Start/Finish	10/21/21,10/21/21
Hammer Weight/Drop	140# / 30	Hole Diameter (in)	3.75 i.d.

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
				Topsoil - 6 inches					
				Vashon Recessional Lacustrine					
5		S-1		Moist, light brown, silty, fine SAND; faint stratification; massive (SM).			4 4 4	8	
				Vashon Ice Contact / Melt-out Till					
				Gravel at 9 feet.					
10		S-2		Moist, brownish gray, silty, fine SAND, some medium sand, some broken gravel; layer (0.5 inches thick) of dark organics observed; unsorted; blowcounts overstated (SM).			22 18 20	38	
				Vashon Advance Outwash					
15		S-3		Moist, brownish gray, silty, fine SAND, some medium to coarse sand, some broken gravel; coarsens with depth; cleaner sand towards bottom of sampler; unsorted (SM).			16 28 31	59	
20		S-4		Moist, brownish gray, fine to medium sandy, GRAVEL, some silt, some coarse sand; broken gravel (GP-GM).			18 47 50/5"	50/5"	
				Gravelly drill action.					

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level ()
- Water Level at time of drilling (ATD)

Logged by: ART
Approved by: JHS

Exploration Boring

associated earth sciences incorporated

Project Number	Exploration Number	Sheet
20210394E001	EB-2	2 of 2

Project Name: PSD- South Hill Site
Location: Puyallup, WA
Driller/Equipment: Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop: 140# / 30

Ground Surface Elevation (ft): ~357
Datum: NAVD88
Date Start/Finish: 10/21/21,10/21/21
Hole Diameter (in): 3.75 i.d.

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
		S-5		Moist, brownish gray to light gray, fine to medium SAND, some silt, some coarse sand, some gravel; unsorted (SM).			50/6"	▲50/6"	
30		S-6		Moist, brownish gray, fine to medium SAND, some silt, some coarse sand, trace gravel; unsorted (SP-SM).			28 50/5"	▲50/5"	
				Bottom of exploration boring at 30.9 feet No groundwater encountered.					
35									
40									
45									

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: ART
Approved by: JHS

Exploration Boring

associated earth sciences incorporated

Project Number	Exploration Number	Sheet
20210394E001	EB-3	1 of 2

Project Name: PSD- South Hill Site
Location: Puyallup, WA
Driller/Equipment: Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop: 140# / 30
Ground Surface Elevation (ft): ~376
Datum: NAVD88
Date Start/Finish: 10/21/21,10/21/21
Hole Diameter (in): 3.75 i.d.

Depth (ft)	S T	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
			Fill					
			Gravelly drilling.					
5		S-1	Moist, gray, silty, gravelly, fine SAND, some medium to coarse sand, contains broken gravel; faint organic odor; unsorted (SM).			12 9 12	31	
			Gravelly drilling.					
10		S-2	Moist, gray, silty, gravelly, fine SAND, some medium to coarse sand; contains broken gravel; small dark brown organic pieces observed; unsorted (SM).			7 9 9	18	
15		S-3	Moist, dark brown to brown, silty, gravelly, fine SAND, trace medium to coarse sand; organics throughout; faint organic odor; unsorted (SM).			12 13 10	23	
20		S-4	Moist, dark gray to bluish gray, silty, fine SAND; organics throughout; unsorted (SM).			7 9 12	21	
			Fill / Weathered Vashon Advance Outwash ?					

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level ()
- Water Level at time of drilling (ATD)

Logged by: ART
Approved by: JHS

associated earth sciences incorporated

Exploration Boring

Project Number	Exploration Number	Sheet
20210394E001	EB-3	2 of 2

Project Name: PSD- South Hill Site
Location: Puyallup, WA
Driller/Equipment: Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop: 140# / 30

Ground Surface Elevation (ft): ~376
Datum: NAVD88
Date Start/Finish: 10/21/21,10/21/21
Hole Diameter (in): 3.75 i.d.

Depth (ft)	ST	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
		S-5		Moist, dark to light brown with slight oxidation, silty, fine SAND, trace gravel; occasional organics (rootlets and larger pieces); unsorted (SM).			5 7 7	14	
				Vashon Advance Outwash Driller reports gravel at 29 feet.					
30		S-6		Moist, brown to light brown, silty, fine SAND, some medium sand, some broken gravel; unsorted (SM).			14 23 19	42	
35		S-7		Moist, grayish brown, fine to medium SAND, some silt, some coarse sand, trace gravel; coarsens with depth; unsorted (SP-SM).			18 20 22	42	
40		S-8		Moist, grayish brown to brownish gray, silty, fine to medium SAND, trace coarse sand; broken gravel observed; unsorted; poor recovery (SM).			25 28 20	48	
				Bottom of exploration boring at 41.5 feet No groundwater encountered.					
45									

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level ()
- Water Level at time of drilling (ATD)

Logged by: ART
Approved by: JHS

associated earth sciences incorporated

Exploration Boring

Project Number	Exploration Number	Sheet
20210394E001	EB-4	1 of 2

Project Name	PSD- South Hill Site	Ground Surface Elevation (ft)	~382
Location	Puyallup, WA	Datum	NAVD88
Driller/Equipment	Advance / D-50 Track Mount H.S.A.	Date Start/Finish	10/21/21,10/21/21
Hammer Weight/Drop	140# / 30	Hole Diameter (in)	3.75 i.d.

Depth (ft)	ST	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
				Fill					
5		S-1		Moist, dark brownish gray, silty, gravelly, fine SAND, some medium to coarse sand, trace organics; faint organic odor; unsorted (SM).			7 8 12	▲20	
10		S-2		Moist, dark brownish gray to greenish gray, silty, gravelly, fine SAND; occasional organics; unsorted (SM).			3 4 4	▲8	
15		S-3		Moist, bluish gray, silty, fine SAND, trace broken gravel; organics throughout; banding (1 inch thick) of dark brown organics; unsorted (SM).			3 3 4	▲7	
20		S-4		Moist, dark brown to bluish brown, silty, fine SAND; abundant organics; organic odor; unsorted (SM).			3 4 5	▲9	

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level ()
- Water Level at time of drilling (ATD)

Logged by: ART
Approved by: JHS

Exploration Boring

Project Number	Exploration Number	Sheet
20210394E001	EB-4	2 of 2

Project Name	PSD- South Hill Site	Ground Surface Elevation (ft)	~382
Location	Puyallup, WA	Datum	NAVD88
Driller/Equipment	Advance / D-50 Track Mount H.S.A.	Date Start/Finish	10/21/21,10/21/21
Hammer Weight/Drop	140# / 30	Hole Diameter (in)	3.75 i.d.

Depth (ft)	Samples	DESCRIPTION	Blows/6"	Blows/Foot
	S-5	As above.	5 6 9	15
		Driller reports gravel at 27 feet.		
		Vashon Recessional Lacustrine		
30	S-6	Moist, light brown with slight mottling, silty, fine SAND ranges to sandy, SILT, trace coarse sand; faintly stratified otherwise massive (SM).	5 5 5	10
35	S-7	Very moist, light brown with iron oxide staining, silty, fine SAND to fine sandy, SILT, trace gravel; faintly stratified otherwise massive (SM-ML).	3 4 5	9
		Vashon Ice Contact / Melt-out Till		
40	S-8	Moist, grayish brown, silty, fine SAND, trace broken gravel; till-like (SM).	5 10 12	22
		Bottom of exploration boring at 41.5 feet No groundwater encountered.		
45				

Column headings: Depth (ft), ST, Samples, Graphic Symbol, DESCRIPTION, Well Completion, Water Level, Blows/6", Blows/Foot (10 20 30 40), Other Tests

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level ()
- Water Level at time of drilling (ATD)

Logged by: ART
Approved by: JHS

associated earth sciences incorporated	**Exploration Boring**		
	Project Number: 20210394E001	Exploration Number: EB-5	Sheet: 1 of 1

Project Name	PSD- South Hill Site	Ground Surface Elevation (ft)	~359
Location	Puyallup, WA	Datum	NAVD88
Driller/Equipment	Advance / D-50 Track Mount H.S.A.	Date Start/Finish	10/22/21,10/22/21
Hammer Weight/Drop	140# / 30	Hole Diameter (in)	3.75 i.d.

Depth (ft)	Samples	DESCRIPTION	Blows/6"	Blows/Foot
		Fill		
	S-1	Moist, grayish brown, silty, fine SAND; dark organic banding; unsorted (SM).	2 5 9	14
		Vashon Recessional Lacustrine Lower 6 inches: Moist, light brown with iron oxide staining, silty, fine SAND; faintly stratified otherwise massive (SM).		
5	S-2	Moist, brownish gray with iron oxide staining, silty, fine SAND ranging to fine sandy, SILT, trace gravel; occasional organics observed; faintly stratified otherwise massive (SM).	5 4 5	9
		Vashon Ice Contact / Melt-out Till		
10	S-3	Moist, brownish gray, silty fine SAND ranges to fine sandy, SILT, some broken gravel, trace medium to coarse sand; till-like (SM-ML).	5 11 11	22
		Vashon Advance Outwash Driller reports gravel.		
15	S-4	Moist, brownish gray, fine to medium sandy, GRAVEL, some silt, some coarse sand; contains broken gravel; unsorted (GP-GM).	12 22 22	44
20	S-5	No recovery; due to gravel.	29 44 50/5"	50/5"
		Bottom of exploration boring at 21.4 feet No groundwater encountered.		

Column headers also include: ST, Graphic Symbol, Well Completion, Water Level, Other Tests. Blows/Foot scale: 10, 20, 30, 40.

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level ()
- Water Level at time of drilling (ATD)

Logged by: ART
Approved by: JHS

Exploration Boring

associated earth sciences incorporated

Project Number	Exploration Number	Sheet
20210394E001	EB-6	1 of 1

Project Name: PSD- South Hill Site
Location: Puyallup, WA
Driller/Equipment: Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop: 140# / 30

Ground Surface Elevation (ft): ~352
Datum: NAVD88
Date Start/Finish: 10/22/21,10/22/21
Hole Diameter (in): 3.75 i.d.

Depth (ft)	Samples	DESCRIPTION	Blows/6"	Blows/Foot
		Fill / Topsoil ?		
5	S-1	Moist, brown to dark brown, silty, fine SAND, trace medium sand; rootlets observed; dark organic banding throughout; unsorted (SM).	2 2 2	4
		Vashon Recessional Lacustrine		
10	S-2	Very moist, light brown iron oxide staining, silty, fine SAND to fine sandy, SILT; faintly stratified otherwise massive (SM-ML).	8 4 6	10
		Gravelly drilling at 12 feet.		
15	S-3	As above; very moist.	2 2 2	4
20	S-4	As above; greater gravel content in tip.	9 7 11	18
		Bottom of exploration boring at 21.5 feet No groundwater encountered.		

Column headings also include: S T, Graphic Symbol, Well Completion, Water Level, Other Tests. Blows/Foot scale: 10, 20, 30, 40.

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level ()
- Water Level at time of drilling (ATD)

Logged by: ART
Approved by: JHS

associated earth sciences incorporated

Exploration Boring

Project Number	Exploration Number	Sheet
20210394E001	EB-7	1 of 1

Project Name: PSD- South Hill Site
Location: Puyallup, WA
Driller/Equipment: Advance / D-50 Track Mount H.S.A.
Hammer Weight/Drop: 140# / 30

Ground Surface Elevation (ft): ~358
Datum: NAVD88
Date Start/Finish: 10/22/21,10/22/21
Hole Diameter (in): 3.75 i.d.

Depth (ft)	Samples	DESCRIPTION	Blows/6"	Blows/Foot
0		**Topsoil - 6 inches**		
		Vashon Recessional Lacustrine		
	S-1	Moist, dark brown, silty, fine SAND, trace medium sand; rootlets observed; unsorted; poor recovery (SM).	5 4 4	8
5	S-2	Moist, light brown with iron oxide staining, fine sandy, SILT, trace medium sand, trace gravel, trace rootlets; faintly stratified otherwise massive (ML).	3 3 3	6
10	S-3	Moist, light brown with iron oxide staining, silty, fine SAND; faintly stratified otherwise massive (SM).	2 3 2	5
		Vashon Ice Contact / Melt-out Till		
15	S-4	Moist, brownish gray, silty, fine SAND ranges to sandy, SILT, some broken gravel, trace coarse sand; unsorted (SM-ML).	10 13 15	28
		Vashon Advance Outwash		
		Driller reports gravel 17.5 feet.		
20	S-5	Moist, brownish gray, fine to medium SAND, some silt, some broken gravel, trace coarse sand, contains gravel (SP-SM).	15 16 17	33
		Bottom of exploration boring at 21.5 feet No groundwater encountered.		

Columns not filled on this log: ST, Graphic Symbol, Well Completion, Water Level, Other Tests. Blows/Foot scale: 10, 20, 30, 40.

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level ()
- Water Level at time of drilling (ATD)

Logged by: ART
Approved by: JHS

Exploration Boring

associated earth sciences incorporated

Project Number	Exploration Number	Sheet
20210394E001	EB-8	1 of 1

Project Name	PSD- South Hill Site	Ground Surface Elevation (ft)	~359
Location	Puyallup, WA	Datum	NAVD88
Driller/Equipment	Advance / D-50 Track Mount H.S.A.	Date Start/Finish	10/22/21,10/22/21
Hammer Weight/Drop	140# / 30	Hole Diameter (in)	3.75 i.d.

Depth (ft)	Samples	DESCRIPTION	Blows/6"	Blows/Foot
		Topsoil - 6 inches		
		Vashon Lacustrine Recessional Outwash		
	S-1	Moist, light brown with iron oxide staining, silty, fine SAND to fine sandy, SILT; faintly stratified otherwise massive (SM-ML).	3 3 1	4
5	S-2	As above; less iron oxide staining.	3 4 3	7
10	S-3	Moist, light brown, silty, fine SAND; massive (SM).	3 4 3	7
15	S-4	Very moist, light brown with iron oxide banding, silty, fine SAND to fine sandy, SILT; massive (SM-ML).	1 2 3	5
		Vashon Ice Contact / Melt-out Till		
20	S-5	Very moist, brownish gray, silty, fine SAND, some broken gravel; coarsens with depth (SM).	13 21 19	40
		Bottom of exploration boring at 21.5 feet No groundwater encountered.		

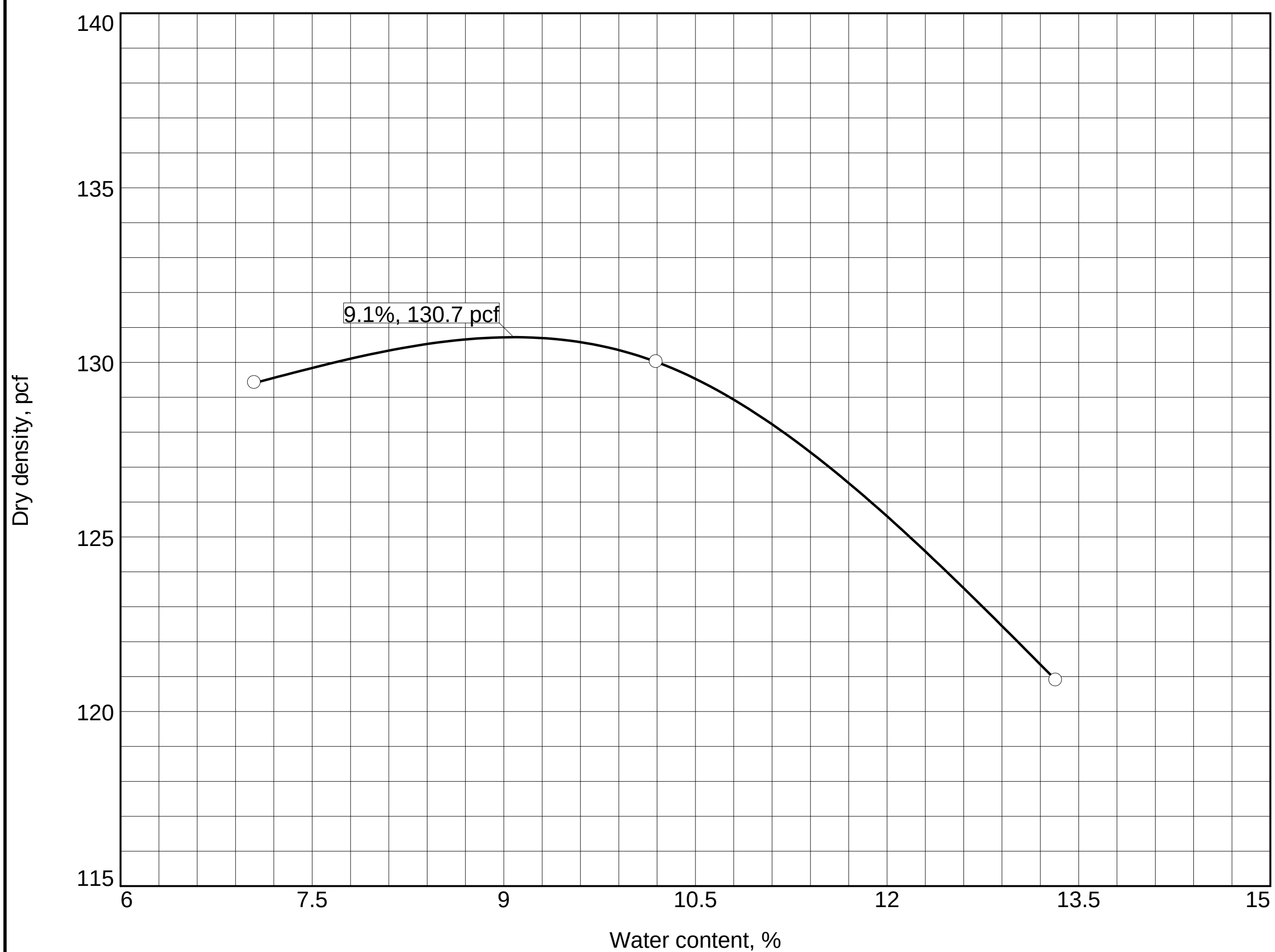
Column headings: Depth (ft), ST, Samples, Graphic Symbol, DESCRIPTION, Well Completion, Water Level, Blows/6", Blows/Foot (10, 20, 30, 40), Other Tests

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level ()
- Water Level at time of drilling (ATD)

Logged by: ART
Approved by: JHS

APPENDIX B

Laboratory Test Results



Test specification: ASTM D 1557-91 Procedure C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 130.7 pcf Optimum moisture = 9.1 %	

Project No. 20210394 E001 **Client:** Puyallup SD
Project: Puyallup SD - South Hill Site
Date: 10/27/2021
○ **Location:** Onsite - Fill **Sample Number:** EB-3

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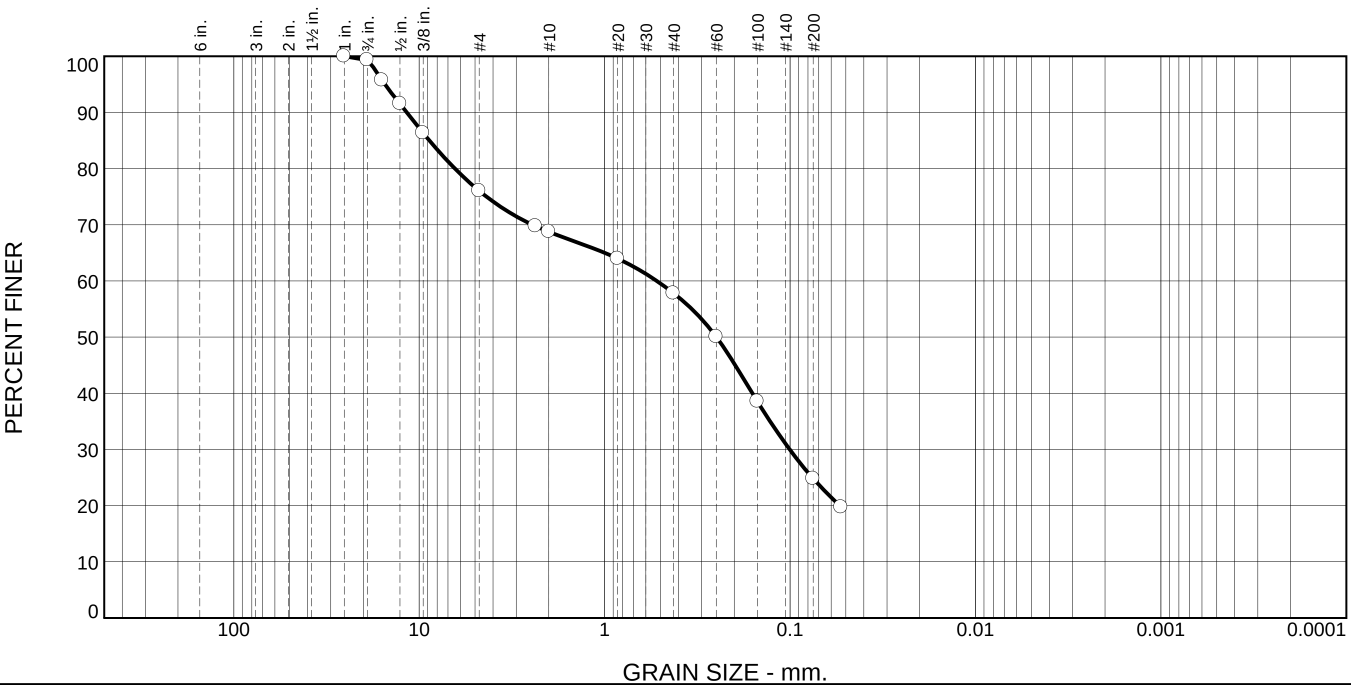
Remarks:

Figure

Tested By: CI **Checked By:** ART/SS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.7	23.3	7.3	10.9	33.0	24.8	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
3/4"	99.3		
5/8"	95.7		
1/2"	91.5		
3/8"	86.3		
#4	76.0		
#8	69.8		
#10	68.7		
#20	64.0		
#40	57.8		
#60	50.1		
#100	38.5		
#200	24.8		
#270	19.7		

* (no specification provided)

Material Description

gravelly, 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}= 11.6660 D_{85}= 8.8174 D_{60}= 0.5234
D_{50}= 0.2493 D_{30}= 0.1005 D_{15}=
D_{10}= C_u= C_c=

Remarks

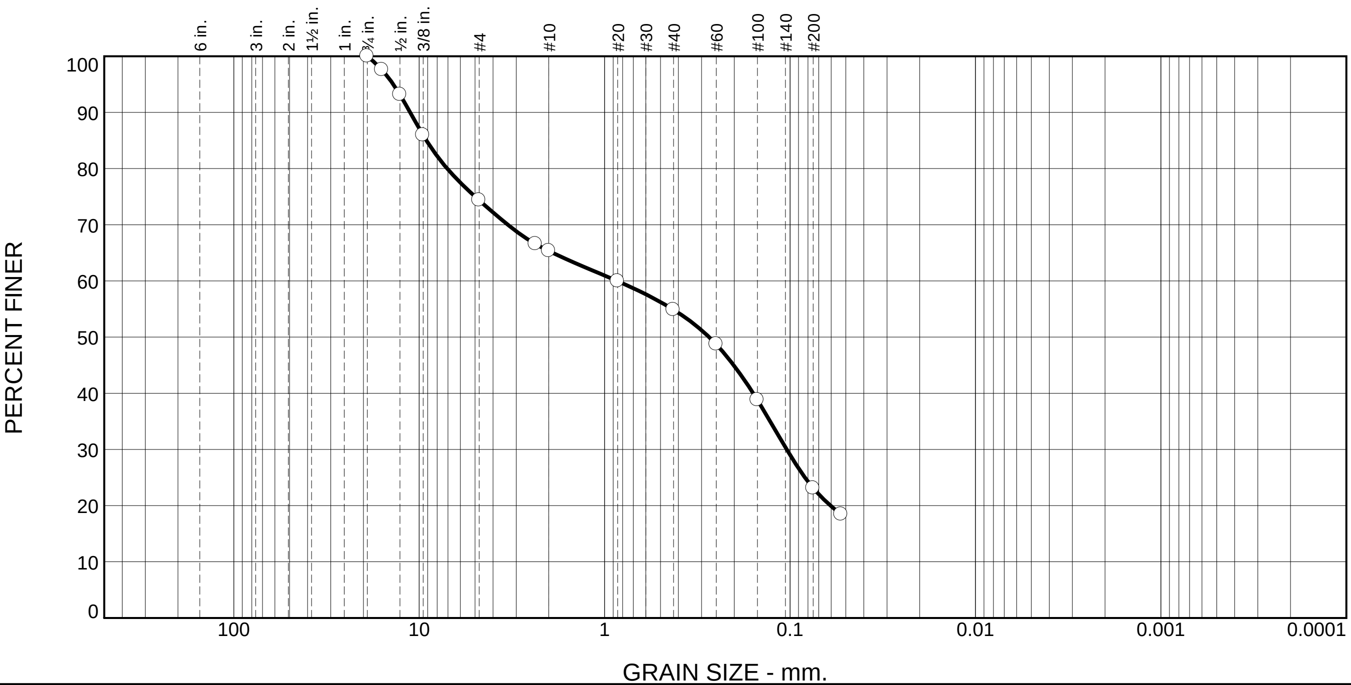
Date Received: 10/26/2021 **Date Tested:** 11/1/2021
Tested By: CI
Checked By: ART/SS
Title:

Location: Onsite - Fill
Sample Number: EB-3
Date Sampled: 10/21/2021

associated earth sciences incorporated

Client: Puyallup SD
Project: Puyallup SD - South Hill Site
Project No: 20210394 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	25.6	9.1	10.4	31.8	23.1	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/4"	100.0		
5/8"	97.6		
1/2"	93.2		
3/8"	85.9		
#4	74.4		
#8	66.6		
#10	65.3		
#20	60.0		
#40	54.9		
#60	48.7		
#100	38.8		
#200	23.1		
#270	18.4		

* (no specification provided)

Material Description

gravelly, 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}= 11.1908 D_{85}= 9.1470 D_{60}= 0.8567
D_{50}= 0.2732 D_{30}= 0.1043 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 10/26/2021 **Date Tested:** 11/1/2021

Tested By: CI

Checked By: ART/SS

Title:

Location: Onsite - Fill
Sample Number: EB-4

Date Sampled: 10/21/2021

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Client: Puyallup SD
Project: Puyallup SD - South Hill Site

Project No: 20210394 E001 **Figure**

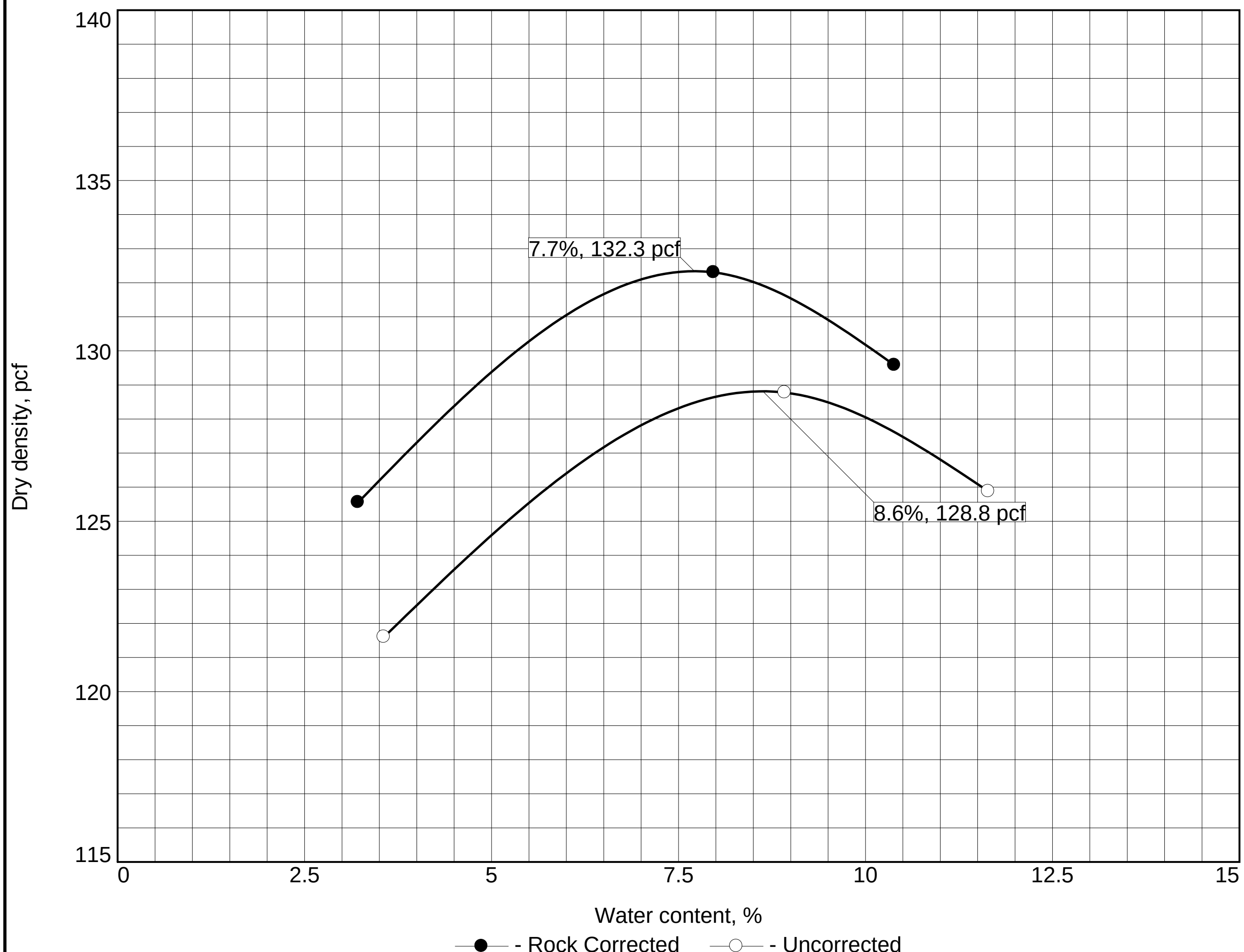
associated earth sciences incorporated

Moisture, Ash, and Organic Matter of Peat and Other Organic Soils - ASTM 2974

Date Sampled	Project	Project No.		Soil Description
10/21/2021	South Hill Site	20210394 E001		fill
Tested By	**Location**	**EB/EP No.**	**Depth**	
CI	Puyallup, WA	EB		

Moisture Content		**Organic Matter and Ash Content**	
Sample ID	**EB-3**	Dry Soil Before Burn + Pan	**625.00**
Wet Weight + Pan	**705.00**	Dry Soil After Burn + Pan	**620.00**
Dry Weight + Pan	**625.00**	Weight of Pan	**245.00**
Weight of Pan	**245.00**	Wt. Loss Due to Ignition	**5.00**
Weight of Moisture	**80.00**	Actual Wt. Of Soil After Burn	**375.00**
Dry Weight of Soil	**380.00**	% Organics	**1.32**
% Moisture	**21.05**		

Moisture Content		**Organic Matter and Ash Content**	
Sample ID	**EB-4**	Dry Soil Before Burn + Pan	**575.00**
Wet Weight + Pan	**620.00**	Dry Soil After Burn + Pan	**570.00**
Dry Weight + Pan	**575.00**	Weight of Pan	**250.00**
Weight of Pan	**250.00**	Wt. Loss Due to Ignition	**5.00**
Weight of Moisture	**45.00**	Actual Wt. Of Soil After Burn	**320.00**
Dry Weight of Soil	**325.00**	% Organics	**1.54**
% Moisture	**13.85**		



Test specification: ASTM D 1557-91 Procedure C Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
							11.3	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 132.3 pcf	128.8 pcf	
Optimum moisture = 7.7 %	8.6 %	

Project No. 20210394 E001 **Client:** Puyallup SD
Project: Puyallup SD - South Hill Site
Date: 10/28/2021
○ **Location:** Onsite - Fill **Sample Number:** EB-4

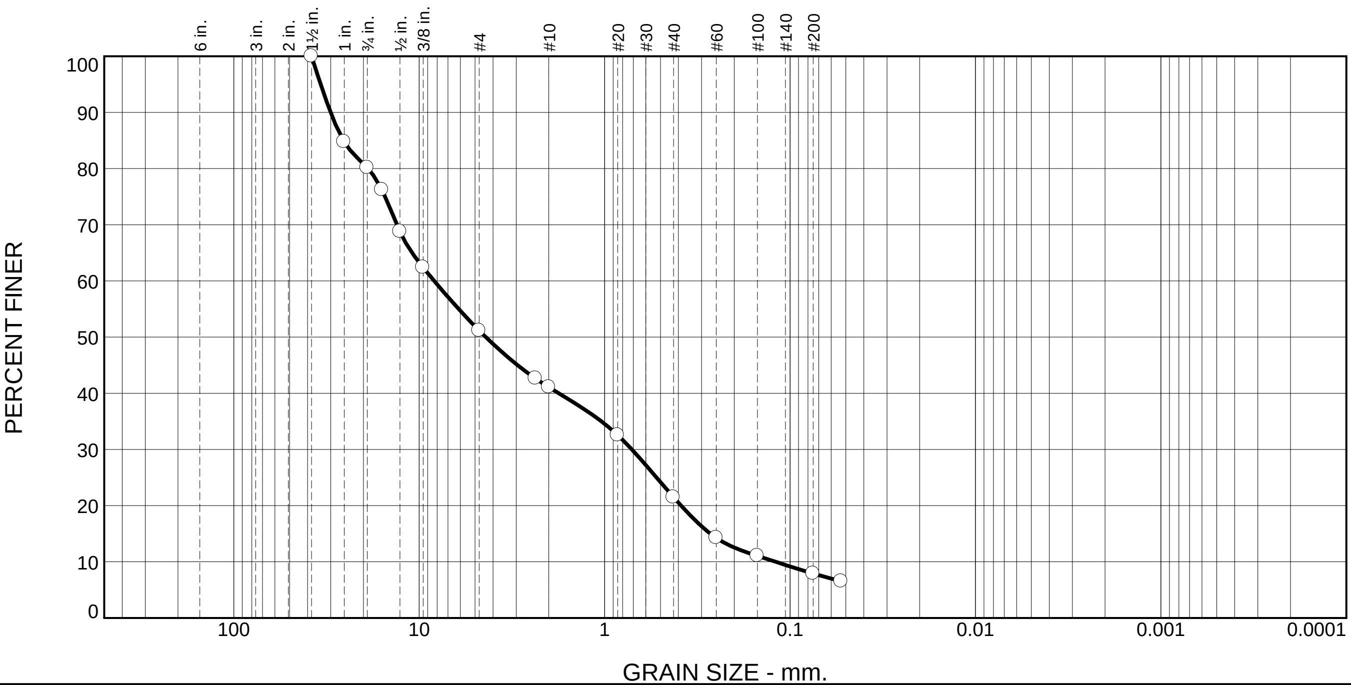
associated earth sciences incorporated

Remarks:

Figure

Tested By: CI **Checked By:** ART/SS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	19.9	28.9	10.1	19.6	13.6	7.9	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	84.8		
3/4"	80.1		
5/8"	76.2		
1/2"	68.8		
3/8"	62.4		
#4	51.2		
#8	42.6		
#10	41.1		
#20	32.5		
#40	21.5		
#60	14.3		
#100	11.1		
#200	7.9		
#270	6.5		

* (no specification provided)

Material Description

very sandy GRAVEL, some silt

Atterberg Limits (ASTM D 4318)

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

Classification

USCS (D 2487)= GP-GM **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 30.0469 D_{85}= 25.6377 D_{60}= 8.3018
D_{50}= 4.3746 D_{30}= 0.7131 D_{15}= 0.2688
D_{10}= 0.1197 C_u= 69.34 C_c= 0.51

Remarks

Date Received: 10/26/2021 **Date Tested:** 11/2/2021
Tested By: CI
Checked By: ART/SS
Title:

Location: Onsite - Outwash
Sample Number: EB-1W **Depth:** 30' **Date Sampled:** 10/20/2021

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Client: Puyallup SD
Project: Puyallup SD - South Hill Site
Project No: 20210394 E001 **Figure**

Particle Size Distribution Report

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	10.3	38.4	12.0	14.6	13.5	11.2	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
3/4"	89.7		
5/8"	85.5		
1/2"	76.0		
3/8"	68.1		
#4	51.3		
#8	41.1		
#10	39.3		
#20	31.1		
#40	24.7		
#60	19.0		
#100	15.5		
#200	11.2		
#270	9.5		

* (no specification provided)

Material Description

very sandy GRAVEL, some silt

Atterberg Limits (ASTM D 4318)

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

Classification

USCS (D 2487)= GW-GM **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 19.2567 D_{85}= 15.6335 D_{60}= 6.8755
D_{50}= 4.4527 D_{30}= 0.7445 D_{15}= 0.1386
D_{10}= 0.0585 C_u= 117.48 C_c= 1.38

Remarks

Date Received: 10/26/2021 **Date Tested:** 11/2/2021
Tested By: CI
Checked By: ART/SS
Title:

Location: Onsite - Outwash
Sample Number: EB-2 **Depth:** 20'
Date Sampled: 10/21/2021

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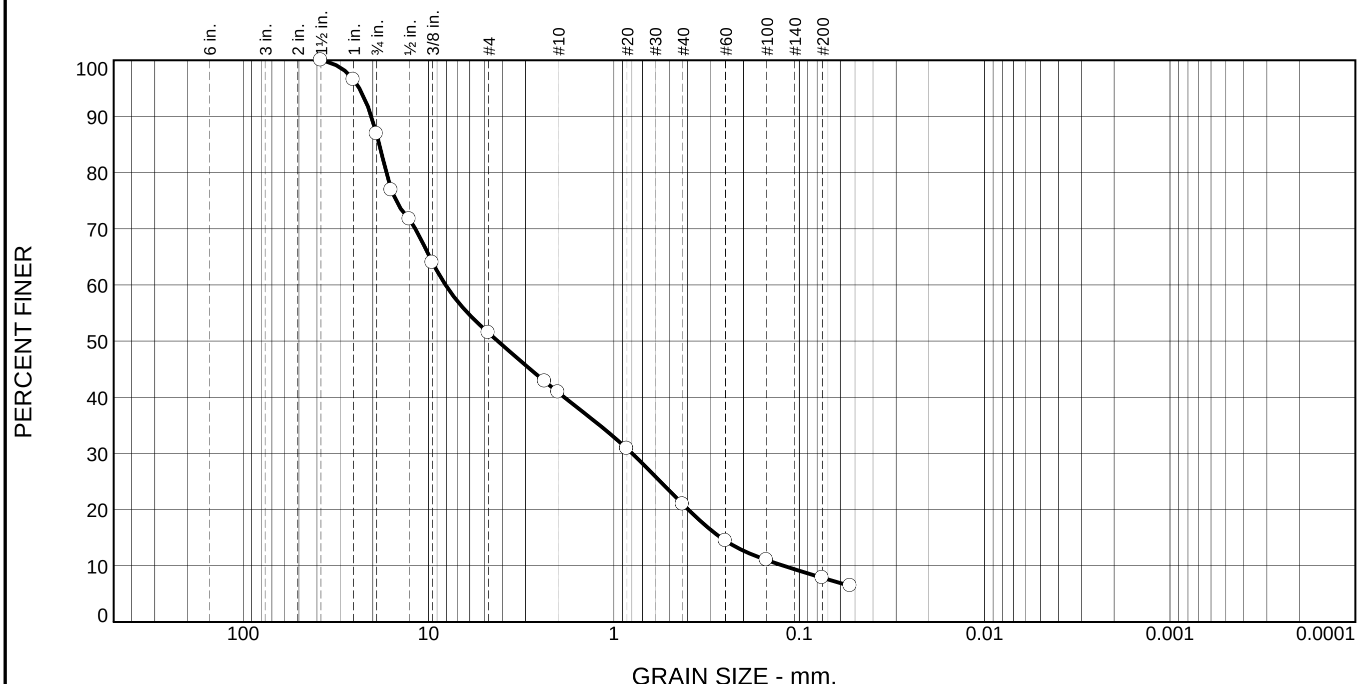
Client: Puyallup SD
Project: Puyallup SD - South Hill Site
Project No: 20210394 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	13.1	35.4	10.6	19.9	13.1	7.9	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	96.5		
3/4"	86.9		
5/8"	76.9		
1/2"	71.7		
3/8"	64.0		
#4	51.5		
#8	42.8		
#10	40.9		
#20	30.9		
#40	21.0		
#60	14.5		
#100	11.0		
#200	7.9		
#270	6.4		

* (no specification provided)

Material Description

very sandy GRAVEL, some silt

Atterberg Limits (ASTM D 4318)

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

Classification

USCS (D 2487)= GP-GM **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 20.3223 D_{85}= 18.4222 D_{60}= 8.0993
D_{50}= 4.2312 D_{30}= 0.7975 D_{15}= 0.2644
D_{10}= 0.1216 C_u= 66.63 C_c= 0.65

Remarks

Date Received: 10/26/2021 **Date Tested:** 11/2/2021
Tested By: CI
Checked By: ART/SS
Title:

Location: Onsite - Outwash
Sample Number: EB-5 **Depth:** 15'
Date Sampled: 10/22/2021

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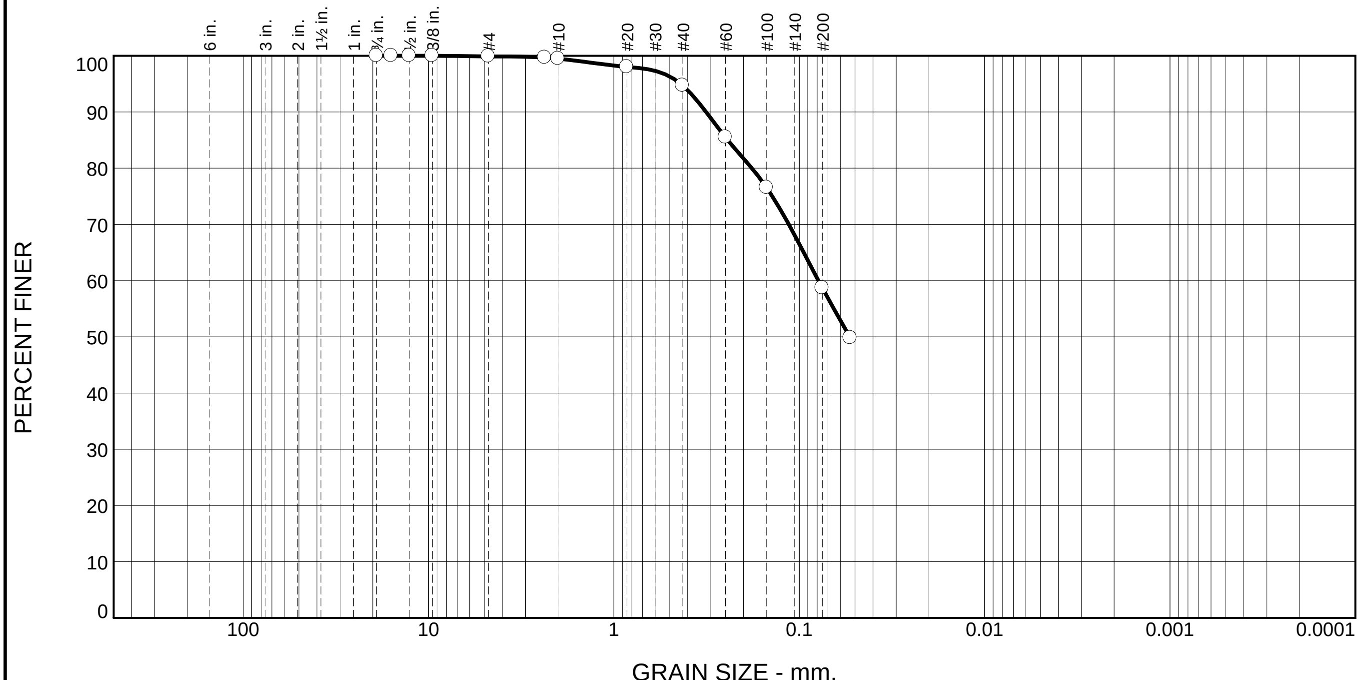
Client: Puyallup SD
Project: Puyallup SD - South Hill Site
Project No: 20210394 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.4	4.8	36.0	58.7	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/4"	100.0		
5/8"	100.0		
1/2"	100.0		
3/8"	100.0		
#4	99.9		
#8	99.7		
#10	99.5		
#20	98.0		
#40	94.7		
#60	85.5		
#100	76.6		
#200	58.7		
#270	49.8		

* (no specification provided)

Material Description

very sandy SILT, trace gravel

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 0.3182 D_{85}= 0.2431 D_{60}= 0.0788
D_{50}= 0.0534 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 10/26/2021 **Date Tested:** 11/2/2021

Tested By: CI

Checked By: ART/SS

Title:

Location: Onsite - Lacustrine
Sample Number: EB-7 **Depth:** 5'

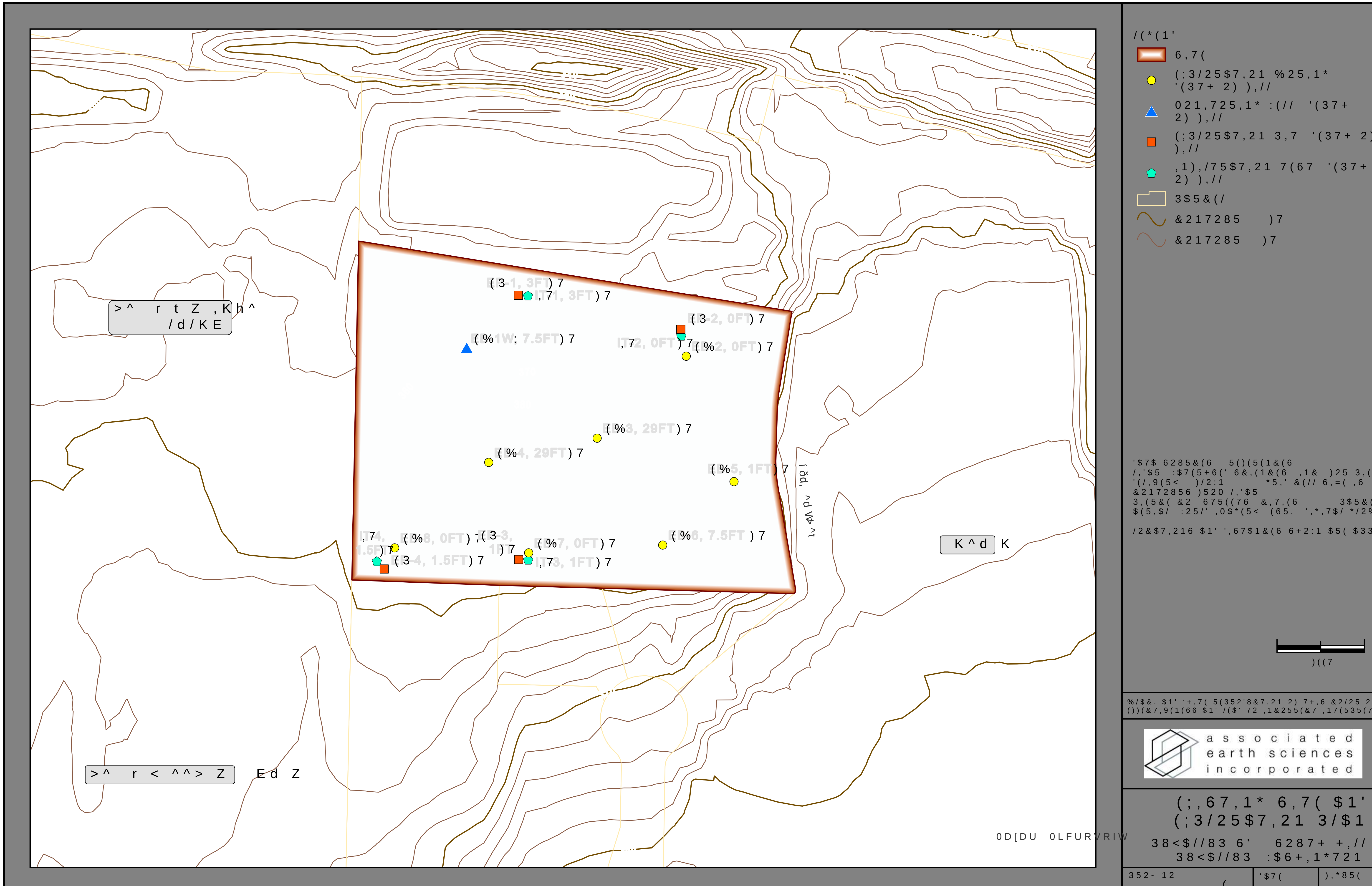
Date Sampled: 10/22/2021

associated earth sciences incorporated

Client: Puyallup SD
Project: Puyallup SD - South Hill Site

Project No: 20210394 E001 **Figure**

APPENDIX C



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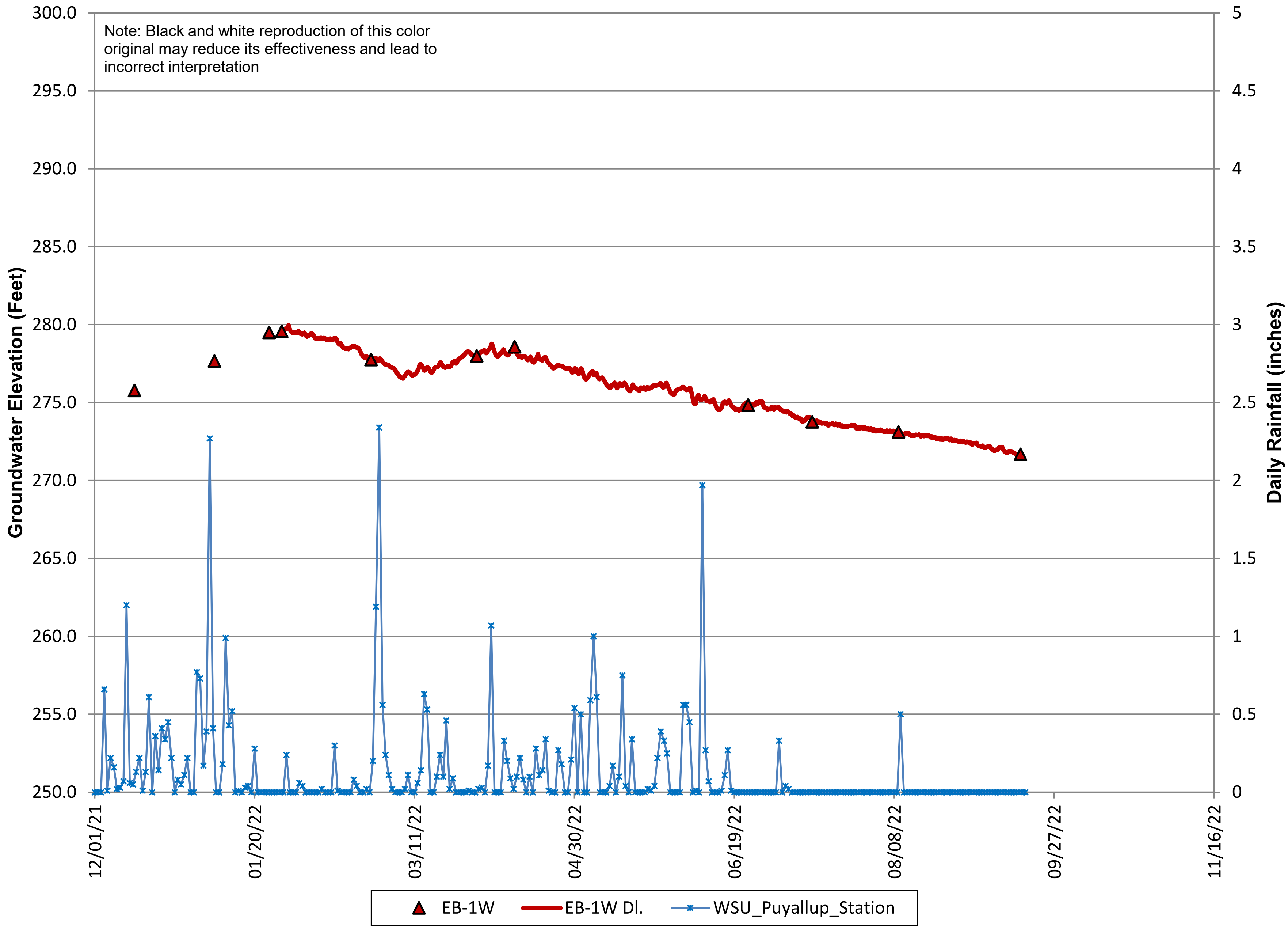


Groundwater Hydrograph
South Hill Site
Puyallup, Washington

Associated Earth Sciences, Inc.
www.aesgeo.com

Project No. 20210394E001
08/23

APPENDIX D

Infiltration Gallery Modeling

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: Infiltration Basin

Site Name:	
Site Address:	
City:	
Report Date:	6/30/2023
Gage:	38 IN CENTRAL
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	0.000 (adjusted)
Version Date:	2023/01/27
Version:	4.2.19

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Steep	4.5
Pervious Total	4.5
Impervious Land Use	acre
Impervious Total	0
Basin Total	4.5

Mitigated Land Use

S Parking

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Mod	0.35
Pervious Total	0.35
Impervious Land Use	acre
DRIVEWAYS FLAT	1.5
Impervious Total	1.5
Basin Total	1.85

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
DRIVEWAYS FLAT	1.2
Impervious Total	1.2
Basin Total	1.2

Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Mod	0.25
Pervious Total	0.25
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.25

Routing Elements
Predeveloped Routing

Mitigated Routing

Gravel Trench Bed 1

Bottom Length:	200.00 ft.
Bottom Width:	32.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	4
Pour Space of material for first layer:	0.33
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	5
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	1086.766
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	1086.766
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0

Discharge Structure

Riser Height: 3.9 ft.

Riser Diameter: 12 in.

Element Flows To:

Outlet 1 Outlet 2

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.146	0.000	0.000	0.000
0.0444	0.146	0.002	0.000	0.740
0.0889	0.146	0.004	0.000	0.740
0.1333	0.146	0.006	0.000	0.740
0.1778	0.146	0.008	0.000	0.740
0.2222	0.146	0.010	0.000	0.740
0.2667	0.146	0.012	0.000	0.740
0.3111	0.146	0.015	0.000	0.740
0.3556	0.146	0.017	0.000	0.740
0.4000	0.146	0.019	0.000	0.740
0.4444	0.146	0.021	0.000	0.740
0.4889	0.146	0.023	0.000	0.740
0.5333	0.146	0.025	0.000	0.740
0.5778	0.146	0.028	0.000	0.740
0.6222	0.146	0.030	0.000	0.740
0.6667	0.146	0.032	0.000	0.740
0.7111	0.146	0.034	0.000	0.740
0.7556	0.146	0.036	0.000	0.740
0.8000	0.146	0.038	0.000	0.740
0.8444	0.146	0.040	0.000	0.740
0.8889	0.146	0.043	0.000	0.740
0.9333	0.146	0.045	0.000	0.740
0.9778	0.146	0.047	0.000	0.740
1.0222	0.146	0.049	0.000	0.740

1.0667	0.146	0.051	0.000	0.740
1.1111	0.146	0.053	0.000	0.740
1.1556	0.146	0.056	0.000	0.740
1.2000	0.146	0.058	0.000	0.740
1.2444	0.146	0.060	0.000	0.740
1.2889	0.146	0.062	0.000	0.740
1.3333	0.146	0.064	0.000	0.740
1.3778	0.146	0.066	0.000	0.740
1.4222	0.146	0.069	0.000	0.740
1.4667	0.146	0.071	0.000	0.740
1.5111	0.146	0.073	0.000	0.740
1.5556	0.146	0.075	0.000	0.740
1.6000	0.146	0.077	0.000	0.740
1.6444	0.146	0.079	0.000	0.740
1.6889	0.146	0.081	0.000	0.740
1.7333	0.146	0.084	0.000	0.740
1.7778	0.146	0.086	0.000	0.740
1.8222	0.146	0.088	0.000	0.740
1.8667	0.146	0.090	0.000	0.740
1.9111	0.146	0.092	0.000	0.740
1.9556	0.146	0.094	0.000	0.740
2.0000	0.146	0.097	0.000	0.740
2.0444	0.146	0.099	0.000	0.740
2.0889	0.146	0.101	0.000	0.740
2.1333	0.146	0.103	0.000	0.740
2.1778	0.146	0.105	0.000	0.740
2.2222	0.146	0.107	0.000	0.740
2.2667	0.146	0.109	0.000	0.740
2.3111	0.146	0.112	0.000	0.740
2.3556	0.146	0.114	0.000	0.740
2.4000	0.146	0.116	0.000	0.740
2.4444	0.146	0.118	0.000	0.740
2.4889	0.146	0.120	0.000	0.740
2.5333	0.146	0.122	0.000	0.740
2.5778	0.146	0.125	0.000	0.740
2.6222	0.146	0.127	0.000	0.740
2.6667	0.146	0.129	0.000	0.740
2.7111	0.146	0.131	0.000	0.740
2.7556	0.146	0.133	0.000	0.740
2.8000	0.146	0.135	0.000	0.740
2.8444	0.146	0.137	0.000	0.740
2.8889	0.146	0.140	0.000	0.740
2.9333	0.146	0.142	0.000	0.740
2.9778	0.146	0.144	0.000	0.740
3.0222	0.146	0.146	0.000	0.740
3.0667	0.146	0.148	0.000	0.740
3.1111	0.146	0.150	0.000	0.740
3.1556	0.146	0.153	0.000	0.740
3.2000	0.146	0.155	0.000	0.740
3.2444	0.146	0.157	0.000	0.740
3.2889	0.146	0.159	0.000	0.740
3.3333	0.146	0.161	0.000	0.740
3.3778	0.146	0.163	0.000	0.740
3.4222	0.146	0.165	0.000	0.740
3.4667	0.146	0.168	0.000	0.740
3.5111	0.146	0.170	0.000	0.740
3.5556	0.146	0.172	0.000	0.740
3.6000	0.146	0.174	0.000	0.740

3.6444	0.146	0.176	0.000	0.740
3.6889	0.146	0.178	0.000	0.740
3.7333	0.146	0.181	0.000	0.740
3.7778	0.146	0.183	0.000	0.740
3.8222	0.146	0.185	0.000	0.740
3.8667	0.146	0.187	0.000	0.740
3.9111	0.146	0.189	0.012	0.740
3.9556	0.146	0.191	0.138	0.740
4.0000	0.146	0.193	0.333	0.740

Analysis Results
POC 1

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

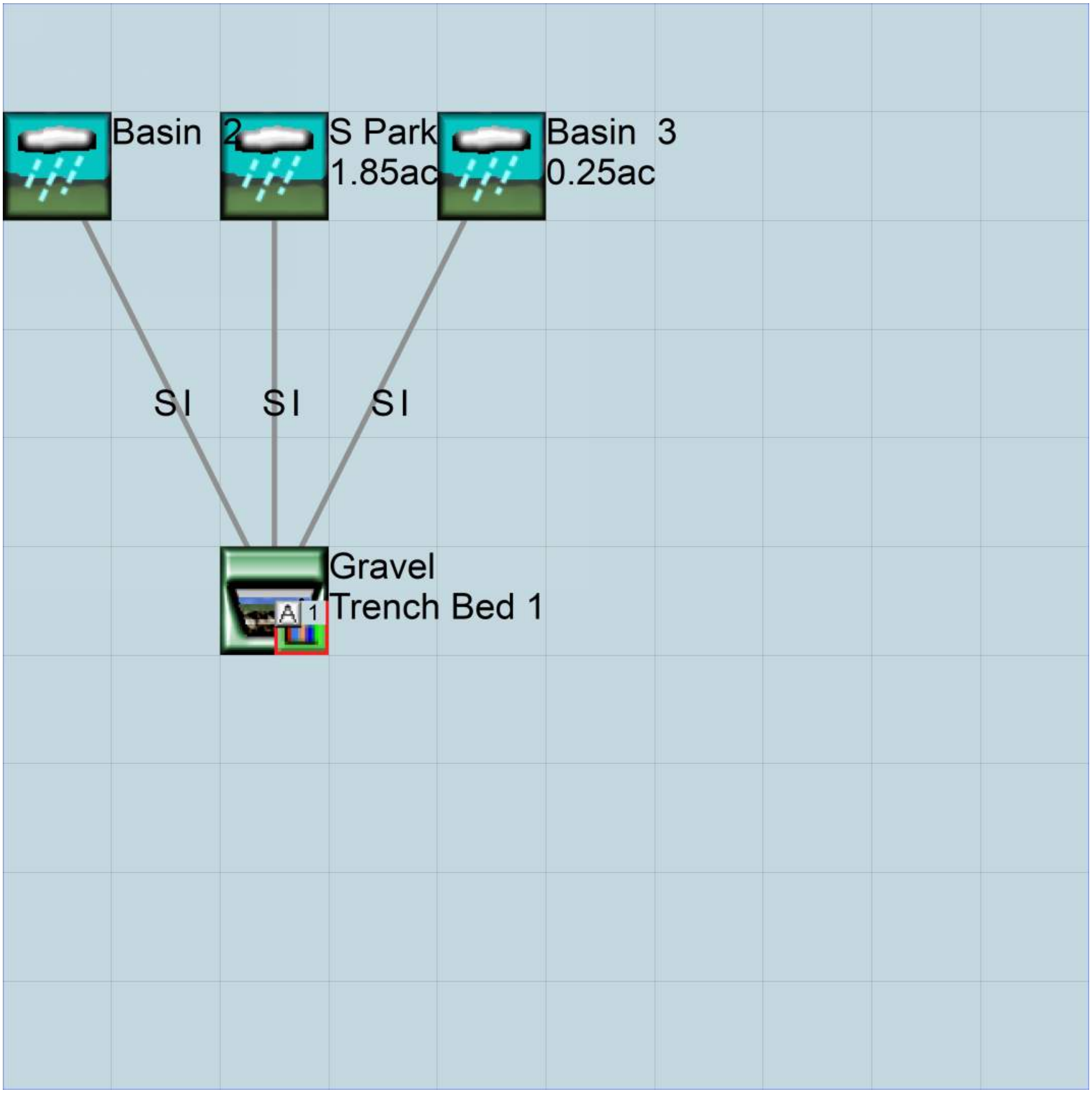
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic

Mitigated Schematic



Predeveloped UCI File

Mitigated UCI File

Predeveloped HSPF Message File

Mitigated HSPF Message File

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6200 Capitol Blvd. Ste F
Olympia, WA. 98501
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Local (360)943-0304

www.clearcreeksolutions.com

North Parking Lot Bioretention Modeling

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: Final Phase - North Parking Lot

Site Name:

Site Address:

City:

Report Date:	10/3/2023
Gage:	38 IN CENTRAL
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	0.000 (adjusted)
Version Date:	2023/01/27
Version:	4.2.19

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Steep	4.5
Pervious Total	4.5
Impervious Land Use	acre
Impervious Total	0
Basin Total	4.5

Mitigated Land Use

Treatment N Parking Lot

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
DRIVEWAYS FLAT	1.2
Impervious Total	1.2
Basin Total	1.2

Routing Elements
Predeveloped Routing

Mitigated Routing

Bioretention 1

Bottom Length:	190.00 ft.
Bottom Width:	5.00 ft.
Material thickness of first layer:	0.25
Material type for first layer:	SMMWW
Material thickness of second layer:	1.5
Material type for second layer:	SMMWW
Material thickness of third layer:	2
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	1
Orifice Diameter (in.):	8
Offset (in.):	5
Flow Through Underdrain (ac-ft.):	440.799
Total Outflow (ac-ft.):	483.075
Percent Through Underdrain:	91.25

Discharge Structure
Riser Height: 1 ft.
Riser Diameter: 12 in.
Element Flows To:
Outlet 1 Outlet 2

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0218	0.0000	0.0000	0.0000
0.0577	0.0218	0.0005	0.0000	0.0000
0.1154	0.0218	0.0010	0.0000	0.0000
0.1731	0.0218	0.0015	0.0000	0.0000
0.2308	0.0218	0.0020	0.0000	0.0000
0.2885	0.0218	0.0025	0.0000	0.0000
0.3462	0.0218	0.0030	0.0000	0.0000
0.4038	0.0218	0.0035	0.0000	0.0000
0.4615	0.0218	0.0040	0.0000	0.0000
0.5192	0.0218	0.0045	0.0000	0.0000
0.5769	0.0218	0.0051	0.0000	0.0000
0.6346	0.0218	0.0056	0.0000	0.0000
0.6923	0.0218	0.0061	0.0000	0.0000
0.7500	0.0218	0.0066	0.0000	0.0000
0.8077	0.0218	0.0071	0.0000	0.0000
0.8654	0.0218	0.0076	0.0000	0.0000
0.9231	0.0218	0.0081	0.0000	0.0000
0.9808	0.0218	0.0086	0.0000	0.0000
1.0385	0.0218	0.0091	0.0000	0.0000
1.0962	0.0218	0.0096	0.0000	0.0000
1.1538	0.0218	0.0101	0.0000	0.0000
1.2115	0.0218	0.0106	0.0000	0.0000
1.2692	0.0218	0.0111	0.0000	0.0000
1.3269	0.0218	0.0116	0.0000	0.0000
1.3846	0.0218	0.0121	0.0000	0.0000
1.4423	0.0218	0.0126	0.0000	0.0000
1.5000	0.0218	0.0131	0.0000	0.0000
1.5577	0.0218	0.0136	0.0000	0.0000
1.6154	0.0218	0.0141	0.0000	0.0000

1.6731	0.0218	0.0146	0.0000	0.0000
1.7308	0.0218	0.0152	0.0000	0.0000
1.7885	0.0218	0.0157	0.0000	0.0000
1.8462	0.0218	0.0162	0.0000	0.0000
1.9038	0.0218	0.0167	0.0000	0.0000
1.9615	0.0218	0.0172	0.0221	0.0000
2.0192	0.0218	0.0178	0.0246	0.0000
2.0769	0.0218	0.0183	0.0273	0.0000
2.1346	0.0218	0.0188	0.0289	0.0000
2.1923	0.0218	0.0193	0.0289	0.0000
2.2500	0.0218	0.0199	0.0605	0.0000
2.3077	0.0218	0.0204	0.0605	0.0000
2.3654	0.0218	0.0209	0.0605	0.0000
2.4231	0.0218	0.0214	0.0605	0.0000
2.4808	0.0218	0.0219	0.0605	0.0000
2.5385	0.0218	0.0225	0.0605	0.0000
2.5962	0.0218	0.0230	0.0605	0.0000
2.6538	0.0218	0.0235	0.0605	0.0000
2.7115	0.0218	0.0240	0.0605	0.0000
2.7692	0.0218	0.0246	0.0605	0.0000
2.8269	0.0218	0.0251	0.0605	0.0000
2.8846	0.0218	0.0256	0.0605	0.0000
2.9423	0.0218	0.0261	0.0605	0.0000
3.0000	0.0218	0.0266	0.0605	0.0000
3.0577	0.0218	0.0272	0.0605	0.0000
3.1154	0.0218	0.0277	0.0605	0.0000
3.1731	0.0218	0.0282	0.0605	0.0000
3.2308	0.0218	0.0287	0.0605	0.0000
3.2885	0.0218	0.0293	0.0605	0.0000
3.3462	0.0218	0.0298	0.0605	0.0000
3.4038	0.0218	0.0303	0.0605	0.0000
3.4615	0.0218	0.0308	0.0605	0.0000
3.5192	0.0218	0.0313	0.0605	0.0000
3.5769	0.0218	0.0319	0.0605	0.0000
3.6346	0.0218	0.0324	0.0605	0.0000
3.6923	0.0218	0.0329	0.0605	0.0000
3.7500	0.0218	0.0334	0.0605	0.0000
3.7500	0.0218	0.0334	0.0605	0.0000

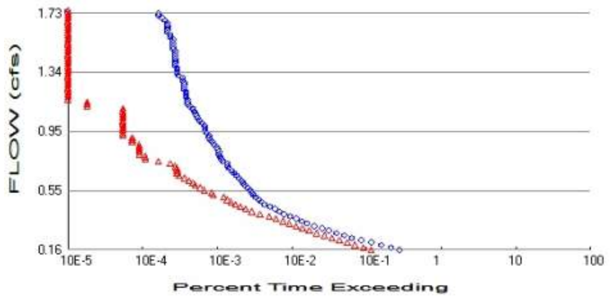
Bioretention Hydraulic Table

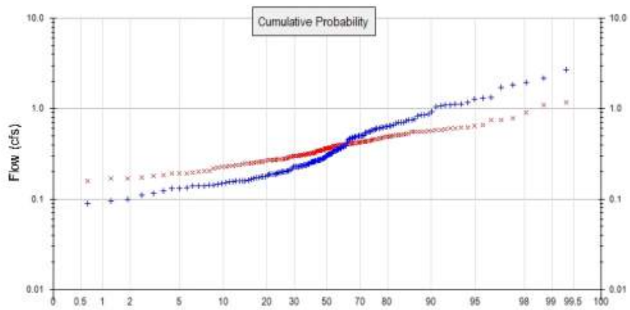
Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**To Amended(cfs)**	**Infilt(cfs)**
3.7500	0.0218	0.0334	0.0000	0.0330	0.0000
3.8077	0.0218	0.0347	0.0000	0.0330	0.0000
3.8654	0.0218	0.0359	0.0000	0.0410	0.0000
3.9231	0.0218	0.0372	0.0000	0.0423	0.0000
3.9808	0.0218	0.0385	0.0000	0.0436	0.0000
4.0385	0.0218	0.0397	0.0000	0.0448	0.0000
4.0962	0.0218	0.0410	0.0000	0.0461	0.0000
4.1538	0.0218	0.0422	0.0000	0.0474	0.0000
4.2115	0.0218	0.0435	0.0000	0.0486	0.0000
4.2692	0.0218	0.0448	0.0000	0.0499	0.0000
4.3269	0.0218	0.0460	0.0000	0.0512	0.0000
4.3846	0.0218	0.0473	0.0000	0.0524	0.0000
4.4423	0.0218	0.0485	0.0000	0.0537	0.0000
4.5000	0.0218	0.0498	0.0000	0.0550	0.0000
4.5577	0.0218	0.0510	0.0000	0.0562	0.0000
4.6154	0.0218	0.0523	0.0000	0.0575	0.0000
4.6731	0.0218	0.0536	0.0000	0.0588	0.0000

4.7308	0.0218	0.0548	0.0000	0.0601	0.0000
4.7885	0.0218	0.0561	0.0800	0.0613	0.0000
4.8462	0.0218	0.0573	0.3147	0.0626	0.0000
4.9038	0.0218	0.0586	0.6273	0.0639	0.0000
4.9615	0.0218	0.0599	0.9795	0.0651	0.0000
5.0192	0.0218	0.0611	1.3333	0.0664	0.0000
5.0769	0.0218	0.0624	1.6517	0.0677	0.0000
5.1346	0.0218	0.0636	1.9054	0.0689	0.0000
5.1923	0.0218	0.0649	2.0830	0.0702	0.0000
5.2500	0.0218	0.0661	2.2271	0.0715	0.0000

Surface retention 1

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 4.5
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 1.2

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.324156
5 year	0.612222
10 year	0.877818
25 year	1.317392
50 year	1.733275
100 year	2.236722

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.353858
5 year	0.490452
10 year	0.585927
25 year	0.712236
50 year	0.810449
100 year	0.912194

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1902	0.217	0.401
1903	0.155	0.524
1904	1.116	0.592
1905	0.197	0.250
1906	0.076	0.280
1907	0.539	0.408
1908	0.232	0.309
1909	0.315	0.403
1910	0.588	0.393
1911	0.378	0.303

1912	1.932	0.747
1913	0.262	0.220
1914	2.168	1.160
1915	0.160	0.196
1916	0.358	0.512
1917	0.114	0.181
1918	0.206	0.400
1919	0.182	0.191
1920	0.390	0.295
1921	0.270	0.232
1922	0.772	0.307
1923	0.279	0.305
1924	0.176	0.390
1925	0.159	0.240
1926	0.282	0.474
1927	0.175	0.277
1928	0.236	0.302
1929	0.551	0.578
1930	0.199	0.618
1931	0.228	0.273
1932	0.268	0.325
1933	0.270	0.302
1934	0.874	0.513
1935	0.204	0.244
1936	0.288	0.311
1937	0.642	0.435
1938	0.241	0.267
1939	0.096	0.350
1940	0.315	0.480
1941	0.143	0.370
1942	0.603	0.437
1943	0.315	0.455
1944	0.852	0.657
1945	0.256	0.497
1946	0.465	0.349
1947	0.153	0.302
1948	0.488	0.349
1949	0.474	0.551
1950	0.159	0.228
1951	0.141	0.229
1952	1.327	0.625
1953	1.118	0.572
1954	0.262	0.324
1955	0.172	0.190
1956	0.090	0.168
1957	0.238	0.287
1958	0.737	0.418
1959	0.603	0.419
1960	0.157	0.296
1961	1.070	0.917
1962	0.275	0.385
1963	0.147	0.224
1964	1.705	0.652
1965	0.505	0.358
1966	0.170	0.185
1967	0.634	0.278
1968	0.254	0.272
1969	0.277	0.346

1970	0.557	0.385
1971	0.511	0.387
1972	2.662	1.106
1973	0.502	0.609
1974	0.580	0.485
1975	1.091	0.554
1976	0.935	0.551
1977	0.130	0.236
1978	0.747	0.433
1979	0.364	0.317
1980	0.615	0.340
1981	0.258	0.412
1982	0.166	0.309
1983	0.482	0.457
1984	0.502	0.399
1985	0.850	0.267
1986	0.236	0.258
1987	0.701	0.368
1988	0.232	0.258
1989	0.231	0.245
1990	0.375	0.316
1991	0.691	0.435
1992	0.462	0.436
1993	0.318	0.527
1994	0.490	0.366
1995	0.138	0.192
1996	0.543	0.360
1997	0.227	0.254
1998	0.497	0.396
1999	0.123	0.250
2000	0.300	0.397
2001	0.188	0.275
2002	1.110	0.562
2003	0.318	0.319
2004	0.384	0.495
2005	1.286	0.752
2006	0.150	0.231
2007	0.447	0.493
2008	0.290	0.299
2009	0.194	0.311
2010	0.240	0.410
2011	0.110	0.173
2012	0.342	0.394
2013	0.411	0.257
2014	0.230	0.267
2015	1.058	0.462
2016	0.133	0.203
2017	0.367	0.608
2018	0.658	0.363
2019	1.164	0.516
2020	0.583	0.404
2021	0.475	0.370
2022	0.699	0.558
2023	0.359	0.565
2024	1.826	0.785
2025	0.225	0.201
2026	0.346	0.343
2027	0.228	0.373

2028	0.139	0.150
2029	0.305	0.319
2030	0.636	0.387
2031	0.152	0.204
2032	0.100	0.170
2033	0.143	0.157
2034	0.202	0.328
2035	0.646	0.406
2036	0.298	0.272
2037	0.132	0.311
2038	0.706	0.419
2039	0.157	0.585
2040	0.198	0.338
2041	0.267	0.415
2042	0.623	0.451
2043	0.378	0.430
2044	0.342	0.367
2045	0.209	0.280
2046	0.258	0.277
2047	0.189	0.417
2048	0.247	0.345
2049	0.334	0.489
2050	0.331	0.318
2051	0.752	0.531
2052	0.174	0.253
2053	0.261	0.342
2054	1.315	0.473
2055	0.192	0.371
2056	0.187	0.440
2057	0.176	0.264
2058	0.190	0.367
2059	0.841	0.419

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	2.6622	1.1602
2	2.1677	1.1064
3	1.9323	0.9167
4	1.8259	0.7845
5	1.7050	0.7518
6	1.3266	0.7472
7	1.3150	0.6571
8	1.2862	0.6519
9	1.1643	0.6252
10	1.1185	0.6181
11	1.1156	0.6093
12	1.1101	0.6079
13	1.0909	0.5920
14	1.0703	0.5845
15	1.0584	0.5780
16	0.9351	0.5719
17	0.8736	0.5649
18	0.8523	0.5623
19	0.8497	0.5582
20	0.8413	0.5543
21	0.7719	0.5514
22	0.7515	0.5513

23	0.7469	0.5312
24	0.7373	0.5267
25	0.7064	0.5239
26	0.7013	0.5159
27	0.6990	0.5130
28	0.6909	0.5122
29	0.6584	0.4974
30	0.6465	0.4951
31	0.6421	0.4927
32	0.6355	0.4895
33	0.6343	0.4855
34	0.6230	0.4801
35	0.6152	0.4741
36	0.6032	0.4730
37	0.6031	0.4616
38	0.5876	0.4571
39	0.5827	0.4550
40	0.5802	0.4514
41	0.5570	0.4404
42	0.5506	0.4365
43	0.5426	0.4361
44	0.5392	0.4350
45	0.5111	0.4349
46	0.5053	0.4325
47	0.5020	0.4304
48	0.5017	0.4195
49	0.4975	0.4193
50	0.4904	0.4187
51	0.4883	0.4181
52	0.4818	0.4173
53	0.4754	0.4146
54	0.4736	0.4118
55	0.4654	0.4103
56	0.4621	0.4083
57	0.4468	0.4061
58	0.4113	0.4040
59	0.3903	0.4029
60	0.3836	0.4012
61	0.3784	0.4001
62	0.3781	0.3990
63	0.3745	0.3969
64	0.3671	0.3956
65	0.3639	0.3941
66	0.3594	0.3932
67	0.3578	0.3905
68	0.3455	0.3873
69	0.3424	0.3866
70	0.3417	0.3853
71	0.3342	0.3852
72	0.3307	0.3729
73	0.3177	0.3706
74	0.3175	0.3701
75	0.3151	0.3696
76	0.3150	0.3676
77	0.3147	0.3666
78	0.3051	0.3665
79	0.3002	0.3662
80	0.2975	0.3628

81	0.2897	0.3602
82	0.2877	0.3578
83	0.2818	0.3495
84	0.2793	0.3495
85	0.2768	0.3494
86	0.2750	0.3463
87	0.2704	0.3447
88	0.2699	0.3431
89	0.2680	0.3418
90	0.2673	0.3401
91	0.2619	0.3381
92	0.2619	0.3282
93	0.2611	0.3252
94	0.2583	0.3245
95	0.2577	0.3190
96	0.2561	0.3190
97	0.2539	0.3182
98	0.2474	0.3169
99	0.2412	0.3159
100	0.2403	0.3115
101	0.2380	0.3113
102	0.2365	0.3113
103	0.2361	0.3086
104	0.2324	0.3085
105	0.2319	0.3069
106	0.2309	0.3050
107	0.2297	0.3028
108	0.2281	0.3022
109	0.2275	0.3019
110	0.2272	0.3019
111	0.2253	0.2990
112	0.2168	0.2956
113	0.2086	0.2950
114	0.2060	0.2865
115	0.2041	0.2803
116	0.2022	0.2796
117	0.1989	0.2783
118	0.1982	0.2771
119	0.1973	0.2770
120	0.1942	0.2750
121	0.1920	0.2734
122	0.1896	0.2725
123	0.1885	0.2719
124	0.1882	0.2671
125	0.1873	0.2671
126	0.1821	0.2668
127	0.1763	0.2637
128	0.1761	0.2579
129	0.1751	0.2578
130	0.1741	0.2570
131	0.1719	0.2538
132	0.1703	0.2526
133	0.1665	0.2496
134	0.1604	0.2496
135	0.1589	0.2451
136	0.1587	0.2436
137	0.1571	0.2395
138	0.1570	0.2362

139	0.1552	0.2316
140	0.1535	0.2313
141	0.1517	0.2289
142	0.1495	0.2277
143	0.1467	0.2237
144	0.1431	0.2202
145	0.1428	0.2037
146	0.1406	0.2027
147	0.1387	0.2007
148	0.1380	0.1960
149	0.1329	0.1916
150	0.1319	0.1912
151	0.1297	0.1898
152	0.1227	0.1849
153	0.1144	0.1811
154	0.1101	0.1726
155	0.0999	0.1695
156	0.0956	0.1678
157	0.0897	0.1573
158	0.0756	0.1498

Duration Flows
The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1621	15196	6343	41	Pass
0.1779	11678	5018	42	Pass
0.1938	8759	3884	44	Pass
0.2097	6415	3033	47	Pass
0.2256	4730	2393	50	Pass
0.2414	3504	1894	54	Pass
0.2573	2781	1501	53	Pass
0.2732	2207	1184	53	Pass
0.2890	1733	945	54	Pass
0.3049	1385	768	55	Pass
0.3208	1108	629	56	Pass
0.3367	882	512	58	Pass
0.3525	751	421	56	Pass
0.3684	627	336	53	Pass
0.3843	525	273	52	Pass
0.4001	436	207	47	Pass
0.4160	378	162	42	Pass
0.4319	329	133	40	Pass
0.4478	280	113	40	Pass
0.4636	235	97	41	Pass
0.4795	217	85	39	Pass
0.4954	198	76	38	Pass
0.5112	180	67	37	Pass
0.5271	168	49	29	Pass
0.5430	158	46	29	Pass
0.5588	152	37	24	Pass
0.5747	141	33	23	Pass
0.5906	129	28	21	Pass
0.6065	123	26	21	Pass
0.6223	117	23	19	Pass
0.6382	109	20	18	Pass
0.6541	100	17	17	Pass
0.6699	93	16	17	Pass
0.6858	87	16	18	Pass
0.7017	80	16	20	Pass
0.7176	77	15	19	Pass
0.7334	76	13	17	Pass
0.7493	66	9	13	Pass
0.7652	63	6	9	Pass
0.7810	60	6	10	Pass
0.7969	59	5	8	Pass
0.8128	58	5	8	Pass
0.8286	57	5	8	Pass
0.8445	55	5	9	Pass
0.8604	50	5	10	Pass
0.8763	47	4	8	Pass
0.8921	44	4	9	Pass
0.9080	43	4	9	Pass
0.9239	43	3	6	Pass
0.9397	40	3	7	Pass
0.9556	38	3	7	Pass
0.9715	38	3	7	Pass
0.9874	37	3	8	Pass

1.0032	35	3	8	Pass
1.0191	32	3	9	Pass
1.0350	30	3	10	Pass
1.0508	29	3	10	Pass
1.0667	28	3	10	Pass
1.0826	27	3	11	Pass
1.0984	26	3	11	Pass
1.1143	24	1	4	Pass
1.1302	22	1	4	Pass
1.1461	22	1	4	Pass
1.1619	22	0	0	Pass
1.1778	21	0	0	Pass
1.1937	21	0	0	Pass
1.2095	21	0	0	Pass
1.2254	20	0	0	Pass
1.2413	20	0	0	Pass
1.2572	20	0	0	Pass
1.2730	20	0	0	Pass
1.2889	19	0	0	Pass
1.3048	19	0	0	Pass
1.3206	17	0	0	Pass
1.3365	16	0	0	Pass
1.3524	16	0	0	Pass
1.3682	16	0	0	Pass
1.3841	15	0	0	Pass
1.4000	15	0	0	Pass
1.4159	15	0	0	Pass
1.4317	15	0	0	Pass
1.4476	15	0	0	Pass
1.4635	15	0	0	Pass
1.4793	15	0	0	Pass
1.4952	14	0	0	Pass
1.5111	14	0	0	Pass
1.5270	14	0	0	Pass
1.5428	14	0	0	Pass
1.5587	14	0	0	Pass
1.5746	13	0	0	Pass
1.5904	13	0	0	Pass
1.6063	12	0	0	Pass
1.6222	12	0	0	Pass
1.6381	12	0	0	Pass
1.6539	12	0	0	Pass
1.6698	12	0	0	Pass
1.6857	11	0	0	Pass
1.7015	10	0	0	Pass
1.7174	9	0	0	Pass
1.7333	9	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
retention 1 POC	☐	439.60			☐	0.00			
Total Volume Infiltrated		439.60	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

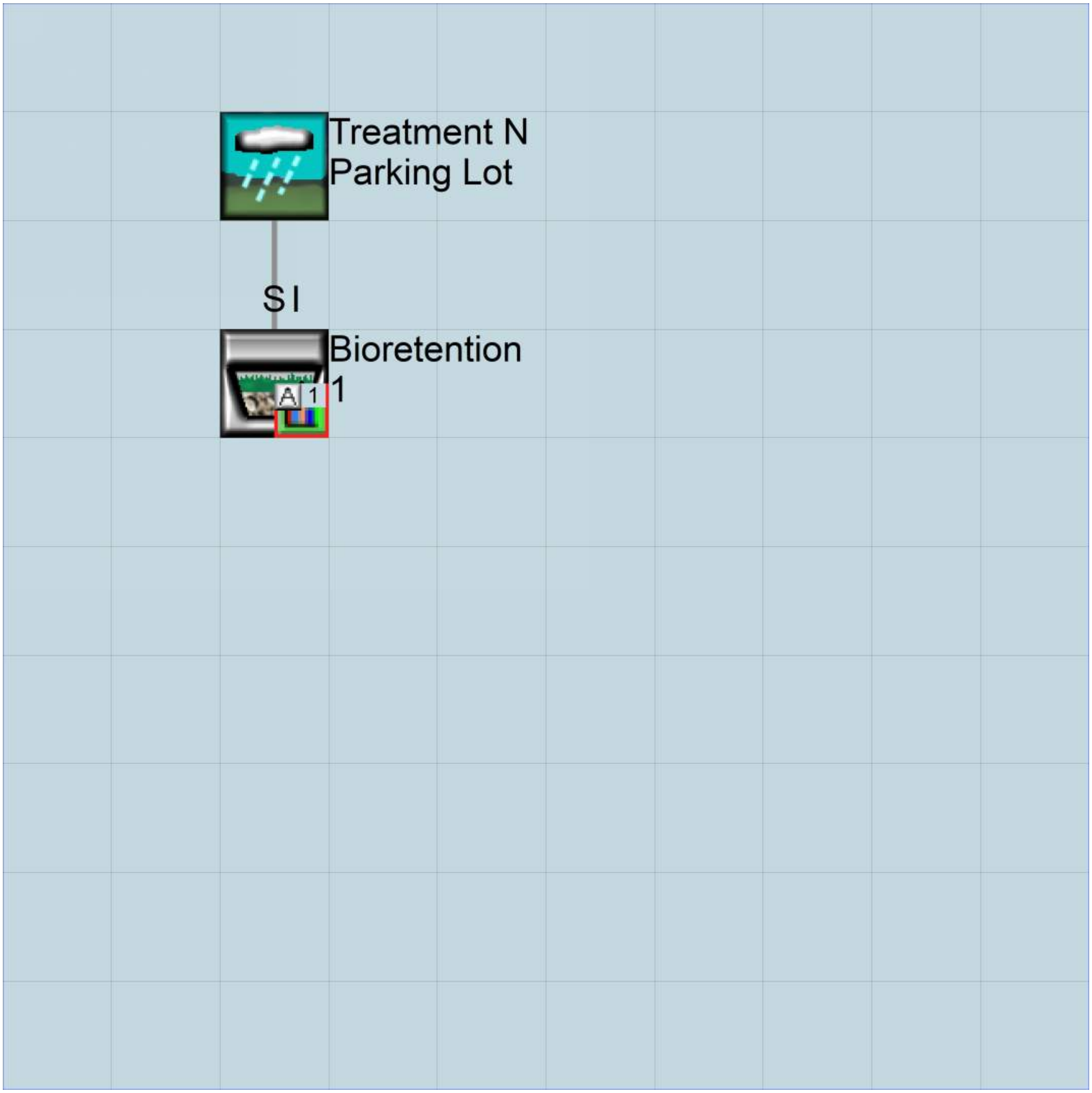
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic

Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   Final Phase - North Parking Lot.wdm
MESSU      25   PreFinal Phase - North Parking Lot.MES
           27   PreFinal Phase - North Parking Lot.L61
           28   PreFinal Phase - North Parking Lot.L62
           30   POCFinal Phase - North Parking Lot1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      18
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                            User  t-series Engl Metr ***
                                             in  out           ***
   18      C, Lawn, Steep          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   18         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   18         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   18         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   18              0       4.5      0.03       400      0.15       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   18              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   18            0.1      0.15      0.25         6       0.3      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   18              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1
```

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  18                         4.5     COPY   501     12
PERLND  18                         4.5     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                          in  out                            ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *        *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
```

```
WDM       1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM       1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   Final Phase - North Parking Lot.wdm
MESSU      25   MitFinal Phase - North Parking Lot.MES
           27   MitFinal Phase - North Parking Lot.L61
           28   MitFinal Phase - North Parking Lot.L62
           30   POCFinal Phase - North Parking Lot1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       5
      GENER        2
      RCHRES       1
      RCHRES       2
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Surface retention  1        MAX                   1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1        1    1
  501        1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
    2        24
  END OPCODE
  PARM
    #    #         K ***
    2             0.
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
```

```
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out            ***
    5      DRIVEWAYS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    5         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    5         0    0    4    0    0    4    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    5         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    5            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    5              0         0
  END IWAT-PARM3

  IWAT-STATE1
```

```
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    5             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Treatment N Parking Lot***
IMPLND   5                        1.2     RCHRES   1      5

******Routing******
IMPLND   5                        1.2     COPY     1     15
RCHRES   1                          1     RCHRES   2      8
RCHRES   2                          1     COPY   501     16
RCHRES   1                          1     COPY   501     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
GENER    2 OUTPUT TIMSER      .0011111     RCHRES   1     EXTNL  OUTDGT 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                         in  out                             ***
    1     Surface retentio-025    2    1    1    1   28    0    1
    2     Bioretention  1         1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1        0  1  0  0    4  5  0  0  0       0  1  0  0  0       2  1  2  2  2
    2        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1             1      0.01       0.0       0.0       0.0       0.0
    2             2      0.04       0.0       0.0       0.0       0.0
```

```
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1           0          4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2           0          4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
*** User-Defined Variable Quantity Lines
***                          addr
***                        <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol2   RCHRES   2 VOL               4
  UVQUAN v2m2   GLOBAL     WORKSP  1         3
  UVQUAN vpo2   GLOBAL     WORKSP  2         3
  UVQUAN v2d2   GENER    2 K       1         3
*** User-Defined Target Variable Names
***                  addr or                         addr or
***                 <------>                        <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m2    1 WORKSP  1         1.0 QUAN
  UVNAME  vpo2    1 WORKSP  2         1.0 QUAN
  UVNAME  v2d2    1 K       1         1.0 QUAN
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER   2                               v2m2            =  1510.67
*** Compute remaining available pore space
  GENER   2                               vpo2            =  v2m2
  GENER   2                               vpo2           -=  vol2
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo2 < 0.0) THEN
  GENER   2                               vpo2            =  0.0
END IF
*** Infiltration volume
  GENER   2                               v2d2            =  vpo2
END SPEC-ACTIONS
FTABLES
  FTABLE      2
   67    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.021809  0.000000  0.000000
  0.057692  0.021809  0.000505  0.000000
  0.115385  0.021809  0.001010  0.000000
  0.173077  0.021809  0.001516  0.000000
  0.230769  0.021809  0.002021  0.000000
  0.288462  0.021809  0.002526  0.000000
  0.346154  0.021809  0.003031  0.000000
  0.403846  0.021809  0.003536  0.000000
  0.461538  0.021809  0.004041  0.000000
  0.519231  0.021809  0.004547  0.000000
  0.576923  0.021809  0.005052  0.000000
  0.634615  0.021809  0.005557  0.000000
  0.692308  0.021809  0.006062  0.000000
  0.750000  0.021809  0.006567  0.000000
  0.807692  0.021809  0.007072  0.000000
  0.865385  0.021809  0.007578  0.000000
  0.923077  0.021809  0.008083  0.000000
  0.980769  0.021809  0.008588  0.000000
  1.038462  0.021809  0.009093  0.000000
  1.096154  0.021809  0.009598  0.000000
  1.153846  0.021809  0.010103  0.000000
  1.211538  0.021809  0.010609  0.000000
  1.269231  0.021809  0.011114  0.000000
```

1.326923	0.021809	0.011619	0.000000
1.384615	0.021809	0.012124	0.000000
1.442308	0.021809	0.012629	0.000000
1.500000	0.021809	0.013134	0.000000
1.557692	0.021809	0.013640	0.000000
1.615385	0.021809	0.014145	0.000000
1.673077	0.021809	0.014650	0.000000
1.730769	0.021809	0.015155	0.000000
1.788462	0.021809	0.015677	0.000000
1.846154	0.021809	0.016199	0.000000
1.903846	0.021809	0.016722	0.000000
1.961538	0.021809	0.017244	0.022094
2.019231	0.021809	0.017766	0.024630
2.076923	0.021809	0.018288	0.027326
2.134615	0.021809	0.018810	0.028936
2.192308	0.021809	0.019332	0.028936
2.250000	0.021809	0.019855	0.060475
2.307692	0.021809	0.020377	0.060475
2.365385	0.021809	0.020899	0.060475
2.423077	0.021809	0.021421	0.060475
2.480769	0.021809	0.021943	0.060475
2.538462	0.021809	0.022465	0.060475
2.596154	0.021809	0.022988	0.060475
2.653846	0.021809	0.023510	0.060475
2.711538	0.021809	0.024032	0.060475
2.769231	0.021809	0.024554	0.060475
2.826923	0.021809	0.025076	0.060475
2.884615	0.021809	0.025598	0.060475
2.942308	0.021809	0.026120	0.060475
3.000000	0.021809	0.026643	0.060475
3.057692	0.021809	0.027165	0.060475
3.115385	0.021809	0.027687	0.060475
3.173077	0.021809	0.028209	0.060475
3.230769	0.021809	0.028731	0.060475
3.288462	0.021809	0.029253	0.060475
3.346154	0.021809	0.029776	0.060475
3.403846	0.021809	0.030298	0.060475
3.461538	0.021809	0.030820	0.060475
3.519231	0.021809	0.031342	0.060475
3.576923	0.021809	0.031864	0.060475
3.634615	0.021809	0.032386	0.060475
3.692308	0.021809	0.032909	0.060475
3.750000	0.021809	0.033431	0.060475
3.750000	0.021809	0.034680	0.060475

END FTABLE 2
FTABLE 1
27 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.021809	0.000000	0.000000	0.000000		
0.057692	0.021809	0.001258	0.000000	0.032986		
0.115385	0.021809	0.002516	0.000000	0.041021		
0.173077	0.021809	0.003775	0.000000	0.042290		
0.230769	0.021809	0.005033	0.000000	0.043559		
0.288462	0.021809	0.006291	0.000000	0.044827		
0.346154	0.021809	0.007549	0.000000	0.046096		
0.403846	0.021809	0.008807	0.000000	0.047365		
0.461538	0.021809	0.010066	0.000000	0.048633		
0.519231	0.021809	0.011324	0.000000	0.049902		
0.576923	0.021809	0.012582	0.000000	0.051171		
0.634615	0.021809	0.013840	0.000000	0.052440		
0.692308	0.021809	0.015099	0.000000	0.053708		
0.750000	0.021809	0.016357	0.000000	0.054977		
0.807692	0.021809	0.017615	0.000000	0.056246		
0.865385	0.021809	0.018873	0.000000	0.057514		
0.923077	0.021809	0.020131	0.000000	0.058783		
0.980769	0.021809	0.021390	0.000000	0.060052		
1.038462	0.021809	0.022648	0.079976	0.061320		
1.096154	0.021809	0.023906	0.314653	0.062589		
1.153846	0.021809	0.025164	0.627270	0.063858		

```
  1.211538  0.021809  0.026422  0.979480  0.065126
  1.269231  0.021809  0.027681  1.333311  0.066395
  1.326923  0.021809  0.028939  1.651684  0.067664
  1.384615  0.021809  0.030197  1.905359  0.068933
  1.442308  0.021809  0.031455  2.082990  0.070201
  1.500000  0.021809  0.032713  2.227125  0.071470
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1              RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    1              RCHRES   2     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   2 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   2 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1002 STAG     ENGL      REPL
RCHRES   1 HYDR   O      1 1        1      WDM   1003 FLOW     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

Legal Notice

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Local (360)943-0304

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South Parking Lot Bioretention Modeling

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: Final Phase - South Parking Lot

Site Name:	
Site Address:	
City:	
Report Date:	10/3/2023
Gage:	38 IN CENTRAL
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	0.000 (adjusted)
Version Date:	2023/01/27
Version:	4.2.19

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Mitigated Land Use

Treatment S Parking Lot

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Mod	0.35
Pervious Total	0.35
Impervious Land Use	acre
DRIVEWAYS FLAT	1.5
Impervious Total	1.5
Basin Total	1.85

Routing Elements
Predeveloped Routing

Mitigated Routing

Bioretention 1

Bottom Length:	200.00 ft.
Bottom Width:	6.00 ft.
Material thickness of first layer:	0.25
Material type for first layer:	SMMWW
Material thickness of second layer:	1.5
Material type for second layer:	SMMWW
Material thickness of third layer:	2
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	1
Orifice Diameter (in.):	8
Offset (in.):	5
Flow Through Underdrain (ac-ft.):	552.693
Total Outflow (ac-ft.):	604.151
Percent Through Underdrain:	91.48

Discharge Structure
Riser Height: 1 ft.
Riser Diameter: 12 in.
Element Flows To:
Outlet 1 Outlet 2

Bioretention Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.0275	0.0000	0.0000	0.0000
0.0577	0.0275	0.0006	0.0000	0.0000
0.1154	0.0275	0.0013	0.0000	0.0000
0.1731	0.0275	0.0019	0.0000	0.0000
0.2308	0.0275	0.0026	0.0000	0.0000
0.2885	0.0275	0.0032	0.0000	0.0000
0.3462	0.0275	0.0038	0.0000	0.0000
0.4038	0.0275	0.0045	0.0000	0.0000
0.4615	0.0275	0.0051	0.0000	0.0000
0.5192	0.0275	0.0057	0.0000	0.0000
0.5769	0.0275	0.0064	0.0000	0.0000
0.6346	0.0275	0.0070	0.0000	0.0000
0.6923	0.0275	0.0077	0.0000	0.0000
0.7500	0.0275	0.0083	0.0000	0.0000
0.8077	0.0275	0.0089	0.0000	0.0000
0.8654	0.0275	0.0096	0.0000	0.0000
0.9231	0.0275	0.0102	0.0000	0.0000
0.9808	0.0275	0.0108	0.0000	0.0000
1.0385	0.0275	0.0115	0.0000	0.0000
1.0962	0.0275	0.0121	0.0000	0.0000
1.1538	0.0275	0.0128	0.0000	0.0000
1.2115	0.0275	0.0134	0.0000	0.0000
1.2692	0.0275	0.0140	0.0000	0.0000
1.3269	0.0275	0.0147	0.0000	0.0000
1.3846	0.0275	0.0153	0.0000	0.0000
1.4423	0.0275	0.0160	0.0000	0.0000
1.5000	0.0275	0.0166	0.0000	0.0000
1.5577	0.0275	0.0172	0.0000	0.0000
1.6154	0.0275	0.0179	0.0000	0.0000

1.6731	0.0275	0.0185	0.0000	0.0000
1.7308	0.0275	0.0191	0.0000	0.0000
1.7885	0.0275	0.0198	0.0000	0.0000
1.8462	0.0275	0.0205	0.0000	0.0000
1.9038	0.0275	0.0211	0.0000	0.0000
1.9615	0.0275	0.0218	0.0279	0.0000
2.0192	0.0275	0.0224	0.0311	0.0000
2.0769	0.0275	0.0231	0.0345	0.0000
2.1346	0.0275	0.0238	0.0366	0.0000
2.1923	0.0275	0.0244	0.0366	0.0000
2.2500	0.0275	0.0251	0.0764	0.0000
2.3077	0.0275	0.0257	0.0764	0.0000
2.3654	0.0275	0.0264	0.0764	0.0000
2.4231	0.0275	0.0271	0.0764	0.0000
2.4808	0.0275	0.0277	0.0764	0.0000
2.5385	0.0275	0.0284	0.0764	0.0000
2.5962	0.0275	0.0290	0.0764	0.0000
2.6538	0.0275	0.0297	0.0764	0.0000
2.7115	0.0275	0.0304	0.0764	0.0000
2.7692	0.0275	0.0310	0.0764	0.0000
2.8269	0.0275	0.0317	0.0764	0.0000
2.8846	0.0275	0.0323	0.0764	0.0000
2.9423	0.0275	0.0330	0.0764	0.0000
3.0000	0.0275	0.0337	0.0764	0.0000
3.0577	0.0275	0.0343	0.0764	0.0000
3.1154	0.0275	0.0350	0.0764	0.0000
3.1731	0.0275	0.0356	0.0764	0.0000
3.2308	0.0275	0.0363	0.0764	0.0000
3.2885	0.0275	0.0370	0.0764	0.0000
3.3462	0.0275	0.0376	0.0764	0.0000
3.4038	0.0275	0.0383	0.0764	0.0000
3.4615	0.0275	0.0389	0.0764	0.0000
3.5192	0.0275	0.0396	0.0764	0.0000
3.5769	0.0275	0.0402	0.0764	0.0000
3.6346	0.0275	0.0409	0.0764	0.0000
3.6923	0.0275	0.0416	0.0764	0.0000
3.7500	0.0275	0.0422	0.0764	0.0000
3.7500	0.0275	0.0422	0.0764	0.0000

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.7500	0.0275	0.0422	0.0000	0.0417	0.0000
3.8077	0.0275	0.0438	0.0000	0.0417	0.0000
3.8654	0.0275	0.0454	0.0000	0.0518	0.0000
3.9231	0.0275	0.0470	0.0000	0.0534	0.0000
3.9808	0.0275	0.0486	0.0000	0.0550	0.0000
4.0385	0.0275	0.0502	0.0000	0.0566	0.0000
4.0962	0.0275	0.0518	0.0000	0.0582	0.0000
4.1538	0.0275	0.0534	0.0000	0.0598	0.0000
4.2115	0.0275	0.0549	0.0000	0.0614	0.0000
4.2692	0.0275	0.0565	0.0000	0.0630	0.0000
4.3269	0.0275	0.0581	0.0000	0.0646	0.0000
4.3846	0.0275	0.0597	0.0000	0.0662	0.0000
4.4423	0.0275	0.0613	0.0000	0.0678	0.0000
4.5000	0.0275	0.0629	0.0000	0.0694	0.0000
4.5577	0.0275	0.0645	0.0000	0.0710	0.0000
4.6154	0.0275	0.0661	0.0000	0.0726	0.0000
4.6731	0.0275	0.0677	0.0000	0.0743	0.0000

4.7308	0.0275	0.0692	0.0000	0.0759	0.0000
4.7885	0.0275	0.0708	0.0800	0.0775	0.0000
4.8462	0.0275	0.0724	0.3147	0.0791	0.0000
4.9038	0.0275	0.0740	0.6273	0.0807	0.0000
4.9615	0.0275	0.0756	0.9795	0.0823	0.0000
5.0192	0.0275	0.0772	1.3333	0.0839	0.0000
5.0769	0.0275	0.0788	1.6517	0.0855	0.0000
5.1346	0.0275	0.0804	1.9054	0.0871	0.0000
5.1923	0.0275	0.0820	2.0830	0.0887	0.0000
5.2500	0.0275	0.0836	2.2271	0.0903	0.0000

Surface retention 1

Analysis Results

POC 1

POC #1 was not reported because POC must exist in both scenarios and both scenarios must have been run.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic

Mitigated Schematic

Predeveloped UCI File

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                  UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM        26   Final Phase - South Parking Lot.wdm
MESSU      25   MitFinal Phase - South Parking Lot.MES
           27   MitFinal Phase - South Parking Lot.L61
           28   MitFinal Phase - South Parking Lot.L62
           30   POCFinal Phase - South Parking Lot1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       8
      IMPLND       5
      GENER        2
      RCHRES       1
      RCHRES       2
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Surface retention  1        MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
    2        24
  END OPCODE
  PARM
    #    #         K ***
    2             0.
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    8     A/B, Lawn, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    8         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
```

```
  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    8         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    8         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    8              0         5       0.8       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    8              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    8            0.1       0.5      0.25         0       0.7      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    8              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out          ***
    5      DRIVEWAYS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    5         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    5         0    0    4    0    0    4    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    5         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    5            400      0.01       0.1       0.1
```

```
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    5             0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    5             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Treatment S Parking Lot***
PERLND   8                        0.35     RCHRES   1      2
PERLND   8                        0.35     RCHRES   1      3
IMPLND   5                         1.5     RCHRES   1      5

******Routing******
PERLND   8                        0.35     COPY     1     12
IMPLND   5                         1.5     COPY     1     15
PERLND   8                        0.35     COPY     1     13
RCHRES   1                           1     RCHRES   2      8
RCHRES   2                           1     COPY   501     16
RCHRES   1                           1     COPY   501     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
GENER    2 OUTPUT TIMSER      .0011111     RCHRES   1     EXTNL  OUTDGT 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                         in  out                             ***
    1     Surface retentio-025    2    1    1    1   28    0    1
    2     Bioretention  1         1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
```

```
    RCHRES  Flags for each HYDR Section                                         ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  5  0  0  0       0  1  0  0  0       2  1  2  2  2
    2        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1             1      0.01       0.0       0.0       0.0       0.0
    2             2      0.04       0.0       0.0       0.0       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                           ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1           0          4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2           0          4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
*** User-Defined Variable Quantity Lines
***                          addr
***                        <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol2   RCHRES   2 VOL              4
  UVQUAN v2m2   GLOBAL     WORKSP  1        3
  UVQUAN vpo2   GLOBAL     WORKSP  2        3
  UVQUAN v2d2   GENER    2 K       1        3
*** User-Defined Target Variable Names
***                  addr or                       addr or
***                 <------>                      <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m2    1 WORKSP  1         1.0 QUAN
  UVNAME  vpo2    1 WORKSP  2         1.0 QUAN
  UVNAME  v2d2    1 K       1         1.0 QUAN
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER   2                               v2m2            =  1908.21
*** Compute remaining available pore space
  GENER   2                               vpo2            =  v2m2
  GENER   2                               vpo2           -=  vol2
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo2 < 0.0) THEN
  GENER   2                               vpo2            =  0.0
END IF
*** Infiltration volume
  GENER   2                               v2d2            =  vpo2
END SPEC-ACTIONS
FTABLES
  FTABLE      2
   67    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.027548  0.000000  0.000000
  0.057692  0.027548  0.000638  0.000000
  0.115385  0.027548  0.001276  0.000000
  0.173077  0.027548  0.001914  0.000000
  0.230769  0.027548  0.002552  0.000000
  0.288462  0.027548  0.003191  0.000000
  0.346154  0.027548  0.003829  0.000000
  0.403846  0.027548  0.004467  0.000000
  0.461538  0.027548  0.005105  0.000000
  0.519231  0.027548  0.005743  0.000000
```

0.576923	0.027548	0.006381	0.000000
0.634615	0.027548	0.007019	0.000000
0.692308	0.027548	0.007657	0.000000
0.750000	0.027548	0.008295	0.000000
0.807692	0.027548	0.008934	0.000000
0.865385	0.027548	0.009572	0.000000
0.923077	0.027548	0.010210	0.000000
0.980769	0.027548	0.010848	0.000000
1.038462	0.027548	0.011486	0.000000
1.096154	0.027548	0.012124	0.000000
1.153846	0.027548	0.012762	0.000000
1.211538	0.027548	0.013400	0.000000
1.269231	0.027548	0.014038	0.000000
1.326923	0.027548	0.014677	0.000000
1.384615	0.027548	0.015315	0.000000
1.442308	0.027548	0.015953	0.000000
1.500000	0.027548	0.016591	0.000000
1.557692	0.027548	0.017229	0.000000
1.615385	0.027548	0.017867	0.000000
1.673077	0.027548	0.018505	0.000000
1.730769	0.027548	0.019143	0.000000
1.788462	0.027548	0.019803	0.000000
1.846154	0.027548	0.020462	0.000000
1.903846	0.027548	0.021122	0.000000
1.961538	0.027548	0.021782	0.027908
2.019231	0.027548	0.022441	0.031112
2.076923	0.027548	0.023101	0.034517
2.134615	0.027548	0.023760	0.036551
2.192308	0.027548	0.024420	0.036551
2.250000	0.027548	0.025079	0.076389
2.307692	0.027548	0.025739	0.076389
2.365385	0.027548	0.026399	0.076389
2.423077	0.027548	0.027058	0.076389
2.480769	0.027548	0.027718	0.076389
2.538462	0.027548	0.028377	0.076389
2.596154	0.027548	0.029037	0.076389
2.653846	0.027548	0.029696	0.076389
2.711538	0.027548	0.030356	0.076389
2.769231	0.027548	0.031016	0.076389
2.826923	0.027548	0.031675	0.076389
2.884615	0.027548	0.032335	0.076389
2.942308	0.027548	0.032994	0.076389
3.000000	0.027548	0.033654	0.076389
3.057692	0.027548	0.034313	0.076389
3.115385	0.027548	0.034973	0.076389
3.173077	0.027548	0.035633	0.076389
3.230769	0.027548	0.036292	0.076389
3.288462	0.027548	0.036952	0.076389
3.346154	0.027548	0.037611	0.076389
3.403846	0.027548	0.038271	0.076389
3.461538	0.027548	0.038930	0.076389
3.519231	0.027548	0.039590	0.076389
3.576923	0.027548	0.040250	0.076389
3.634615	0.027548	0.040909	0.076389
3.692308	0.027548	0.041569	0.076389
3.750000	0.027548	0.042228	0.076389
3.750000	0.027548	0.043807	0.076389

END FTABLE 2

FTABLE 1

27 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.027548	0.000000	0.000000	0.000000		
0.057692	0.027548	0.001589	0.000000	0.041667		
0.115385	0.027548	0.003179	0.000000	0.051816		
0.173077	0.027548	0.004768	0.000000	0.053419		
0.230769	0.027548	0.006357	0.000000	0.055021		
0.288462	0.027548	0.007947	0.000000	0.056624		
0.346154	0.027548	0.009536	0.000000	0.058227		
0.403846	0.027548	0.011125	0.000000	0.059829		

```
  0.461538  0.027548  0.012715  0.000000  0.061432
  0.519231  0.027548  0.014304  0.000000  0.063034
  0.576923  0.027548  0.015893  0.000000  0.064637
  0.634615  0.027548  0.017483  0.000000  0.066239
  0.692308  0.027548  0.019072  0.000000  0.067842
  0.750000  0.027548  0.020661  0.000000  0.069444
  0.807692  0.027548  0.022250  0.000000  0.071047
  0.865385  0.027548  0.023840  0.000000  0.072650
  0.923077  0.027548  0.025429  0.000000  0.074252
  0.980769  0.027548  0.027018  0.000000  0.075855
  1.038462  0.027548  0.028608  0.079976  0.077457
  1.096154  0.027548  0.030197  0.314653  0.079060
  1.153846  0.027548  0.031786  0.627270  0.080662
  1.211538  0.027548  0.033376  0.979480  0.082265
  1.269231  0.027548  0.034965  1.333311  0.083868
  1.326923  0.027548  0.036554  1.651684  0.085470
  1.384615  0.027548  0.038144  1.905359  0.087073
  1.442308  0.027548  0.039733  2.082990  0.088675
  1.500000  0.027548  0.041322  2.227125  0.090278
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1              RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    1              RCHRES   2     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   2 HYDR   RO      1 1        1     WDM   1008 FLOW     ENGL      REPL
RCHRES   2 HYDR   STAGE   1 1        1     WDM   1009 STAG     ENGL      REPL
RCHRES   1 HYDR   STAGE   1 1        1     WDM   1010 STAG     ENGL      REPL
RCHRES   1 HYDR   O       1 1        1     WDM   1011 FLOW     ENGL      REPL
COPY     1 OUTPUT MEAN    1 1     48.4     WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN    1 1     48.4     WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
```

```
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17

END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

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