Stormwater Site Plan Report

Project Name: Keimig 5th St
Project Address: 111 5th St SE Puyallup WA
Parcel No.: 728200-0112
Owner/ Applicant: Samantha Keimig
Submittal Date: February 13, 2025

Engineer's stamp required date with signature. [Storm Report, Pg 1]

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Project Overview

The project site is located in Puyallup on a 10,000 sf (0.23 acre) lot zoned CG (General Commercial). The site contains no improvements and minimal vegetation. The city of Puyallup Comprehensive Plan classifies the site as Auto Oriented Commercial. The owner proposes to develop the site with a structure for light industrial use, and associated storage. Access will be taken from 111th St.

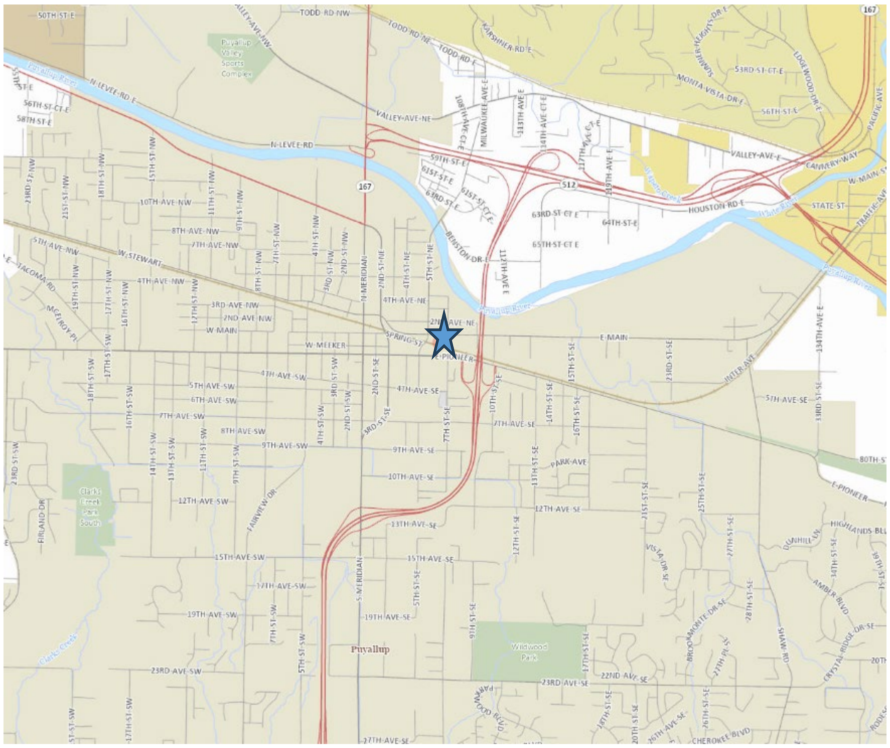


Figure 1: Locus map with project site highlighted.

Revise highlighted portions. There is no SFR on the lot and the lot is accessed by a public alley. The CIty does not have a 111th St [Storm Report, Pg 2]

Existing Conditions

The project site is located in Puyallup on a 0.23-acre lot zoned CG (Parcel No 728200-0112) on the south side of 111th St. The lot presently contains a single-family dwelling along with a driveway. The lot is generally flat, with a local low area in the central portion of the site. Slopes on site vary from 2-7%. Under existing conditions runoff that does not infiltrate and disperse enters two separate catch basins north of the site in 111th St. The catch basins connecting to City of Puyallup infrastructure, flow to the Puyallup River.

Proposed Conditions

The owner proposes to clean and grub the site, construct a 4,028 sf building, as well as a driveway with four parking spots, walkways, and a 2-foot Right-of-Way dedication to provide a city standard 10-foot half alley width. Utility work includes a connection to the existing water service line in 7th street SE, as well as storm connections to the existing catch basins in 111th St. Additionally the existing sewer main in East Maine will be extended south down 7th Street SE, and west along 111th St. to the subject property frontage.

The proposed project will result in a total of 7,282 sf of new plus replaced hard surface. Proposed hard surface will consist of 4,028 of roof area, and 2,916 sf of on-site driveway and walkways and 338 sf of off-site ROW improvements.

MR 3 does not involve the TESC plan. [Storm Report, Pg 3]

Refer to the 2019 Ecology Manual for Western Washington. [Storm Report, Pg 3]

Jurisdictional Requirements

The proposed project is subject to Minimum Requirements #1-9 (hereafter MR) as outlined below with a brief summary of how they will be met.

MR #1: Preparation of Storm Water Site Plans	Stormwater Site Plans are included with this submittal. Please see C2.
MR #2: Construction Stormwater Pollution Prevention Plan (CSWPPP)	A Construction Stormwater Pollution Prevention Plan has been prepared as part of the Stormwater Site Plan packet that is included with this submittal. Please see C1.
MR #3: Source Control of Pollution	A Temporary Erosion and Sediment Control Plan is included with this submittal. Please see C1.
MR #4: Preservation of Natural Drainage Systems and Outfalls	The proposed development will not alter the existing drainage pattern for this lot. Under existing conditions flows overland off-site to the north entering the public drainage system. Under proposed conditions runoff will be collected and routed to the public drainage system. This maintains the existing flow pattern to the maximum extent practicable.
MR #5: On-site Stormwater Management State which list is being used. Remove BMP consideration here and refer to the section below on Page 5. [Storm Report, Pg 3]	Full Dispersion is infeasible because minimum setbacks and flow path lengths cannot be met. Infiltration BMPs are infeasible due to a shallow water table. Dispersion BMPs are infeasible because minimum setbacks and flow path lengths cannot be met In the absence of feasible BMPs runoff will be routed to catch basins connecting to existing city stormwater infrastructure.
MR #6: Runoff Treatment	The proposed project does not exceed the 5,000 sf PGHS threshold. The water quality standard does not apply.
MR #7: Flow Control MR 7: Reference a WWHM report for the 0.15 cfs criteria. [Storm Report, Pg 3]	Total effective hard surface is less than 10,000 sf, the project does not convert ¾ acres or more to lawn, and through a combination of effective hard surfaces and converted vegetation areas the proposed development does not cause a 0.15 cfs increase using 15-minute time steps for either TDA. Flow Control is not required.
MR #8: Wetlands Protection	There are no wetlands in the vicinity of the proposed project.
MR #9: Operations and Maintenance	Operations and Maintenance instructions for BMPs requiring maintenance have been included in the Appendix.

State specific depth ground water is below ground elevation. [Storm Report, Pg 4]

Infiltration Feasibility Assessment

Onsite infiltration is **infeasible** for the project. A report prepared by Icicle Creek Engineers dated July 20th, 2022 evaluated subsurface conditions, including two soil borings, and states: “Due to the relatively shallow groundwater table and the relatively shallow depth to low-permeability soil, we expect that disposal of stormwater by infiltration may be infeasible at the Keimig/Castaneda Property.” These findings, in conjunction with specific site design and requirements, renders infiltration infeasible as the required separation from the bottom of infiltration devices to the high-water mark cannot be provided. The full Geotechnical Report is attached as an appendix.

Offsite Runoff and Downstream Analysis

The proposed project increases the hard surface area from 0 sf to 6,944 sf while maintaining existing flow patterns. There are no upstream tributary areas which flow onto the site.

The site contains two Threshold Discharge Areas (TDA). Under existing conditions, flows that do not infiltrate on-site flow to the alley north of the site where each TDA enters two separate catch basins. TDA one flows to Structure D4-06593, which subsequently flows west through a series of pipes, 8” in diameter or larger, and drainage structures before discharging to the Puyallup River. TDA two flows to Structure D4-06625, which subsequently flows east through a series of pipes, 8” in diameter or larger, and drainage structures before discharging to the Puyallup River. Given that the two TDAs remain separate until the discharge in the river, and that the river is over ¼ mile away from each catch basin, the two TDA approach is validated. Figure 2 depicts the downstream flow path for both TDAs.

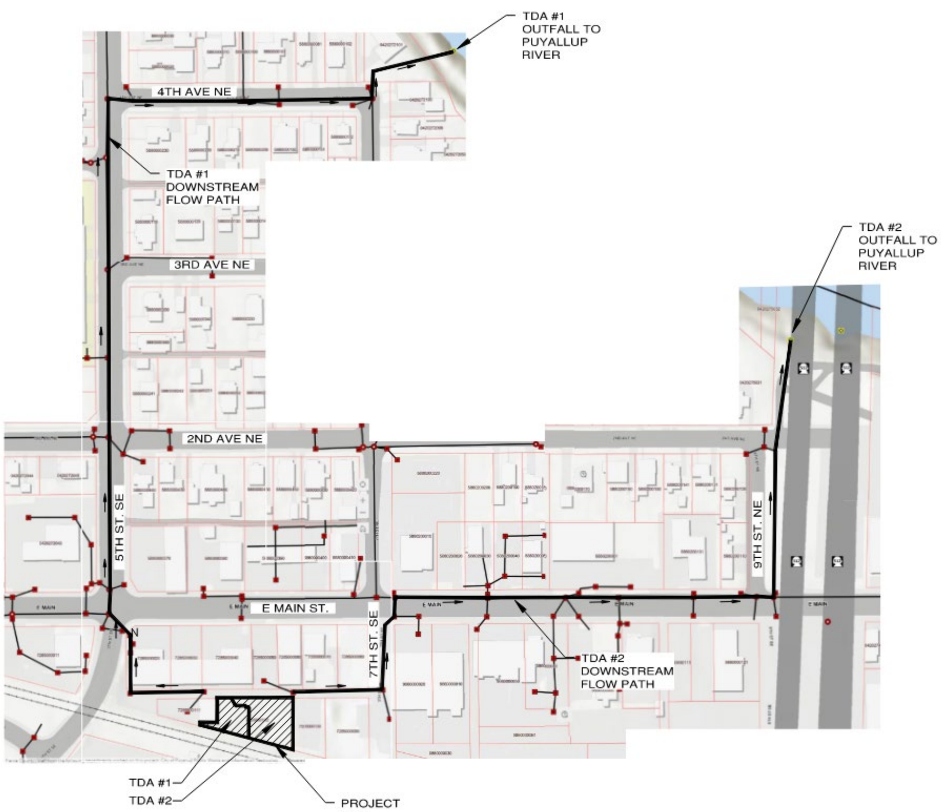


Figure 2: Downstream flow path for each TDA. Figure created by ESM Engineers.

Hydrology/ Hydraulic Analysis
Formal hydrology and pipe flow hydraulic calculations were not completed for the proposed project. Assuming a Manning's Roughness Coefficient of n=0.12 a 6" PVC pipe at a 0.5% slope will provide capacity for approximately 0.462 cfs. The Rational Method would yield a maximum flow for the 100-year storm from the entire site impervious area of approximately 0.432 cfs. The proposed 6" pipes provide adequate capacity.

MR #5 On-Site Stormwater Management – List Approach
Lawn and Landscaped Areas:
Post-construction soil quality and depth will be in accordance with BMP T5.13 in Chapter 5 of Volume V of the DOE Manual. Compost-amended soil is required.

Roofs:
Full Dispersion is **infeasible** for the project due to the lack of a 100 lf flowpath.

Downspout Full Infiltration is **infeasible** for the project. Given that pipes require 3' of cover, and the high-water table was found to be 4.4' below the surface, the project is unable to meet the required 1' separation from the bottom of infiltration systems to the high-water table.

Downspout Dispersion is **infeasible** for the project due to inability to provide required vegetated flow path lengths.

A Perforated Stub-out Connection is **infeasible** for the project as the perforated pipe would be located under impervious or heavily compacted surfaces.

In the **absence of feasible BMPs** runoff from the roof surface will be collected via gutters and routed to a catch basin north of the site connecting to existing city stormwater infrastructure.

Reconsider permeable pavement. ground water limit is 1 ft below bottom of facility. [Storm Report, Pg 5]

Other Hard Surfaces (ie Driveway):
Full Dispersion is **infeasible** for the project due to the lack of a 100 lf flowpath.

Permeable Pavement is **infeasible** for the project. Permeable pavements require 3 feet separation from the high groundwater table which was encountered at 4.4' below the surface. The required depth of 3' clearance, as well as the 1' paved section and 0.5' treatment layer requires a minimum depth of 4.5'.

Sheet Flow Dispersion is **infeasible** for this project. There is insufficient space to provide the required vegetated flow paths.

In the absence of feasible BMPs runoff from the driveway surface will be intercepted by a catch basin and routed to existing city stormwater infrastructure.

MR #7 Flow Control
The proposed project does not require flow control because the proposed development does not cause a 0.15 cfs increase using 15-minute time steps. According to the WWHM2012 modeling performed a 0.043 cfs increase is expected from the existing conditions to the proposed conditions for TDA #1. A 0.097 cfs increase is expected for TDA #2. Therefore, the project is Flow Control Exempt. A more detailed analysis of each TDA is provided below. The entire modeling report is included in the appendices.

Bioretention and concentrated flow dispersion were not analyzed in the report. [Storm Report, Pg 5]

Include basin map of site showing TDAs for pre and post developed conditions. [Storm Report, Pg 6]

In the post development condition, the pre-developed condition TDAs are maintained to the maximum extent practical. However, due the development constraints, TDA #1 increased from 1,678 sf to 3,369 sf, and TDA #2 decreased to 6,631 sf.

TDA #1 contains the parking lot and sidewalk areas. Runoff from TDA #1 will either be collected and piped, or sheet flow to Structure D4-06593 in the alley north of the project site. When modeled in WWHM using 15- minute timesteps the post developed scenario concluded a 0.043 cfs increase.

TDA #2 contains the building roof area as well as the remainder of the site. Runoff from TDA #2 will either be collected and piped, or sheet flow to Structure D4-06625 om the alley north of the project site. When modeled in WWHM using 15- minute timesteps the post developed scenario concluded a 0.097 cfs increase.

Appendix

1) Figure 1-3.1 Flow Chart for Determining Minimum Requirements for New Development
2) Figure 1.3.3 Flow Chart for Determining Minimum Requirements #5
3) Geotechnical Report Prepared by Icicle Creek Engineers on July 20, 2022
4) WWHM Project Report

Figure I-3.1: Flow Chart for Determining Requirements for New Development

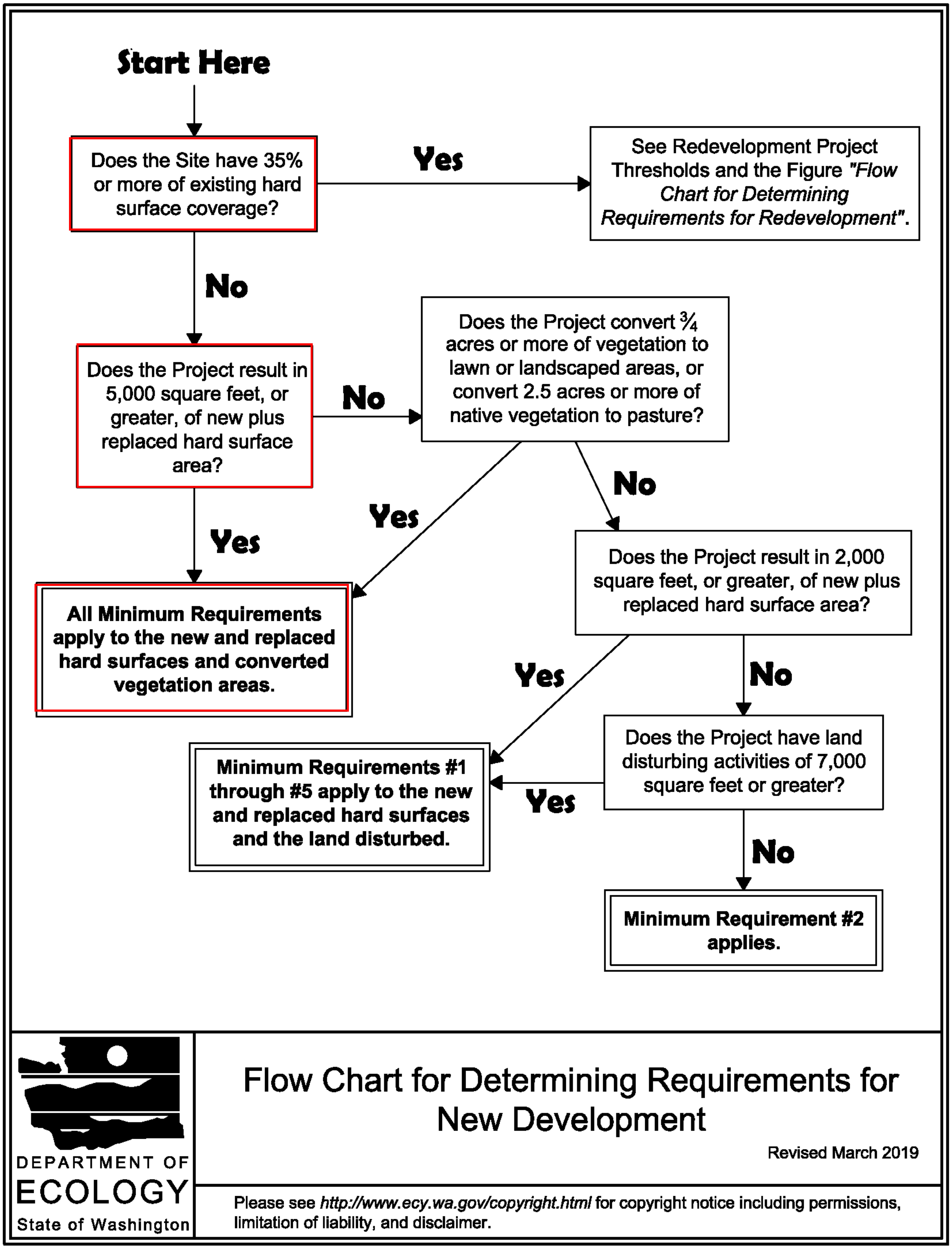
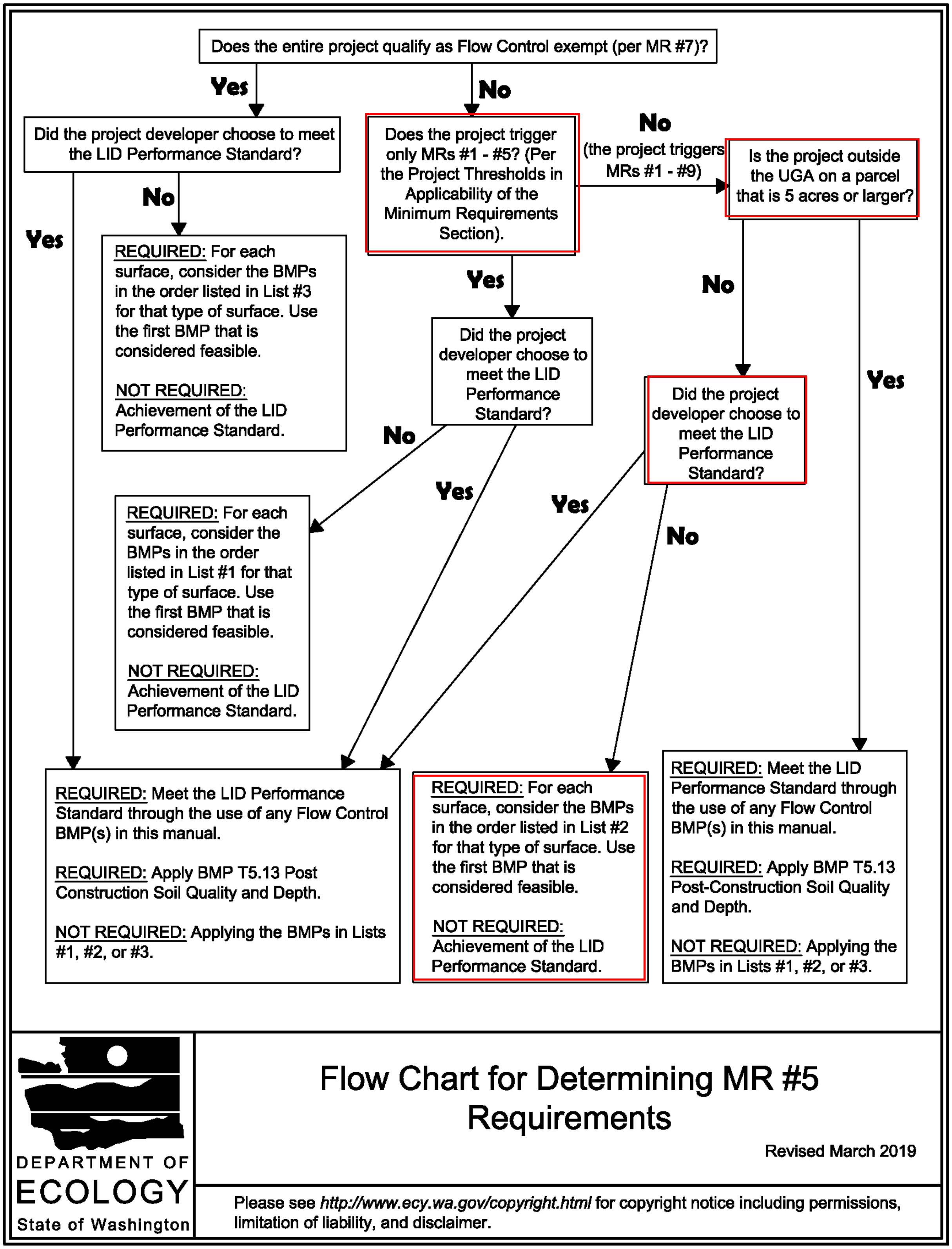


Figure I-3.3: Flow Chart for Determining MR #5 Requirements



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Geotechnical Engineering Services
Proposed Commercial Building
Pierce County Parcel No. 728500-0112
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Prepared For:
Samantha Keimig and Jackson Castaneda

Prepared By:
Icicle Creek Engineers, Inc.

July 20, 2022

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1113 27th Street Place NW
Puyallup, Washington 98371

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1.0 INTRODUCTION

This report summarizes the results of Icicle Creek Engineers' (ICE's) geotechnical engineering services related to a proposed commercial building located at Pierce County Parcel No. 728500-0112 in Puyallup, Washington (referred to as the Keimig/Castaneda Property in this report). The Keimig/Castaneda Property is shown relative to nearby physical features on the Vicinity Map and Site Plan, Figures 1 and 2, respectively.

Our services were completed in general accordance with our Proposal dated February 14, 2022, and were authorized in writing by Samantha Keimig and Jackson Castaneda, the property owners, on February 21, 2022.

2.0 PROJECT DESCRIPTION

Our project understanding is based on telephone and email correspondence with Ms. Keimig and Mr. Castaneda, Jeff McCann (the Land Use Consultant), and Brandon Loucks, PE with ESM Consulting Engineers, LLC (ESM). Information and documentation related to this project is referenced as follows:

- Cascade Land Surveying, May 8, 2014, *Surveyed For: Robert & Karen Trail*, two sheets.
- ESM, undated, *Jackson Castaneda & Samantha Keimig, 5th St CUP, Basemap,* scale 1 inch = 30 feet.

Based on our review of the above-referenced information and our correspondence with the project team, we understand that the preliminary plan for development of the Keimig/Castaneda Property includes a single-story, approximately 3,200-square-feet commercial building, along with a pedestrian plaza and parking areas as conceptually shown on Figure 2. The Keimig/Castaneda Property is nearly-level and unvegetated; we expect clearing and grading will be limited.

We expect that underground utilities may be installed below pavement and/or building areas; details about underground utility locations or depths are not known at this time. We understand that the preliminary plan for stormwater disposal from the roof and paved areas is infiltration (if feasible), or tying in with the street drainage collection system if infiltration is infeasible.

3.0 SCOPE OF SERVICES

The purpose of our services was to explore and evaluate subsurface soil and groundwater conditions as a basis for evaluating foundation support and stormwater infiltration feasibility. Specifically, our services included the following:

- Review readily available geologic and geotechnical information in the vicinity of the Keimig/Castaneda Property.
- Complete a visit to the Keimig/Castaneda Property to observe existing surface conditions.
- Explore subsurface soil and groundwater conditions by drilling two test borings to depths of about 20 and 31.5 feet.
- Install a groundwater monitoring well (piezometer) in one of the test borings.

Provide test results from piezometer. [Storm Report, Pg 12]

- Complete laboratory testing (moisture content determination and grain size analysis) on soil samples obtained from the test borings.
- Evaluate pertinent physical and engineering characteristics of the soils based on the results of the test borings, laboratory testing and our experience.
- Describe and characterize soil and groundwater conditions at the Keimig/Castaneda Property.
- Provide a preliminary evaluation of liquefaction potential for the Keimig/Castaneda Property, based on the shallow subsurface conditions observed in the test borings and our general knowledge of deeper soil and groundwater conditions in the Puyallup valley.
- Provide recommendations for the proposed building regarding earthwork including site preparation and overexcavation and replacement of any unsuitable soils (compressible or weak near-surface soils), structural fill placement and compaction and subgrade preparation requirements, and suitability of on-site soils for use as structural fill. This includes evaluation of the effects of weather and/or construction equipment on the workability of site soils.
- Develop recommendations for shallow foundation design, including allowable soil bearing pressures and settlement estimates.
- Provide preliminary recommendations for reducing post-construction settlements due to static loads and liquefaction.
- Provide recommendations for slab-on-grade floor.
- Provide seismic design criteria, including Seismic Site Class (American Society of Civil Engineers) and other seismic design criteria.
- Evaluate soil infiltration characteristics using the Soil Grain Size Analysis Method (Volume 5, Section 5.4) as described in Washington State Department of Ecology's (Ecology's) 2019 Stormwater Management Manual for Western Washington (SMMWW).
- Provide an evaluation of feasibility of stormwater infiltration. If feasible, provide recommendations for short-term (field) and long-term (design) infiltration rate(s) based on the Soil Grain Size Analysis.

4.0 REGULATORY CONSIDERATIONS

Based on our review of the Puyallup Municipal Code (PMC) section 21.06.1210.3.c, the Keimig/Castaneda Property may be considered a Seismic Hazard Area. PMC section 21.06.1250.2 requires that "*Construction of new buildings and additions to existing buildings within a seismic hazard area shall conform to the International Building Code standards for seismic protection*."

5.0 SITE CONDITIONS

5.1 GENERAL

Shane Markus, PE, LEG of ICE completed site visits to the Keimig/Castaneda Property on February 24, 2022 to mark the locations of two test borings (Borings B-1 and B-2) for the purpose of the underground utility locate and for site reconnaissance, and on March 2, 2022 to observe the drilling of two test borings.

Our understanding of the Keimig/Castaneda Property is based on our review of in-house geological information, review of nearby subsurface explorations (from in-house sources, Washington State Department of Natural Resources (DNR; https://www.dnr.wa.gov/geologyportal), and the Ecology Well Report Viewer), geologic map review (DNR), historic aerial photograph review (US Army Corps of Engineers, US Geological Survey EarthExplorer – https://earthexplorer. usgs.gov/, and Google Earth), surface reconnaissance of the Keimig/Castaneda Property, observations of subsurface conditions in the two test borings at the Keimig/Castaneda Property, and our laboratory testing program.

5.2 GEOGRAPHIC AND TOPOGRAPHIC SETTING

The approximately 10,000-square-feet Keimig/Castaneda Property is located in the Puyallup River valley. The property is nearly-level, varying from about Elevation 49.5 to 51 feet, based on LiDAR-based Digital Terrain Model (DTM) data (Pierce 2011 acquisition; https://lidarportal.dnr.wa.gov/), processed by ICE for 1-foot topographic contours using Environmental Systems Research Institute (Esri) ArcGIS 10.6. The Keimig/Castaneda Property is bordered to the west, north and east by parking lots, alleyways and urban commercial development (single-story retail and warehouse structures). The Keimig/Castaneda Property is bordered to the south by a double-track main rail line elevated about 2- to 3-feet above the property on an embankment of railroad ballast (clean 2- to 4-inch rock).

5.3 GEOLOGIC SETTING

The surficial geology of the Keimig/Castaneda Property has been mapped by the DNR (November 2015, *Geologic Map of the Tacoma 1:100,000-scale Quadrangle, Washington*, Map Series 2015-03) as underlain by Alluvium. Alluvium typically consists of stratified (layered) silt and sand with variable amounts of gravel, typically in a loose/soft to medium dense/medium stiff condition.

Subsequent modifications of the ground surface may have resulted in the placement of fill of varying character in the vicinity of the Keimig/Castaneda Property, considering the extended history of site use in nearby areas (commercial development and construction/use of the rail line).

5.4 SITE OBSERVATIONS

The Keimig/Castaneda Property is currently undeveloped and gravel-surfaced, with grass growing up through the gravel. The Keimig/Castaneda Property is nearly level, with the embankment for the rail line rising abruptly along the south property boundary. Construction materials are stockpiled in local parts of the site. The Keimig/Castaneda Property is surrounded by a temporary chain-link fence. We observed storm drains in the alley and parking lots surrounding the site.

5.5 SUBSURFACE CONDITIONS

5.5.1 Geotechnical Test Borings

Subsurface conditions at the Keimig/Castaneda Property were explored by drilling two test borings (Borings B-1 and B-2) to depths of 20 and 31.5 feet (respectively) on March 2, 2022 using a CME 55LCX rubber-tracked hollow-stem auger drill rig, owned and operated by Gregory Drilling, Inc. of North Bend, Washington. The locations of the test borings are shown on Figure 2.

Disturbed soil samples were obtained at approximately 2½- and 5-foot depth intervals using a split-spoon sampler. The sampler was driven 18 inches using a 140-pound hammer falling 30 inches (Standard Penetration Test – SPT). The number of blows required to drive the sampler the last 12 inches or other specified interval was recorded on the boring log.

The borings were continuously observed by Mr. Markus who classified the soils encountered, observed groundwater conditions and prepared a detailed log of the borings. After completion, a groundwater monitoring well (piezometer) was installed in Boring B-1. Piezometer installation was completed in general accordance with Ecology requirements; installation details are shown on the boring log. Boring B-2 was backfilled in general accordance with Ecology guidelines.

An explanation for the boring logs is presented in Figure 3. The boring logs are presented in Figures 4 and 5. The soil consistencies noted on the boring logs are based on the conditions observed, our experience and judgement, and blow count data obtained during drilling. The depth to groundwater was measured during drilling using a water level meter lowered into the hollow-stem auger once samples appeared saturated; the water level was allowed to stabilize in the auger prior to the measurement being recorded.

The soil samples obtained from the test borings were visually examined in our soils laboratory and selected samples were tested to evaluate pertinent physical characteristics. The testing program included moisture content by ASTM Test Method D 2216, and grain size analysis (particle size distribution) by ASTM Test Methods C 117 and C 136. The moisture content test results are shown on the boring logs. The particle size distribution reports are shown on Figures 6 and 7.

Soils encountered were classified in general accordance with the classification system described in Figure 3. The boring logs are based on our interpretation of the field and laboratory data. The boring logs also indicate the depths at which the soil characteristics change, although the change might be gradual. If the change occurred between samples in the boring, it was interpreted. The boring locations as shown on Figure 2 were measured in the field relative to existing site features, supplemented with a geo-referenced map and hand-held GPS device (cell phone). Elevations of the test borings were estimated using 1-foot topographic contours from LiDAR DTM data (Pierce 2011 acquisition; https://lidarportal.dnr.wa.gov/), processed by ICE using Esri ArcGIS 10.6.

The soil types encountered in each test boring is described below. The native soil conditions encountered in the test borings were consistent with the DNR (2015) mapping of Alluvium.

Boring B-1: Boring B-1 encountered about 1½ feet of Fill, consisting of loose gravel with silt and sand. Coarse-grained Alluvium was encountered from about 1½ to 6 feet, consisting of loose fine to medium sand with silt. Fine-grained Alluvium was encountered from about 6 to 7½ feet, consisting of soft silt. Coarse-grained Alluvium was encountered from about 7½ to 17 feet, consisting of very loose to loose silty sand. Fine-grained Alluvium was encountered from about 17 to 20 feet at the completion depth of Boring B-1, consisting of medium stiff silt with sand.

Boring B-2: Boring B-2 encountered about ½ foot of Fill, consisting of 5/8-inch-minus crushed rock. Coarse-grained Alluvium was encountered from about ½ to 3½ feet, consisting of very loose silty sand with gravel. Fine-grained Alluvium was encountered from about 3½ to 6 feet, consisting of soft silt with sand. Coarse-grained Alluvium was encountered from about 6 to 15½ feet, consisting of very loose to medium dense sand with occasional fine gravel. Fine-grained Alluvium was encountered from about 15½ to 22½ feet, consisting of stiff silt with sand. Coarse-grained Alluvium was encountered from about 22½ to 31½ feet at the completion depth of Boring B-2, consisting of medium dense sand with silt grading to silty sand at about 27½ feet.

At the time of drilling, groundwater was encountered in Borings B-1 and B-2 at depths of about 4.4 feet and 4.8 feet, respectively.

5.5.2 Supplemental Subsurface Information

As part of this evaluation, we reviewed nearby subsurface explorations from in-house sources, from the DNR (https://www.dnr.wa.gov/geologyportal), and from the Ecology Well Report Viewer to evaluate expected conditions deeper than the maximum depths of our borings. Geotechnical test borings are available about 1- to 1½-miles north and northwest of the Keimig/Castaneda Property, on the north side of the Puyallup River but still within the Puyallup River valley bottom. Based on our review of these geotechnical test borings, similar interlayering of very loose to medium dense sand and soft to medium stiff silt is present to the completion depths of these borings at 50 to 100 plus feet. Based on our review of Well Reports from the immediate vicinity of the Keimig/Castaneda Property, groundwater was consistently encountered at relatively shallow depths (less than about 10-feet-deep).

5.6 SEISMIC SETTING

The Puget Sound lowland is located in the forearc of the Cascadia Subduction Zone. Seismicity of this region is attributed primarily to the subduction zone interaction between the Juan de Fuca plate, the continental forearc of the North American plate, and the landward continental arc. The Juan de Fuca plate is subducting beneath the North American plate.

The majority of historical earthquakes in this region have occurred at depths of 20 miles or less. Most major earthquakes (magnitudes greater than 8.5) occur within the deep, subcrustal zone (greater than 20-mile depth). Thick deposits of glacial and non-glacial sediments occur throughout most of the Puget Sound area. Due to the thick sediment cover, little is known regarding the nature of faults in the underlying bedrock. The Seattle Fault, the Southern Whidbey Island Fault and the Tacoma Fault zones are structural geology features that have indicated ground displacement in the Quaternary-age glacial, interglacial and post-glacial sediments in the Puget Sound region.

An abbreviated list of major (great than magnitude 5) earthquake events in the Puget Sound region according to the Pacific Northwest Seismic Network is presented below:

Provide continuous groundwater monitoring during winter months per Section III-3.2 of Ecology Manual. [Storm report, Pg16]

Summary of Major Seismic Events in the Puget Sound Region			
Seismic Event	**Date**	**Location**	**Richter Magnitude**
Cascadia Earthquake	January 26, 1700	Cascadia Sub. Zone	8.7 – 9.2*
North Cascades Earthquake	December 15, 1872	Chelan, WA	6.8*
Pickering Passage Earthquake	February 15, 1946	Olympia, WA	5.8
Strait of Georgia Earthquake	June 23, 1946	Courtenay, BC	7.4
Olympia Earthquake	April 13, 1949	Olympia, WA	7.1
Seattle-Tacoma Earthquake	April 29, 1965	SeaTac, WA	6.5
Duvall Earthquake	May 3, 1996	Duvall, WA	5.4
Satsop Earthquake	July 3, 1999	Satsop, WA	5.7
Nisqually Earthquake	February 28, 2001	Olympia, WA	6.8
* Estimated from historical information.			

Based on our review of the USGS Unified Hazard Tool (https://earthquake.usgs.gov/hazards/interactive/), the most significant contributor to the seismic hazard at the Keimig/Castaneda Property is a potential Cascadia Subduction Zone earthquake about 50 to 90 miles away with a very high intensity (magnitude 9). Another earthquake contributing to the seismic hazard at the Keimig/Castaneda Property includes a shallow local (about 20-miles away) crustal earthquake with a moderate intensity (up to magnitude 7).

6.0 PRELIMINARY INFILTRATION EVALUATION

We completed a preliminary evaluation of infiltration rates in general accordance with Ecology's 2019 SMMWW (Volume 5, Section 5.4, *Option 3: Soil Grain Size Analysis*). Grain size analyses were completed on selected soil samples obtained from the test borings; the particle size distribution reports are presented as Figures 6 and 7. The following is a summary of our preliminary infiltration analysis results (short-term and long-term rates):

Provide calculations for infiltration rates. [Storm report, Pg16]

Test Boring Number/Sample Number	Sample Depth (feet)	Geologic Unit	Soil Type	Soil Infiltration Rate (short-term / long-term(1)) (inches per hour - iph)
B-1 / S-1	3.5	Alluvium (coarse-grained)	SP-SM – sand with silt	31 / 8.4
B-2 / S-2 & S-3	4 & 5.5	Alluvium (fine-grained)	ML – silt with sand	0.6 / 0.16

(1) The long-term infiltration rate includes correction factors to account for in-situ density, test method, maintenance and biofouling. The long-term infiltration rate should be used for sizing infiltration facilities.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 GENERAL

Based on our information review, site observations, and the results of our subsurface exploration and laboratory testing program, it is our opinion that the proposed building at the Keimig/Castaneda Property is feasible from a geotechnical standpoint. However, the Keimig/Castaneda Property is underlain by zones of loose or soft Alluvium with a relatively high groundwater level which are conditions that need to be considered in the building design, as described in the remainder of this report.

7.2 SEISMIC CONSIDERATIONS

7.2.1 Seismic Design Criteria

Based on our review of PMC section 17.04.030 which refers to Washington Administrative Code (WAC) Chapter 51-50, we understand that the 2018 International Building Code (IBC) will be the adopted building code of reference at the time of design and permitting for the proposed building.

The 2018 IBC both presents requirements for seismic design criteria and refers to requirements of the 2016 American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI) 7-16 (Minimum Design Loads for Buildings and Other Structures). Both the 2018 IBC and ASCE 7-16 require structures to be designed for earthquake ground motions with a two percent probability of exceedance in 50 years, corresponding to a target risk of structural collapse of one percent in 50 years considering a generic structural fragility factor.

Because of the presence of potentially liquefiable soils, the subsurface conditions at the Keimig/Castaneda Property correspond to Site Class F, as defined by ASCE/SEI 7-16 Section 20.3.1. Within Site Class F, ASCE/SEI 7-16 requires that a site-specific ground response analysis be completed, with the exception of structures with fundamental periods of vibration equal to or less than 0.5 seconds; these structures may be assigned Seismic Site Class using ASCE/SEI 7-16 Section 20.3 and designed accordingly using methods in 2018 IBC Section 1613. Because only one story is planned, we assume the proposed building at the Keimig/Castaneda Property will have a fundamental period of less than 0.5 seconds.

Based on our analysis of boring logs and our review of available geologic information, we interpret the on-site conditions at the Keimig/Castaneda Property to correspond to Seismic Site Class E ("Soft Clay Soil"). The Seismic Site Class was developed based on the recommended procedure using SPT N-values (Standard Penetration Test blow count), as described in ASCE/SEI 7-16 Section 20.4.2. We considered SPT N-values from Borings B-1 and B-2 and reviewed supplemental geotechnical test borings in the area for this evaluation.

We recommend the following seismic parameters for use in design of structures for the project.

Seismic Design Parameters	
Site Class[1]	E
Site-Modified Peak Ground Acceleration (PGA_M)[2]	0.600
Design-Level PGA[3]	0.400
Short Period Spectral Response Acceleration, S_S[4]	1.269
1-Second Period Spectral Response Acceleration, S_1[4]	0.437
Site Coefficient, F_a[5]	1.2
Site Coefficient, F_v[5]	2.326
Short Period Design-Level Spectral Response Acceleration, S_{DS}[6]	1.015
1-Second Period Design-Level Spectral Response Acceleration, S_{D1}[6]	0.676

(1) The subsurface conditions correspond to Site Class F, but, assuming a structural fundamental period of less than 0.5 seconds, Site Class E was determined using average N-values (ASCE/SEI 7-16 Section 20.4.2).
(2) Based on the Maximum Considered Earthquake – Geometric Mean (MCE_G) Seismic Ground Motion Maps in ASCE 7-16 (Figure 22-9), adjusted for the Site Coefficient F_{PGA} = 1.2 (Table 11.8-1).
(3) Two-thirds of the PGA_M (2018 IBC Section 1613.2.4).
(4) Based on the Risk-Targeted Maximum Considered Earthquake (MCE_R) Ground Motion Response Acceleration Maps in the 2018 IBC (Figures 1613.2.1(1) and 16.13.2.1(2)), adjusted following 2018 IBC Sections 1613.2.3 and 1613.2.4.
(5) From 2018 IBC Table 1613.2.3(1) and Table 1613.2.3(2).
(6) ASCE 7-16 Section 11.4.8 Exception 3 was assumed; the requirements of the exception should be reviewed by the structural engineer.

7.2.2 Liquefaction Susceptibility

Soil liquefaction is a phenomenon where soils experience a rapid loss of shear strength as pore water pressures increase in response to strong ground shaking. Loss of soil strength and migration of water can result in soils that flow, deform or erupt. Soil liquefaction may cause ground settlement, lateral deformation, excessive ground oscillation, and/or sand boils or soil eruptions, potentially resulting in structural damage.

Liquefaction generally occurs in loose to medium dense sand deposits, though recent studies have shown that gravels, silty sands and non-plastic sandy silts may also be susceptible to liquefaction. Additionally, soil saturation (groundwater) is a necessary component of liquefaction susceptibility.

The potential for liquefaction to initiate is typically quantified by comparing the Cyclic Stress Ratio (CSR – the driving forces of liquefaction, which are based on ground shaking amplitude, frequency content and duration) to the Cyclic Resistance Ratio (CRR – the resisting forces to liquefaction, which are related to soil strength and grain size distribution). Procedures for determining the CSR and CRR are outlined in Idriss and Boulanger (2004, *Semi-Empirical Procedures for Evaluating Liquefaction Potential During Earthquakes*). To determine the CSR, we used the site-adjusted MCE_G PGA of 0.600g (see section **7.2.1** of this report), and an earthquake magnitude M_W of 7.83 (obtained as the mean magnitude from the USGS Unified Hazard deaggregation tool). To determine the CRR, we used correlations between SPT blow-count (N) value and the CRR, adjusted for the fines content of the soil (based on sample observations and laboratory test results).

Based on our evaluation of the subsurface soil and groundwater conditions, and our analysis using Idriss and Boulanger (2004), **the very loose to medium dense sand and very soft to soft silt layers (where non-plastic) below the groundwater table (4.4- to 4.8-feet) of the soil profile are moderately to highly susceptible to soil liquefaction** during a design ground motion (earthquake/seismic event) prescribed by IBC 2018 and ASCE 7-16 Seismic Design Maps.

7.2.3 Seismically-Induced Settlements and Lateral Spreading

Based on empirical methods described by Tokimatsu and Seed (1987, *Evaluations of settlements in sand due to earthquake shaking*) and Ishihara and Yoshimine (1992, *Evaluation of settlements in sand deposits following liquefaction during earthquakes*), which correlate the SPT N value and ground motion to expected ground settlements, **we estimate that liquefaction-induced ground settlements in the area of the Keimig/Castaneda Property could be on the order of several inches** during design ground motions prescribed by IBC 2018 and ASCE 7-16 Seismic Design Maps. We expect that liquefaction may be initiated uniformly across the Keimig/Castaneda Property, but there is also a risk of differential seismically-induced settlement (if unmitigated).

Lateral spreading is the phenomenon wherein the ground surface displaces toward a gentle slope or free face during liquefaction, resulting in permanent lateral deformation. An approximately 20-feet-high free face is located about 1,100-feet northeast of the Keimig/Castaneda Property, along the banks of the Puyallup River. Based on Youd and Bartlett (1994, *Empirical Prediction of Liquefaction-Induced Lateral Spread*) and Youd *et al.* (2002, *Revised Multilinear Regression Equations for Prediction of Lateral Spread Displacement*), **lateral spreading (horizontal displacement) is possible toward the free face along the Puyallup River on the order of several inches** during design ground motions prescribed by IBC 2018 and ASCE 7-16 Seismic Design Maps.

7.3 GEOTECHNICAL DESIGN RECOMMENDATIONS

7.3.1 Foundation Support

As previously described, the Keimig/Castaneda Property is underlain by very loose/soft to medium dense/ stiff Alluvium (silt and sand). In our opinion, these soils are not suitable for directly supporting the proposed building on conventional shallow foundations, due to the risk of unacceptable differential settlements during a design seismic event and/or static loading; however, the design recommendation provided below should acceptably mitigate the potential for seismic and/or static differential settlement and should improve bearing support.

We recommend that the proposed building be founded on shallow footings that bear on a pad of Structural Fill (referred to as a “Bearing Pad”) placed over the native soils across the entire structure footprint. We recommend overexcavating at least 2-feet below footing subgrade elevation across the entirety of the building footprint. The bearing pad should extend at least 2-feet out from the edges of the spread footings to accommodate the “zone of influence” of footing stress. We recommend that the overexcavated subgrade be compacted in place (if compactible as Structural Fill – see section **7.4.2** of this report) or covered with a woven reinforcing geosynthetic (such as Tencate Mirafi® RS380i or equal). We recommend that the Bearing Pad fill be composed of well-drained sand, gravel and cobbles (Washington State Department of Transportation (WSDOT) 2022 Standard Specifications 9-03.14(1) Gravel Borrow). Alternatively, Crushed Surfacing Base Course (CSBC) could be used for the Bearing Pad as described in WSDOT 2022 Standard Specifications 9-03.9(3). The Bearing Pad should be placed and compacted as described in section **7.4.2** of this report.

Conventional spread footings are adequate if the Bearing Pad is constructed as described. The Bearing Pad mitigates the risk of static and seismic differential settlement by serving as a diaphragm to buffer the effects of an earthquake event, and by dissipating foundation stresses uniformly across the building footprint, thereby mitigating both static and seismic differential settlements.

We recommend that exterior footings be embedded a minimum of 18-inches below the adjacent ground surface for frost protection; interior footings can be embedded 12 inches. We recommend that continuous and isolated column footings have minimum widths of 16 and 24 inches, respectively. We anticipate that footings may be designed using an **allowable soil bearing pressure of 1,500 pounds per square foot** (psf) for dead plus long-term live loads. This value may be increased by one-third when considering transient loads, such as wind or seismic.

We estimate that post-construction static settlement of shallow footings, constructed as recommended on a Bearing Pad, will be on the order of ½ to ¾ inch for the assumed loading conditions. Static differential settlements should not exceed about ½ inch over 50 feet. We expect static settlements to occur relatively quickly (mostly within about 1 month of construction). We expect liquefaction-induced differential settlements to be minimized if the Bearing Pad and shallow footings are constructed as recommended, but the risk of liquefaction-induced differential settlement cannot be eliminated.

7.3.2 Slab-on-Grade Support

The slab-on-grade subgrade should be prepared in accordance with section **7.4.1** of this report. We recommend that the subgrade surface be compacted so that a minimum compaction of 95 percent of the Maximum Dry Density (MDD) is obtained in accordance with ASTM Test Method D 1557 before placing Structural Fill or capillary break material.

We recommend that a 6-inch-thick layer of medium to coarse sand and gravel containing less than 3-percent fines (material passing the US Standard No. 200 sieve) by weight based on the fraction of the material passing the ¾-inch sieve be placed below the bottom elevation of the floor slab to provide uniform support and a capillary break. A vapor retarder and/or waterproofing should be provided if there is a potential for surface or shallow groundwater to occur or migrate under the slab.

Post-construction static slab settlements for a 150 psf live load are expected to be less than ¾ inch. In addition, the on-grade slabs could experience seismically-induced settlements on the order of several inches during a major earthquake.

We expect that liquefaction may be initiated uniformly across the Keimig/Castaneda Property, but there is also a risk of differential seismically-induced settlement, which is minimized with the use of the Bearing Pad. We expect liquefaction-induced differential settlements to be minimized if the Bearing Pad and slab-on-grades are constructed as recommended, but the risk of liquefaction-induced differential settlement cannot be eliminated.

7.3.3 Stormwater Disposal

As described in section **6.0** of this report, we completed a preliminary evaluation of infiltration rates of select soil samples in general accordance with Ecology's 2019 SMMWW (Volume 5, Section 5.4, *Option 3: Soil Grain Size Analysis*).

Based on this evaluation, the shallower coarse-grained Alluvium (extending from near-surface to about 6 to 3.5 feet in Borings B-1 and B-2, respectively) is relatively permeable. The underlying fine-grained Alluvium (below about 6- and 3.5-feet in Borings B-1 and B-2, respectively) is relatively impermeable. These depths are described in the table below. As described in section **5.5.1** of this report, groundwater was encountered at depths of about 4.4 and 4.8 feet in Borings B-1 and B-2, respectively.

Soil Type	Approximate Depth of Layer (Boring B-1) (feet)	Approximate Depth of Layer (Boring B-2) (feet)	Preliminary Soil Infiltration Rate (short-term / long-term) (inches per hour – iph(1))
Alluvium (coarse-grained)	1.5 to 6	0.5 to 3.5	31 / 8.4
Alluvium (fine-grained)	6 to 7.5	3.5 to 6	0.6 / 0.16

(1) The long-term (design) infiltration rate includes correction factors to account for in-situ density, test method, maintenance and biofouling. The long-term infiltration rate should be used for design (sizing) infiltration facilities.

We recommend using the long-term (design) infiltration rates for each soil type for sizing infiltration facilities. Due to the relatively shallow groundwater table and the relatively shallow depth to low-permeability soil, we expect that disposal of stormwater by infiltration may be infeasible at the Keimig/Castaneda Property. We understand that permeable pavement is being considered; permeable pavement may be feasible depending on the elevation of the final subgrade and the ponding depth within the base course (refer to Ecology's 2019 SMMWW).

7.4 EARTHWORK CONSIDERATIONS

7.4.1 Site Preparation

Sod and Topsoil should be stripped and removed from pavement areas. Fill can be evaluated on a case-by-case basis for support of pavements. Stripping should be minimized to the extent that only the footprint of these areas is affected. We expect that the stripping depth will be 6 to 12 inches for pavement areas. Greater stripping depths may be necessary where organic or very soft/loose soils are observed. Individual roots larger than 1-inch diameter should be grubbed to at least 12-inches below the design subgrade.

As previously described, we recommend a 2-feet-deep overexcavation (total 3-feet-deep excavation including the 1 foot recommended embedment) within the footprint of the proposed building (slab-on-grade and footing areas).

Following stripping, the exposed pavement, slab-on-grade and footing subgrade areas should be thoroughly proofrolled in dry weather and probed in wet weather to evaluate areas of soft, loose, or otherwise unsuitable subgrade areas.

In pavement areas, soft, loose or wet soils identified during proofrolling or probing should be removed and replaced with Structural Fill (as described in section **7.4.2** of this report) up to about 3 feet below final subgrade elevation. Where soft, loose, or wet soils are present below 3 feet, we recommend that a woven geotextile fabric, such as Tencate Mirafi® RS380i or equal, be placed in the bottom of the excavation prior to backfilling with Structural Fill.

Within the building footprint, organic soils identified during proofrolling or probing should be removed and replaced with Structural Fill (as described in section **7.4.2** of this report), regardless of depth.

7.4.2 Structural Fill

The term "Structural Fill" refers to any fill material placed under pavements, slab-on-grades, building foundations, or other load-bearing and settlement-sensitive features. We recommend that all fill used in these applications at the Keimig/Castaneda Property meet the following criteria regarding composition, placement and compaction of Structural Fill.

Structural Fill should be free of organic material or debris and have a maximum particle size of 6 inches. The material should contain less than five percent fines (soil particles passing the US Standard No. 200

sieve) by weight relative to the portion finer than the ¾-inch sieve. If earthwork is done during generally dry weather conditions, the fines content may be increased.

As a guideline, Structural Fill should be placed in horizontal lifts which are 12 inches or less in loose thickness. The actual lift thickness depends on the quality of the fill material and the size of the compaction equipment.

We recommend that Structural Fill placed in the pavement, slab-on-grade and footing areas be uniformly compacted to at least 95 percent of the MDD obtained in general accordance with ASTM Test Method D 1557. Materials such as pea gravel, washed rock, quarry spalls, Controlled Density Fill (CDF) and lean mix concrete do not require the same rigorous placement and compaction procedures, but they should be placed in a manner suitable for the purpose. Nonstructural fill placed in landscape areas need only be compacted to the degree required for trafficability of construction equipment and effective surface drainage.

We expect that the Fill and coarse-grained Alluvium (provided no abundant roots or organic fragments) that are excavated may be reused for Structural Fill during periods of extended dry weather. During wet weather, it may be necessary to import soil containing less than five percent fines (soil particles passing the US Standard No. 200 sieve). Moisture conditioning (wetting or drying) may be required, especially where silt contents are higher. Fine-grained Alluvium may not be easily compactible to 95 percent of the MDD. As previously described, Structural Fill for the Bearing Pad should be composed of well-drained sand, gravel and cobbles as described in WSDOT 2022 Standard Specifications 9-03.14(1) Gravel Borrow. Alternatively, CSBC could be used for the Bearing Pad as described in WSDOT 2022 Standard Specifications 9-03.9(3).

7.4.3 Excavation Considerations

Based on our geotechnical test borings, we expect excavatability of the site soils using conventional heavy construction equipment to be relatively easy. Temporary cut slopes greater than 4-feet deep should be made at an inclination of 1H:1V (horizontal to vertical) or flatter. Flatter slopes may be needed if instability is observed. All temporary cut slopes must comply with the provisions of Title 296 Washington Administrative Code (WAC), Part N, *Excavation, Trenching and Shoring*. We recommend that cut slopes for temporary excavations be made the responsibility of the contractor. The contractor is present at the site continuously and is best able to observe changes in site and soil conditions and to monitor the performance of excavations.

We recommend that all excavations extending below groundwater be fully dewatered.

7.5 DRAINAGE

We recommend that perimeter footing drains be installed adjacent to the exterior footings of the proposed building. These drains should consist of 4-inch diameter, perforated, smooth-walled pipe bedded in at least 6 inches of 1¼-inch uniform washed rock, with the base of the pipe at the base of any adjacent footings. The bedding should be enclosed within a nonwoven geotextile fabric such as Tencate Mirafi® 160N to reduce the potential for infiltration of fines into the drainage material from the native soils. The pipe should be placed with the perforations down. The perforated pipe should be connected to a tightline collection system that discharges away from structures. The ground surface surrounding the proposed building should be sloped down and away from the structure.

7.6 GEOTECHNICAL OBSERVATION DURING CONSTRUCTION

A representative from ICE should observe preparation for, placement and compaction of Structural Fill, including completing an adequate number of in-place density tests in the Structural Fill to evaluate if the desired degree of compaction is being achieved. A representative from ICE should also be present to observe pavement, slab-on-grade, footing and Bearing Pad subgrade preparation and advise on the extent of any remedial action needed. A representative from ICE should observe the base of infiltration facilities, if used, after excavation to subgrade to evaluate whether the native materials at the base of the facilities are as expected and that the provided long-term (design) infiltration rates are applicable.

8.0 USE OF THIS REPORT

We have prepared this report for use by Samantha Keimig and Jackson Castaneda. The data and report should be provided to prospective contractors for bidding or estimating purposes and to permitting agencies, but our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

When the design has been finalized, we recommend that the final design drawings and specifications be reviewed by our firm to confirm that our recommendations have been interpreted and implemented as intended.

There is the possibility that subsurface conditions could vary with location across the Keimig/Castaneda Property, as well as with time. A contingency for unexpected conditions should be included in the project budget and schedule. Sufficient observation, testing and consultation should be provided by our firm during construction to evaluate whether the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions encountered during the work differ from those anticipated, and to evaluate whether or not earthwork and foundation installation activities comply with the contract plans and specifications.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in this area at the time the report was prepared. No warranty or other conditions, express or implied, should be understood.

****

We appreciate the opportunity to be of service to Samantha Keimig and Jackson Castaneda on this project. If you have any questions concerning this report or if we can provide additional services, please call.

Yours very truly,
Icicle Creek Engineers, Inc.

Shane J. Markus, PE, LEG
Project Engineer/Geologist

Brian R. Beaman, PE, LEG, LHG
Principal Engineer/Geologist/Hydrogeologist

Document ID: 1420001.Report
Attachments: Vicinity Map – Figure 1
Site Plan – Figure 2
Explanation for Boring Logs – Figure 3
Boring Logs – Figures 4 and 5
Particle Size Distribution Reports – Figures 6 and 7

Submitted via email

FIGURES

Notes: 1) Aerial Photograph dated March 3, 2021 obtained from Esri ArcGIS World Imagery layer.
2) Parcel boundary based on Pierce County GIS data.

0 500 1,000
Approximate Scale in Feet

VICINITY MAP

PROPOSED COMMERCIAL BUILDING
PIERCE COUNTY PARCEL NO. 728500-0112, PUYALLUP, WASHINGTON

ICICLECREEK ENGINEERS
29335 NE 20th Street
Carnation, Washington 98014
(425) 333-0093

SCALE: As Shown
DESIGNED: ---
DRAWN: BRB
CHECKED: KSK
DATE: 07/20/2022

ICE FILE NO.
1420-001
Figure
1

EXPLANATION

B-1 Test Boring Location - "p" indicates installation of a monitor well

Keimig/Castaneda Property - Pierce County Parcel No. 728500-0112

Notes: 1) Aerial Photograph dated August 14, 2020 obtained from Google Earth.
2) LiDAR-based Digital Terrain Model (DTM) data (Pierce 2011 acquisition) obtained from the Washington State Department of Natural Resources, Washington LiDAR Portal (https://lidarportal.dnr.wa.gov/); processed by ICE for 1-foot topographic contour intervals using Environmental Systems Research Institute (Esri) ArcGIS 10.6.
3) Preliminary locations of parking pad and commercial building are based on our review of the ESM site plan (ESM, undated, *Jackson Castaneda & Samantha Keimig, 5th St CUP, Basemap*, scale 1 inch = 30 feet).
3) Parcel boundary obtained from Pierce County GIS data.

0 25 50

Approximate Scale in Feet

SITE PLAN

PROPOSED COMMERCIAL BUILDING
PIERCE COUNTY PARCEL NO. 728500-0112, PUYALLUP, WASHINGTON

ICICLECREEK ENGINEERS
29335 NE 20th Street
Carnation, Washington 98014
(425) 333-0093

SCALE: As Shown
DESIGNED: ---
DRAWN: SJM
CHECKED: BRB/KSK
DATE: 07/20/2022

ICE FILE NO.
1420-001

Figure
2

Unified Soil Classification System

MAJOR DIVISIONS			Soil Classification and Generalized Group Description	
Coarse-Grained Soils More than 50% retained on the No. 200 sieve	GRAVEL More than 50% of coarse fraction retained on the No. 4 sieve	CLEAN GRAVEL	GW	Well-graded gravels
			GP	Poorly-graded gravels
		GRAVEL WITH FINES	GM	Gravel and silt mixtures
			GC	Gravel and clay mixtures
	SAND More than 50% of coarse fraction passes the No. 4 sieve	CLEAN SAND	SW	Well-graded sand
			SP	Poorly-graded sand
		SAND WITH FINES	SM	Sand and silt mixtures
			SC	Sand and clay mixtures
Fine-Grained Soils More than 50% passing the No. 200 sieve	SILT AND CLAY Liquid Limit less than 50	INORGANIC	ML	Low-plasticity silts
			CL	Low-plasticity clays
		ORGANIC	OL	Low plasicity organic silts and organic clays
	SILT AND CLAY Liquid Limit greater than 50	INORGANIC	MH	High-plasticity silts
			CH	High-plasticity clays
		ORGANIC	OH	High-plasticity organic silts and organic clays
Highly Organic Soils	Primarily organic material with organic odor		PT	Peat

Notes: 1) Soil classification based on visual classification of soil is based on ASTM Test Method D 2488.
2) Soil classification using laboratory tests is based on ASTM Test Method D 2487.
3) Description of soil density or consistency is based on interpretation of blow count data and/or test data.

Soil Particle Size Definitions

Component	Size Range
Boulders	Coarser than 12 inch
Cobbles	3 inch to 12 inch
Gravel	3 inch to No. 4 (4.78 mm)
Coarse	3 inch to 3/4 inch
Fine	3/4 inch to No. 4 (4.78 mm)
Sand	No. 4 (4.78 mm) to No. 200 (0.074mm)
Coarse	No. 4 (4.78 mm) to No. 10 (2.0 mm)
Medium	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Finer than No. 200 (0.074 mm)

Soil Moisture Modifiers

Soil Moisture	Description
Dry	Absence of moisture
Moist	Damp, but no visible water
Wet	Visible water

Key to Boring Log Symbols

Sampling Method	Boring Log Symbol	Description
Blows required to drive a 2.4 inch I.D. split-barrel sampler 12-inches or other indicated distance using a 300-pound hammer falling 30 inches.	34	Location of relatively undisturbed sample
	12	Location of disturbed sample
	21	Location of sample attempt with no recovery
Blows required to drive a 1.5-inch I.D. split barrel sampler (SPT - Standard Penetration Test) 12-inches or other indicated distance using a 140-pound hammer falling 30 inches.	14	Location of sample obtained in general accordance with Standard Penetration Test (ASTM D-1586) test procedures.
	30	Location of SPT sampling attempt with no recovery.
Pushed Sampler	P	Sampler pushed with the weight of the hammer or against weight of the drilling rig.
Grab Sample	G	Sample obtained from drill cuttings.

Note: The lines separating soil types on the logs represents approximate boundaries only. The actual boundaries may vary or be gradual.

Laboratory Tests

Test	Symbol
Moisture Content	MC
Density	DN
Grain Size	GS
Percent Fines	PF
Atterberg Limits	AL
Hydrometer Analysis	HA
Consolidation	CN
Compaction	CP
Permeability	PM
Unconfined Compression	UC
Unconsolidated Undrained TX	UU
Consolidated Undrained TX	CU
Consolidated Drained TX	CD
Chemical Analysis	CA

EXPLANATION FOR BORING LOGS

PROPOSED COMMERCIAL BUILDING
PIERCE COUNTY PARCEL NO. 728500-0112, PUYALLUP, WASHINGTON

ICICLECREEK ENGINEERS
29335 NE 20th Street
Carnation, Washington 98014
(425) 333-0093

SCALE: None
DESIGNED: --
DRAWN: SJM
CHECKED: BRB/KSK
DATE: 07/20/2022

ICE FILE NO. 1420-001

Figure 3

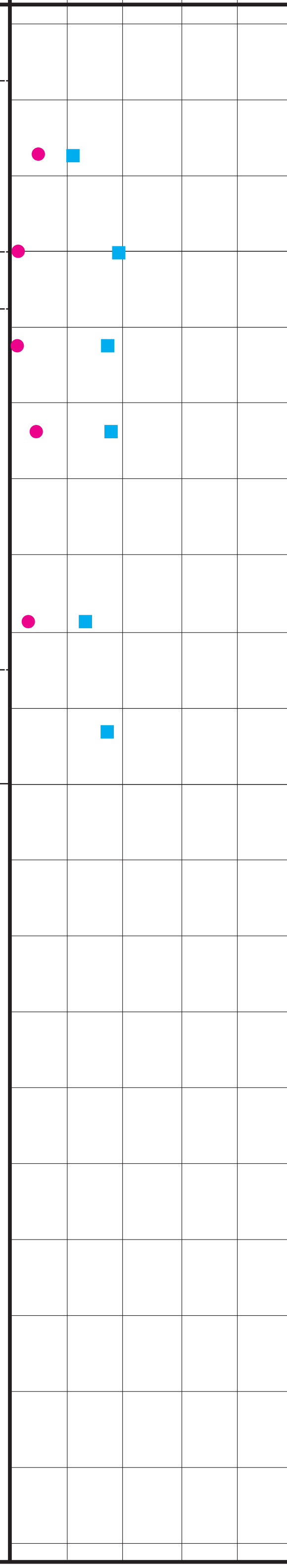
Boring B-1

Latitude 47.191302; Longitude -122.286816

Approximate Ground Surface Elevation: 50 feet

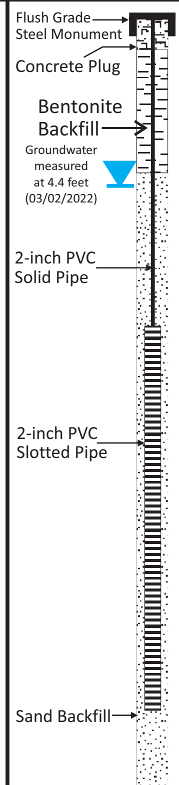
Depth in Feet	Description	Group Symbol	Blow Count	Laboratory Testing
0	Grayish-brown fine to coarse GRAVEL with silt and sand (loose, moist) (Fill)	GP-GM		
	Grayish-brown fine to medium SAND with silt (loose, moist) (Alluvium)	SP-SM	10	MC/ GSD
5	grades to wet at about 4.4 feet	SP-SM	2	MC
	Mottled gray and brown SILT (soft, moist) (Alluvium)	ML		
	Grayish-brown silty fine to medium SAND (very loose, wet) (Alluvium)	SM	2	MC
10	grades to loose at about 10 feet	SM	9	MC
15		SM	5	MC
	Grayish-brown SILT with sand (medium stiff, moist) (Alluvium)	ML		MC
20	Boring completed at about 20 feet on March 2, 2022.			

Penetration Resistance (Blows/foot - ●) 20 40 60 80
Moisture Content (Percent - ■) 20 40 60 80



Comments/ Groundwater Observations

Ecology Well Tag ID #BMS-984



See Figure 3 for explanation of symbols

SJM: 03/02/22

Logged by: SJM

Project Name: Proposed Commercial Building, Pierce County Parcel No. 728500-0112

ICE File No. 1420-001

Boring B-2

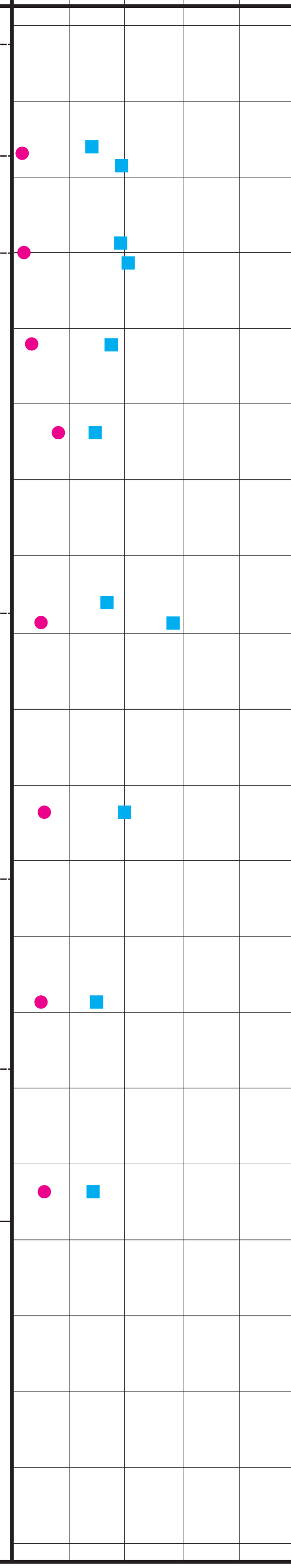
Latitude 47.191277; Longitude -122.286539

Approximate Ground Surface Elevation: 49.5 feet

Depth in Feet	Description	Group Symbol	Blow Count	Laboratory Testing	Comments/ Groundwater Observations
0	5/8-inch-minus crushed rock (loose, moist) (Fill)	GM			
	Dark brown silty fine to medium SAND with gravel (very loose, moist) (Alluvium)	SM	2	MC	
	Mottled gray and brown SILT with sand (soft, moist) (Alluvium)	ML		MC/ GSD	Groundwater measured at about 4.8 feet at the time of drilling
5		ML	3	MC/ GSD	
	Brown silty fine to medium SAND with occasional fine gravel (very loose, wet) grades to grayish-brown, loose at about 7.5 feet	SM		MC	
		SM	5	MC	
10	grades to medium dense at about 10 feet	SM	16	MC	Bentonite Backfill
15		SM			
	Grayish-brown SILT with sand (stiff, moist) (Alluvium)	ML	10	MC	
20	grades to gray, with wood and root fragments at about 20 feet	ML	12	MC	
	Gray fine to coarse SAND with silt (medium dense, wet) (Alluvium)				
25		SP-SM	10	MC	
	Gray silty fine to medium SAND (medium dense, wet) (Alluvium)				
30		SM	12	MC	
	Boring completed at about 31.5 feet on March 2, 2022.				
35					
40					

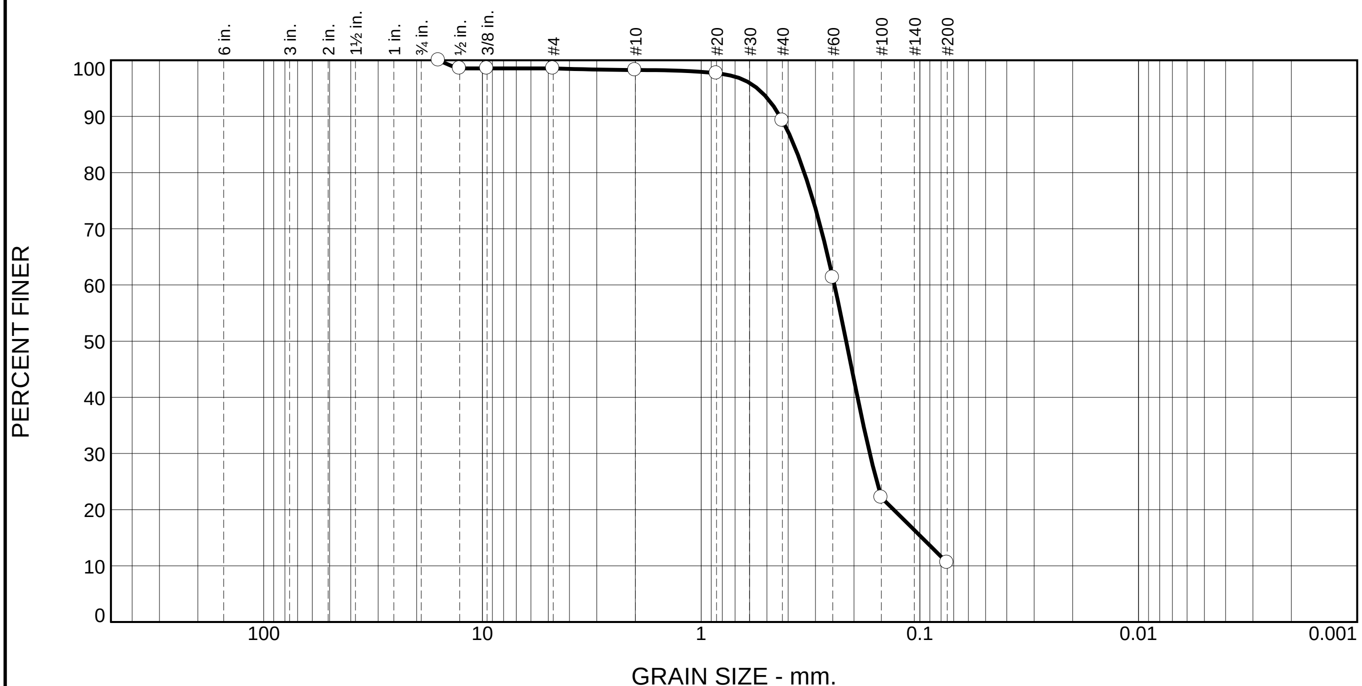
Penetration Resistance (Blows/foot - ●) 20 40 60 80

Moisture Content (Percent - ■) 20 40 60 80



See Figure 3 for explanation of symbols

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.4	0.3	9.0	78.7	10.6	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
5/8	100.0		
1/2	98.6		
3/8	98.6		
#4	98.6		
#10	98.3		
#20	97.7		
#40	89.3		
#60	61.3		
#100	22.2		
#200	10.6		

* (no specification provided)

Material Description

Grayish-brown fine to medium SAND with silt (Alluvium)

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 0.4354 D_{85}= 0.3769 D_{60}= 0.2458
D_{50}= 0.2172 D_{30}= 0.1693 D_{15}= 0.0977
D_{10}= C_u= C_c=

Remarks

MC = 21%

Date Received: 03/21/2022 **Date Tested:** 03/28/2022

Tested By: CEN

Checked By: SJM

Title: Project Engineer/Geologist

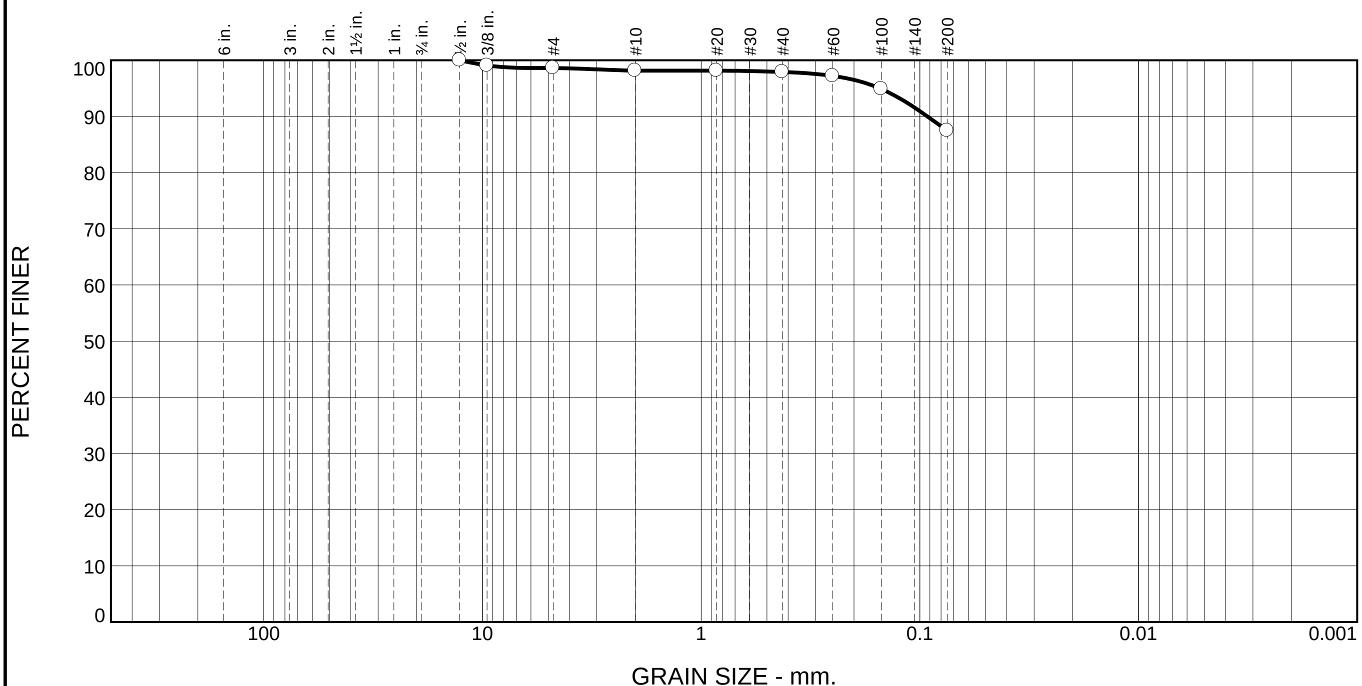
Source of Sample: Boring Data **Depth:** 3.5 feet **Date Sampled:** 03/02/2022
Sample Number: B-1, S-1

ICICLE CREEK ENGINEERS, INC.

Carnation, WA

Client: Samantha Keimig and Jackson Castaneda
Project: Proposed Commercial Building
Pierce County Parcel No. 728500-0112
Project No: 1420-001 **Figure** 6

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.4	0.5	0.2	10.4	87.5	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1/2	100.0		
3/8	99.1		
#4	98.6		
#10	98.1		
#20	98.1		
#40	97.9		
#60	97.2		
#100	94.9		
#200	87.5		

* (no specification provided)

Material Description

Mottled gray and brown SILT with sand (Alluvium)

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 0.0923 D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

MC = 39%

Date Received: 03/21/2022 **Date Tested:** 03/28/2022
Tested By: CEN
Checked By: SJM
Title: Project Engineer/Geologist

Source of Sample: Boring Data **Depth:** 4/5.5 feet **Date Sampled:** 03/02/2022
Sample Number: B-2,S-2/S-3

ICICLE CREEK ENGINEERS, INC.

Carnation, WA

Client: Samantha Keimig and Jackson Castaneda
Project: Proposed Commercial Building
Pierce County Parcel No. 728500-0112
Project No: 1420-001 **Figure** 7

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	default[50]
Site Name:	
Site Address:	
City:	
Report Date:	10/17/2024
Gage:	SPU 158 Year 5min
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2021/08/18
Version:	4.2.18

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year
Low Flow Threshold for POC2:	50 Percent of the 2 Year
High Flow Threshold for POC2:	50 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	0.077
Pervious Total	0.077
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.077

Element Flows To:

Surface	Interflow	Groundwater

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	0.152
Pervious Total	0.152
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.152

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.029
Pervious Total	0.029
Impervious Land Use	acre
ROADS FLAT	0.048
Impervious Total	0.048
Basin Total	0.077

Element Flows To:

Surface	Interflow	Groundwater

Basin 2

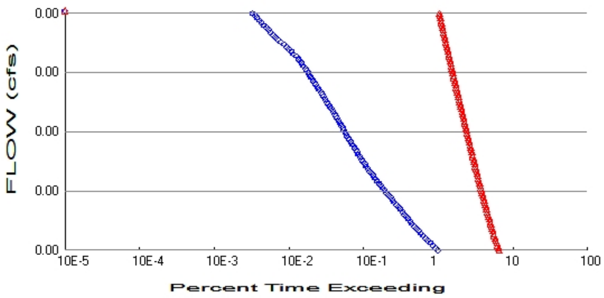
Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.041
Pervious Total	0.041
Impervious Land Use	acre
ROADS FLAT	0.111
Impervious Total	0.111
Basin Total	0.152

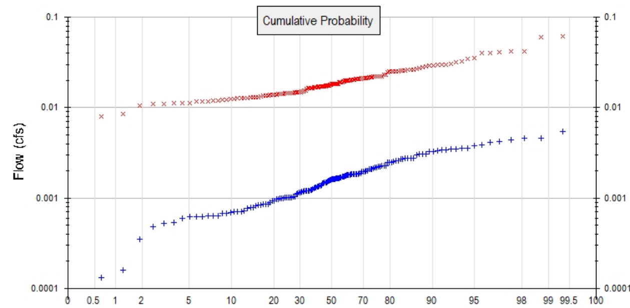
Element Flows To:

Surface	Interflow	Groundwater

Mitigated Routing

Analysis Results
POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.077
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.029
Total Impervious Area: 0.048

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.001623
5 year	0.002524
10 year	0.003014
25 year	0.003513
50 year	0.003809
100 year	0.004053

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.017984
5 year	0.024644
10 year	0.029562
25 year	0.03638
50 year	0.041915
100 year	0.047854

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1902	0.001	0.020
1903	0.001	0.022
1904	0.002	0.030
1905	0.001	0.012
1906	0.000	0.013
1907	0.002	0.019
1908	0.002	0.015
1909	0.002	0.017
1910	0.003	0.018
1911	0.002	0.020

1912	0.005	0.040
1913	0.003	0.013
1914	0.001	0.062
1915	0.001	0.012
1916	0.002	0.021
1917	0.001	0.008
1918	0.002	0.017
1919	0.001	0.011
1920	0.002	0.016
1921	0.002	0.013
1922	0.002	0.022
1923	0.001	0.014
1924	0.001	0.025
1925	0.001	0.011
1926	0.002	0.020
1927	0.001	0.016
1928	0.001	0.013
1929	0.003	0.026
1930	0.002	0.026
1931	0.002	0.013
1932	0.001	0.014
1933	0.001	0.014
1934	0.003	0.025
1935	0.002	0.011
1936	0.001	0.017
1937	0.002	0.023
1938	0.001	0.012
1939	0.000	0.015
1940	0.001	0.025
1941	0.001	0.025
1942	0.002	0.021
1943	0.001	0.020
1944	0.002	0.030
1945	0.002	0.021
1946	0.001	0.018
1947	0.001	0.013
1948	0.003	0.018
1949	0.003	0.026
1950	0.001	0.015
1951	0.001	0.022
1952	0.005	0.033
1953	0.004	0.029
1954	0.001	0.015
1955	0.001	0.013
1956	0.001	0.013
1957	0.002	0.014
1958	0.004	0.020
1959	0.003	0.020
1960	0.001	0.014
1961	0.003	0.042
1962	0.001	0.017
1963	0.001	0.012
1964	0.001	0.041
1965	0.003	0.018
1966	0.001	0.014
1967	0.001	0.022
1968	0.001	0.017
1969	0.001	0.015

1970	0.002	0.018
1971	0.003	0.018
1972	0.002	0.060
1973	0.003	0.030
1974	0.001	0.023
1975	0.003	0.029
1976	0.002	0.028
1977	0.001	0.011
1978	0.003	0.021
1979	0.001	0.020
1980	0.002	0.021
1981	0.002	0.017
1982	0.001	0.014
1983	0.003	0.021
1984	0.001	0.021
1985	0.002	0.025
1986	0.002	0.012
1987	0.003	0.019
1988	0.002	0.012
1989	0.002	0.011
1990	0.002	0.015
1991	0.002	0.022
1992	0.002	0.019
1993	0.002	0.022
1994	0.003	0.017
1995	0.001	0.012
1996	0.004	0.018
1997	0.001	0.015
1998	0.002	0.019
1999	0.000	0.018
2000	0.001	0.017
2001	0.001	0.013
2002	0.002	0.029
2003	0.002	0.015
2004	0.002	0.021
2005	0.003	0.040
2006	0.001	0.018
2007	0.001	0.022
2008	0.002	0.017
2009	0.001	0.013
2010	0.001	0.017
2011	0.001	0.017
2012	0.001	0.017
2013	0.001	0.017
2014	0.001	0.015
2015	0.001	0.030
2016	0.001	0.015
2017	0.003	0.026
2018	0.005	0.018
2019	0.004	0.027
2020	0.001	0.020
2021	0.002	0.017
2022	0.001	0.027
2023	0.002	0.032
2024	0.004	0.042
2025	0.002	0.017
2026	0.003	0.018
2027	0.001	0.020

2028	0.001	0.008
2029	0.002	0.014
2030	0.003	0.026
2031	0.001	0.009
2032	0.001	0.014
2033	0.001	0.017
2034	0.001	0.014
2035	0.004	0.020
2036	0.002	0.014
2037	0.000	0.018
2038	0.002	0.020
2039	0.000	0.035
2040	0.001	0.014
2041	0.001	0.018
2042	0.004	0.021
2043	0.002	0.022
2044	0.002	0.016
2045	0.002	0.013
2046	0.002	0.015
2047	0.001	0.017
2048	0.002	0.014
2049	0.002	0.021
2050	0.001	0.017
2051	0.002	0.025
2052	0.001	0.017
2053	0.002	0.014
2054	0.002	0.035
2055	0.001	0.017
2056	0.001	0.022
2057	0.001	0.011
2058	0.002	0.021
2059	0.003	0.026

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0054	0.0621
2	0.0046	0.0598
3	0.0045	0.0423
4	0.0044	0.0421
5	0.0042	0.0407
6	0.0041	0.0405
7	0.0039	0.0401
8	0.0038	0.0351
9	0.0036	0.0345
10	0.0036	0.0328
11	0.0035	0.0318
12	0.0035	0.0304
13	0.0034	0.0301
14	0.0034	0.0300
15	0.0033	0.0300
16	0.0033	0.0291
17	0.0033	0.0291
18	0.0031	0.0286
19	0.0031	0.0281
20	0.0031	0.0272
21	0.0030	0.0267
22	0.0027	0.0264

23	0.0027	0.0262
24	0.0027	0.0262
25	0.0027	0.0259
26	0.0027	0.0256
27	0.0027	0.0255
28	0.0026	0.0255
29	0.0026	0.0253
30	0.0025	0.0252
31	0.0025	0.0250
32	0.0025	0.0250
33	0.0025	0.0247
34	0.0023	0.0233
35	0.0023	0.0233
36	0.0023	0.0224
37	0.0022	0.0223
38	0.0022	0.0223
39	0.0022	0.0222
40	0.0022	0.0222
41	0.0021	0.0220
42	0.0021	0.0219
43	0.0021	0.0219
44	0.0021	0.0215
45	0.0020	0.0214
46	0.0020	0.0213
47	0.0020	0.0212
48	0.0020	0.0211
49	0.0020	0.0210
50	0.0019	0.0209
51	0.0019	0.0207
52	0.0019	0.0207
53	0.0019	0.0207
54	0.0018	0.0206
55	0.0018	0.0206
56	0.0018	0.0204
57	0.0018	0.0203
58	0.0018	0.0203
59	0.0018	0.0200
60	0.0018	0.0200
61	0.0018	0.0200
62	0.0018	0.0200
63	0.0018	0.0199
64	0.0017	0.0198
65	0.0017	0.0196
66	0.0017	0.0195
67	0.0017	0.0193
68	0.0017	0.0192
69	0.0017	0.0191
70	0.0017	0.0189
71	0.0017	0.0184
72	0.0017	0.0184
73	0.0017	0.0184
74	0.0016	0.0184
75	0.0016	0.0184
76	0.0016	0.0183
77	0.0016	0.0182
78	0.0016	0.0182
79	0.0016	0.0181
80	0.0016	0.0178

81	0.0016	0.0178
82	0.0016	0.0176
83	0.0016	0.0176
84	0.0015	0.0175
85	0.0015	0.0175
86	0.0015	0.0174
87	0.0015	0.0173
88	0.0015	0.0173
89	0.0015	0.0172
90	0.0014	0.0172
91	0.0014	0.0171
92	0.0014	0.0171
93	0.0014	0.0171
94	0.0013	0.0170
95	0.0013	0.0170
96	0.0013	0.0170
97	0.0013	0.0169
98	0.0013	0.0168
99	0.0013	0.0168
100	0.0013	0.0166
101	0.0012	0.0166
102	0.0012	0.0165
103	0.0012	0.0165
104	0.0012	0.0164
105	0.0012	0.0161
106	0.0012	0.0156
107	0.0012	0.0154
108	0.0012	0.0152
109	0.0012	0.0150
110	0.0012	0.0148
111	0.0011	0.0147
112	0.0011	0.0147
113	0.0011	0.0147
114	0.0010	0.0146
115	0.0010	0.0146
116	0.0010	0.0146
117	0.0010	0.0145
118	0.0010	0.0145
119	0.0010	0.0144
120	0.0010	0.0144
121	0.0010	0.0142
122	0.0010	0.0142
123	0.0010	0.0141
124	0.0010	0.0140
125	0.0010	0.0140
126	0.0009	0.0139
127	0.0009	0.0139
128	0.0009	0.0138
129	0.0009	0.0137
130	0.0008	0.0137
131	0.0008	0.0137
132	0.0008	0.0133
133	0.0008	0.0132
134	0.0008	0.0132
135	0.0008	0.0130
136	0.0008	0.0129
137	0.0008	0.0128
138	0.0007	0.0128

139	0.0007	0.0128
140	0.0007	0.0126
141	0.0007	0.0126
142	0.0007	0.0126
143	0.0007	0.0124
144	0.0007	0.0122
145	0.0006	0.0120
146	0.0006	0.0120
147	0.0006	0.0117
148	0.0006	0.0117
149	0.0006	0.0117
150	0.0006	0.0112
151	0.0006	0.0112
152	0.0005	0.0112
153	0.0005	0.0110
154	0.0005	0.0109
155	0.0003	0.0106
156	0.0002	0.0086
157	0.0001	0.0080
158	0.0001	0.0079

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0008	54337	362930	667	Fail
0.0008	50243	353622	703	Fail
0.0009	46542	344370	739	Fail
0.0009	43318	336060	775	Fail
0.0009	40298	327972	813	Fail
0.0010	37517	320271	853	Fail
0.0010	34902	312626	895	Fail
0.0010	32581	305479	937	Fail
0.0011	30354	298609	983	Fail
0.0011	28254	291851	1032	Fail
0.0011	26432	285535	1080	Fail
0.0011	24803	279330	1126	Fail
0.0012	23318	273513	1172	Fail
0.0012	21922	267474	1220	Fail
0.0012	20642	261879	1268	Fail
0.0013	19440	256450	1319	Fail
0.0013	18304	251242	1372	Fail
0.0013	17219	246034	1428	Fail
0.0014	16166	241104	1491	Fail
0.0014	15158	236284	1558	Fail
0.0014	14266	231519	1622	Fail
0.0014	13451	227087	1688	Fail
0.0015	12676	222766	1757	Fail
0.0015	11950	218445	1827	Fail
0.0015	11235	214068	1905	Fail
0.0016	10570	209968	1986	Fail
0.0016	9983	205924	2062	Fail
0.0016	9374	201935	2154	Fail
0.0017	8847	198113	2239	Fail
0.0017	8332	194456	2333	Fail
0.0017	7867	190855	2426	Fail
0.0018	7457	187199	2510	Fail
0.0018	7030	183764	2613	Fail
0.0018	6620	180440	2725	Fail
0.0018	6277	177171	2822	Fail
0.0019	5978	173958	2909	Fail
0.0019	5706	170800	2993	Fail
0.0019	5445	167642	3078	Fail
0.0020	5197	164595	3167	Fail
0.0020	4943	161604	3269	Fail
0.0020	4706	158723	3372	Fail
0.0021	4515	155842	3451	Fail
0.0021	4335	152961	3528	Fail
0.0021	4159	150302	3613	Fail
0.0021	3958	147587	3728	Fail
0.0022	3763	144817	3848	Fail
0.0022	3581	142269	3972	Fail
0.0022	3416	139831	4093	Fail
0.0023	3267	137283	4202	Fail
0.0023	3134	134790	4300	Fail
0.0023	3027	132463	4376	Fail
0.0024	2929	130136	4443	Fail
0.0024	2815	127920	4544	Fail
0.0024	2682	125649	4684	Fail

0.0024	2556	123433	4829	Fail
0.0025	2454	121327	4944	Fail
0.0025	2359	119222	5053	Fail
0.0025	2256	117117	5191	Fail
0.0026	2143	115178	5374	Fail
0.0026	2041	113128	5542	Fail
0.0026	1952	111134	5693	Fail
0.0027	1861	109195	5867	Fail
0.0027	1779	107366	6035	Fail
0.0027	1688	105483	6248	Fail
0.0027	1619	103655	6402	Fail
0.0028	1561	101937	6530	Fail
0.0028	1483	100164	6754	Fail
0.0028	1407	98336	6989	Fail
0.0029	1340	96674	7214	Fail
0.0029	1271	95067	7479	Fail
0.0029	1219	93516	7671	Fail
0.0030	1163	91910	7902	Fail
0.0030	1103	90358	8192	Fail
0.0030	1057	88863	8407	Fail
0.0031	1006	87201	8668	Fail
0.0031	964	85705	8890	Fail
0.0031	920	84320	9165	Fail
0.0031	873	82935	9500	Fail
0.0032	815	81550	10006	Fail
0.0032	774	80165	10357	Fail
0.0032	738	78724	10667	Fail
0.0033	694	77339	11143	Fail
0.0033	637	76120	11949	Fail
0.0033	601	74846	12453	Fail
0.0034	556	73627	13242	Fail
0.0034	517	72353	13994	Fail
0.0034	478	71134	14881	Fail
0.0034	434	69916	16109	Fail
0.0035	394	68752	17449	Fail
0.0035	363	67589	18619	Fail
0.0035	339	66370	19578	Fail
0.0036	310	65317	21070	Fail
0.0036	295	64209	21765	Fail
0.0036	273	63157	23134	Fail
0.0037	252	62104	24644	Fail
0.0037	237	61107	25783	Fail
0.0037	223	60110	26955	Fail
0.0037	206	59168	28722	Fail
0.0038	195	58226	29859	Fail
0.0038	180	57229	31793	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

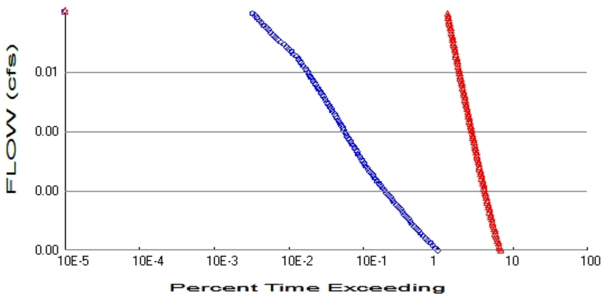
Water Quality BMP Flow and Volume for POC #1

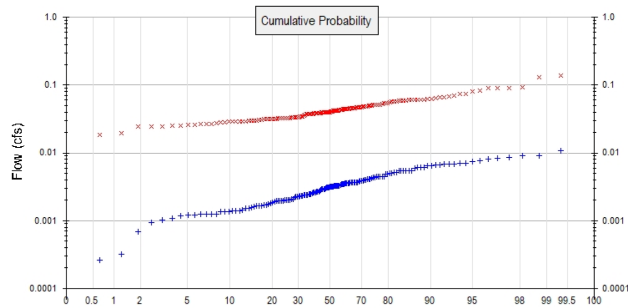
On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

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
Total Volume Infiltrated		0.00	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 = Failed

POC 2





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 0.152
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2
Total Pervious Area: 0.041
Total Impervious Area: 0.111

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	Flow(cfs)
2 year	0.003203
5 year	0.004983
10 year	0.00595
25 year	0.006935
50 year	0.00752
100 year	0.008001

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	Flow(cfs)
2 year	0.04054
5 year	0.055076
10 year	0.065739
25 year	0.080442
50 year	0.092321
100 year	0.10502

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	Predeveloped	Mitigated
1902	0.002	0.046
1903	0.002	0.051
1904	0.003	0.065
1905	0.002	0.027
1906	0.001	0.029
1907	0.005	0.042
1908	0.004	0.033
1909	0.004	0.039
1910	0.005	0.040
1911	0.003	0.045
1912	0.011	0.084

1913	0.005	0.031
1914	0.001	0.137
1915	0.002	0.027
1916	0.003	0.049
1917	0.001	0.019
1918	0.003	0.039
1919	0.003	0.025
1920	0.003	0.034
1921	0.004	0.029
1922	0.004	0.048
1923	0.003	0.032
1924	0.001	0.057
1925	0.002	0.025
1926	0.003	0.046
1927	0.002	0.038
1928	0.002	0.029
1929	0.005	0.059
1930	0.003	0.059
1931	0.003	0.029
1932	0.002	0.032
1933	0.002	0.031
1934	0.007	0.055
1935	0.003	0.026
1936	0.003	0.038
1937	0.004	0.054
1938	0.003	0.027
1939	0.000	0.033
1940	0.003	0.059
1941	0.001	0.058
1942	0.004	0.047
1943	0.002	0.045
1944	0.004	0.067
1945	0.004	0.048
1946	0.002	0.039
1947	0.001	0.029
1948	0.007	0.040
1949	0.006	0.060
1950	0.002	0.034
1951	0.002	0.052
1952	0.009	0.069
1953	0.008	0.062
1954	0.003	0.033
1955	0.002	0.029
1956	0.001	0.029
1957	0.004	0.032
1958	0.009	0.043
1959	0.005	0.043
1960	0.001	0.031
1961	0.005	0.094
1962	0.003	0.039
1963	0.001	0.028
1964	0.002	0.089
1965	0.006	0.039
1966	0.002	0.032
1967	0.003	0.047
1968	0.003	0.038
1969	0.003	0.034
1970	0.004	0.040

1971	0.007	0.040
1972	0.004	0.131
1973	0.005	0.069
1974	0.003	0.052
1975	0.007	0.061
1976	0.004	0.061
1977	0.001	0.024
1978	0.006	0.045
1979	0.002	0.044
1980	0.003	0.045
1981	0.003	0.040
1982	0.001	0.033
1983	0.005	0.046
1984	0.002	0.046
1985	0.004	0.054
1986	0.003	0.026
1987	0.006	0.043
1988	0.004	0.027
1989	0.003	0.025
1990	0.004	0.033
1991	0.003	0.050
1992	0.004	0.044
1993	0.004	0.051
1994	0.006	0.038
1995	0.001	0.028
1996	0.007	0.039
1997	0.003	0.034
1998	0.003	0.042
1999	0.000	0.042
2000	0.002	0.038
2001	0.001	0.030
2002	0.004	0.062
2003	0.004	0.033
2004	0.004	0.048
2005	0.007	0.092
2006	0.002	0.042
2007	0.002	0.049
2008	0.003	0.040
2009	0.002	0.030
2010	0.002	0.039
2011	0.002	0.040
2012	0.002	0.039
2013	0.002	0.038
2014	0.001	0.034
2015	0.003	0.065
2016	0.001	0.036
2017	0.005	0.058
2018	0.009	0.039
2019	0.008	0.058
2020	0.003	0.045
2021	0.004	0.037
2022	0.002	0.061
2023	0.004	0.073
2024	0.007	0.090
2025	0.003	0.038
2026	0.005	0.042
2027	0.002	0.047
2028	0.002	0.018

2029	0.004	0.032
2030	0.007	0.060
2031	0.002	0.019
2032	0.001	0.032
2033	0.002	0.040
2034	0.002	0.032
2035	0.008	0.043
2036	0.004	0.032
2037	0.001	0.042
2038	0.003	0.044
2039	0.000	0.081
2040	0.002	0.033
2041	0.002	0.042
2042	0.007	0.046
2043	0.004	0.051
2044	0.005	0.036
2045	0.003	0.030
2046	0.004	0.033
2047	0.003	0.039
2048	0.004	0.032
2049	0.003	0.048
2050	0.002	0.038
2051	0.003	0.055
2052	0.002	0.038
2053	0.004	0.033
2054	0.004	0.074
2055	0.001	0.040
2056	0.002	0.051
2057	0.002	0.025
2058	0.003	0.048
2059	0.005	0.060

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	**Predeveloped**	**Mitigated**
1	0.0107	0.1375
2	0.0090	0.1309
3	0.0090	0.0939
4	0.0087	0.0915
5	0.0084	0.0896
6	0.0081	0.0893
7	0.0076	0.0839
8	0.0074	0.0810
9	0.0070	0.0739
10	0.0070	0.0735
11	0.0069	0.0693
12	0.0068	0.0687
13	0.0068	0.0666
14	0.0067	0.0652
15	0.0066	0.0648
16	0.0065	0.0620
17	0.0064	0.0619
18	0.0061	0.0612
19	0.0061	0.0609
20	0.0060	0.0606
21	0.0059	0.0605
22	0.0054	0.0605
23	0.0054	0.0598

24	0.0054	0.0589
25	0.0054	0.0587
26	0.0054	0.0587
27	0.0054	0.0583
28	0.0051	0.0581
29	0.0051	0.0578
30	0.0050	0.0569
31	0.0049	0.0553
32	0.0049	0.0546
33	0.0048	0.0542
34	0.0045	0.0539
35	0.0045	0.0524
36	0.0044	0.0516
37	0.0044	0.0513
38	0.0044	0.0513
39	0.0043	0.0512
40	0.0043	0.0509
41	0.0042	0.0498
42	0.0042	0.0493
43	0.0041	0.0492
44	0.0041	0.0481
45	0.0040	0.0480
46	0.0039	0.0478
47	0.0039	0.0478
48	0.0039	0.0476
49	0.0039	0.0472
50	0.0037	0.0472
51	0.0037	0.0469
52	0.0037	0.0464
53	0.0037	0.0462
54	0.0037	0.0461
55	0.0036	0.0460
56	0.0036	0.0458
57	0.0036	0.0455
58	0.0036	0.0449
59	0.0036	0.0448
60	0.0036	0.0447
61	0.0036	0.0447
62	0.0035	0.0445
63	0.0035	0.0444
64	0.0034	0.0439
65	0.0034	0.0435
66	0.0034	0.0434
67	0.0034	0.0432
68	0.0033	0.0429
69	0.0033	0.0424
70	0.0033	0.0423
71	0.0033	0.0423
72	0.0033	0.0422
73	0.0033	0.0419
74	0.0032	0.0417
75	0.0032	0.0417
76	0.0032	0.0404
77	0.0032	0.0403
78	0.0032	0.0403
79	0.0032	0.0400
80	0.0031	0.0399
81	0.0031	0.0398

82	0.0031	0.0398
83	0.0031	0.0398
84	0.0030	0.0395
85	0.0029	0.0393
86	0.0029	0.0393
87	0.0029	0.0393
88	0.0029	0.0391
89	0.0029	0.0391
90	0.0028	0.0391
91	0.0027	0.0390
92	0.0027	0.0390
93	0.0027	0.0390
94	0.0026	0.0386
95	0.0026	0.0385
96	0.0026	0.0382
97	0.0026	0.0382
98	0.0026	0.0379
99	0.0025	0.0378
100	0.0025	0.0377
101	0.0024	0.0376
102	0.0024	0.0376
103	0.0024	0.0375
104	0.0024	0.0370
105	0.0024	0.0364
106	0.0024	0.0356
107	0.0023	0.0344
108	0.0023	0.0343
109	0.0023	0.0341
110	0.0023	0.0339
111	0.0023	0.0338
112	0.0022	0.0335
113	0.0022	0.0332
114	0.0021	0.0331
115	0.0021	0.0330
116	0.0020	0.0329
117	0.0020	0.0327
118	0.0020	0.0327
119	0.0020	0.0326
120	0.0020	0.0326
121	0.0020	0.0323
122	0.0020	0.0322
123	0.0020	0.0321
124	0.0019	0.0320
125	0.0019	0.0318
126	0.0018	0.0317
127	0.0018	0.0316
128	0.0018	0.0316
129	0.0017	0.0316
130	0.0017	0.0314
131	0.0017	0.0309
132	0.0017	0.0306
133	0.0017	0.0297
134	0.0016	0.0296
135	0.0016	0.0296
136	0.0015	0.0295
137	0.0015	0.0292
138	0.0014	0.0292
139	0.0014	0.0292

140	0.0014	0.0291
141	0.0014	0.0290
142	0.0014	0.0288
143	0.0013	0.0283
144	0.0013	0.0280
145	0.0013	0.0272
146	0.0013	0.0268
147	0.0012	0.0268
148	0.0012	0.0266
149	0.0012	0.0262
150	0.0012	0.0259
151	0.0012	0.0253
152	0.0011	0.0251
153	0.0010	0.0246
154	0.0009	0.0246
155	0.0007	0.0242
156	0.0003	0.0195
157	0.0003	0.0185
158	0.0002	0.0183

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0016	54326	376835	693	Fail
0.0017	50171	368193	733	Fail
0.0017	46570	359883	772	Fail
0.0018	43357	352126	812	Fail
0.0018	40287	344537	855	Fail
0.0019	37462	337224	900	Fail
0.0020	34919	330299	945	Fail
0.0020	32598	323595	992	Fail
0.0021	30343	317113	1045	Fail
0.0021	28276	310853	1099	Fail
0.0022	26432	304870	1153	Fail
0.0023	24786	298942	1206	Fail
0.0023	23307	293402	1258	Fail
0.0024	21933	287751	1311	Fail
0.0024	20637	282488	1368	Fail
0.0025	19418	277225	1427	Fail
0.0026	18282	272239	1489	Fail
0.0026	17230	267308	1551	Fail
0.0027	16160	262488	1624	Fail
0.0027	15147	257835	1702	Fail
0.0028	14266	253292	1775	Fail
0.0029	13451	248915	1850	Fail
0.0029	12670	244538	1930	Fail
0.0030	11939	240217	2012	Fail
0.0030	11235	236173	2102	Fail
0.0031	10559	232129	2198	Fail
0.0032	9978	228306	2288	Fail
0.0032	9374	224483	2394	Fail
0.0033	8847	220661	2494	Fail
0.0033	8332	217060	2605	Fail
0.0034	7861	213625	2717	Fail
0.0035	7462	210024	2814	Fail
0.0035	7030	206534	2937	Fail
0.0036	6609	203210	3074	Fail
0.0036	6271	199830	3186	Fail
0.0037	5978	196561	3288	Fail
0.0038	5701	193404	3392	Fail
0.0038	5437	190357	3501	Fail
0.0039	5197	187254	3603	Fail
0.0039	4939	184263	3730	Fail
0.0040	4706	181382	3854	Fail
0.0041	4513	178556	3956	Fail
0.0041	4334	175842	4057	Fail
0.0042	4153	173016	4166	Fail
0.0042	3958	170357	4304	Fail
0.0043	3766	167642	4451	Fail
0.0044	3577	165039	4613	Fail
0.0044	3411	162379	4760	Fail
0.0045	3259	159831	4904	Fail
0.0045	3134	157393	5022	Fail
0.0046	3027	154956	5119	Fail
0.0047	2926	152573	5214	Fail
0.0047	2813	150136	5337	Fail
0.0048	2682	147809	5511	Fail

0.0048	2555	145537	5696	Fail
0.0049	2451	143321	5847	Fail
0.0049	2358	141105	5984	Fail
0.0050	2255	138945	6161	Fail
0.0051	2142	136840	6388	Fail
0.0051	2038	134734	6611	Fail
0.0052	1952	132685	6797	Fail
0.0052	1859	130579	7024	Fail
0.0053	1777	128585	7236	Fail
0.0054	1690	126646	7493	Fail
0.0054	1619	124762	7706	Fail
0.0055	1561	122823	7868	Fail
0.0055	1482	120940	8160	Fail
0.0056	1407	119167	8469	Fail
0.0057	1338	117339	8769	Fail
0.0057	1270	115621	9104	Fail
0.0058	1217	113904	9359	Fail
0.0058	1161	112186	9662	Fail
0.0059	1103	110469	10015	Fail
0.0060	1055	108807	10313	Fail
0.0060	1005	107256	10672	Fail
0.0061	963	105704	10976	Fail
0.0061	919	104042	11321	Fail
0.0062	872	102547	11759	Fail
0.0063	814	100995	12407	Fail
0.0063	772	99444	12881	Fail
0.0064	737	98004	13297	Fail
0.0064	694	96563	13913	Fail
0.0065	636	95067	14947	Fail
0.0066	601	93627	15578	Fail
0.0066	553	92242	16680	Fail
0.0067	516	90857	17607	Fail
0.0067	478	89527	18729	Fail
0.0068	433	88253	20381	Fail
0.0069	394	86979	22075	Fail
0.0069	363	85705	23610	Fail
0.0070	339	84375	24889	Fail
0.0070	310	83156	26824	Fail
0.0071	295	81938	27775	Fail
0.0072	273	80719	29567	Fail
0.0072	252	79500	31547	Fail
0.0073	237	78337	33053	Fail
0.0073	223	77118	34582	Fail
0.0074	206	76010	36898	Fail
0.0075	194	74902	38609	Fail
0.0075	179	73849	41256	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #2

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
Total Volume Infiltrated		0.00	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 = Failed

Model Default Modifications

Total of 0 changes have been made.

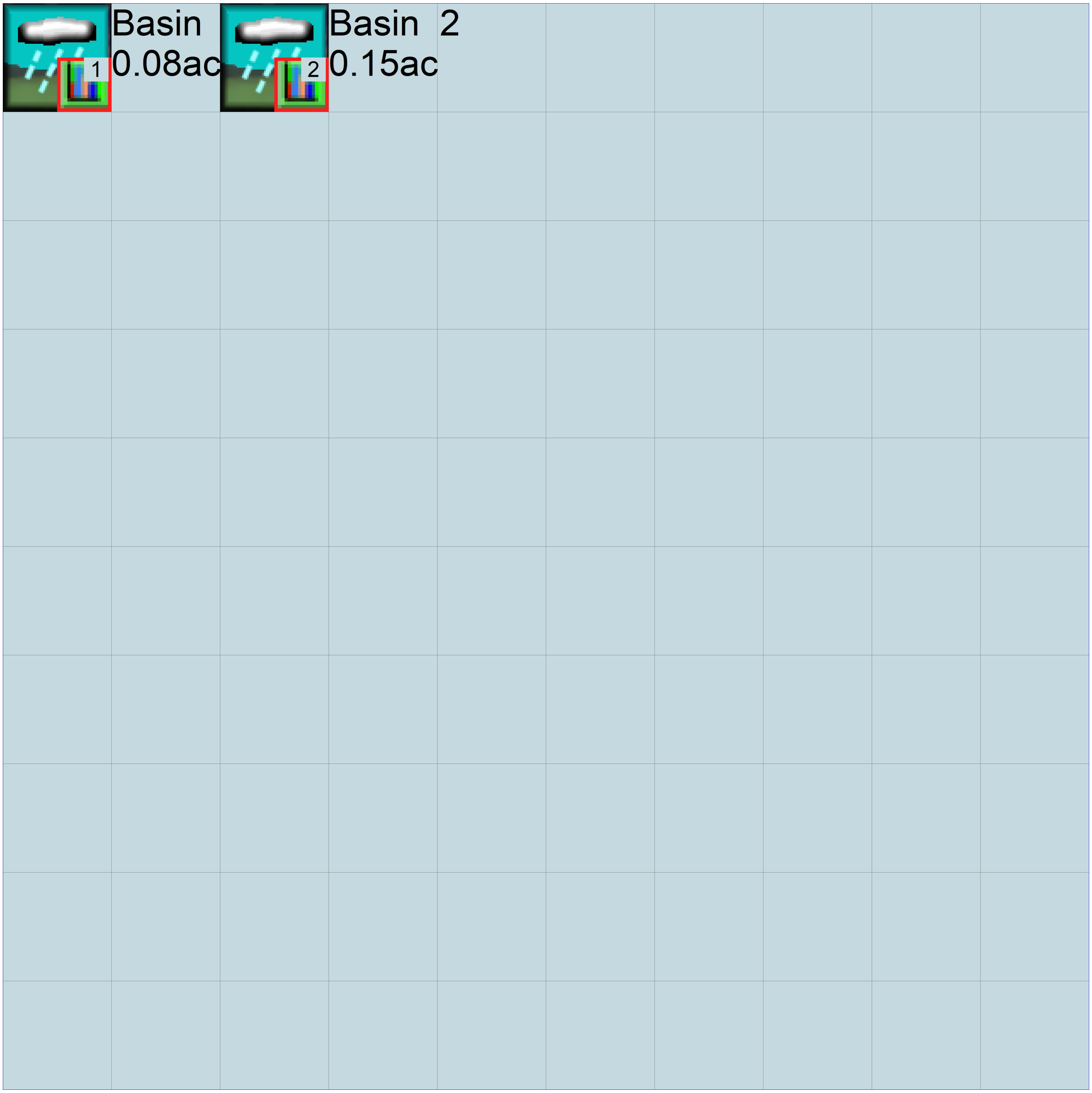
PERLND Changes

No PERLND changes have been made.

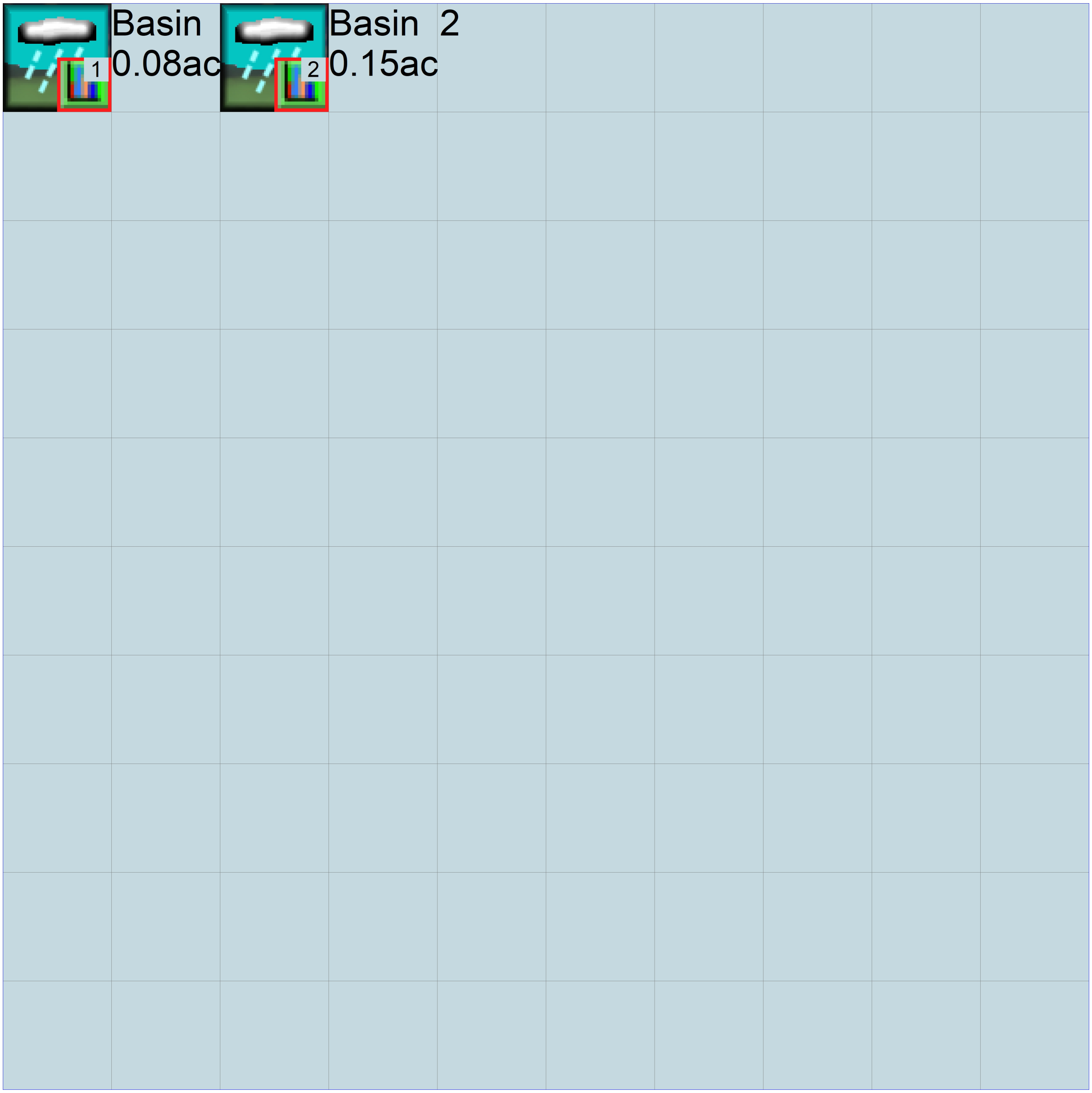
IMPLND Changes

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   default[50].wdm
MESSU      25   Predefault[50].MES
           27   Predefault[50].L61
           28   Predefault[50].L62
           30   POCdefault[50]1.dat
           31   POCdefault[50]2.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      10
      COPY       501
      COPY       502
      DISPLY       1
      DISPLY       2
    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
    2        Basin  2                    MAX                     1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1        1    1
  501        1    1
  502        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           ***
   10     C, Forest, Flat         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 ***
   10         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  *********
   10         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 ***
   10         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
   10              0       4.5      0.08       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   10              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                   ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   10            0.2       0.5      0.35         6       0.5       0.7
  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
   10              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  10                       0.077     COPY   501     12
PERLND  10                       0.077     COPY   501     13
Basin  2***
PERLND  10                       0.152     COPY   502     12
PERLND  10                       0.152     COPY   502     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
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     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
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    502 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   default[50].wdm
MESSU      25   Mitdefault[50].MES
           27   Mitdefault[50].L61
           28   Mitdefault[50].L62
           30   POCdefault[50]1.dat
           31   POCdefault[50]2.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND       1
      COPY       501
      COPY       502
      DISPLY       1
      DISPLY       2
    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
    2        Basin  2                    MAX                      1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  502         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           ***
   16     C, Lawn, Flat           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 ***
   16         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  *********
   16         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 ***
   16         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
   16              0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                 ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   16            0.1      0.25      0.25         6       0.5      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
   16              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           ***
    1      ROADS/FLAT            1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

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

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

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
  END IWAT-PARM2
```

```
  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1           0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1           0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  16                       0.029     COPY   501     12
PERLND  16                       0.029     COPY   501     13
IMPLND   1                       0.048     COPY   501     15
Basin  2***
PERLND  16                       0.041     COPY   502     12
PERLND  16                       0.041     COPY   502     13
IMPLND   1                       0.111     COPY   502     15

******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
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     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     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
COPY     2 OUTPUT MEAN   1 1     48.4      WDM    702 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    802 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

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


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

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