Stormwater Management Report

December 31, 2023

King Short Plat

Prepared for:

Jon King
6705 67th Drive NE
Marysville, WA 98270

Prepared by:

12/31/2023

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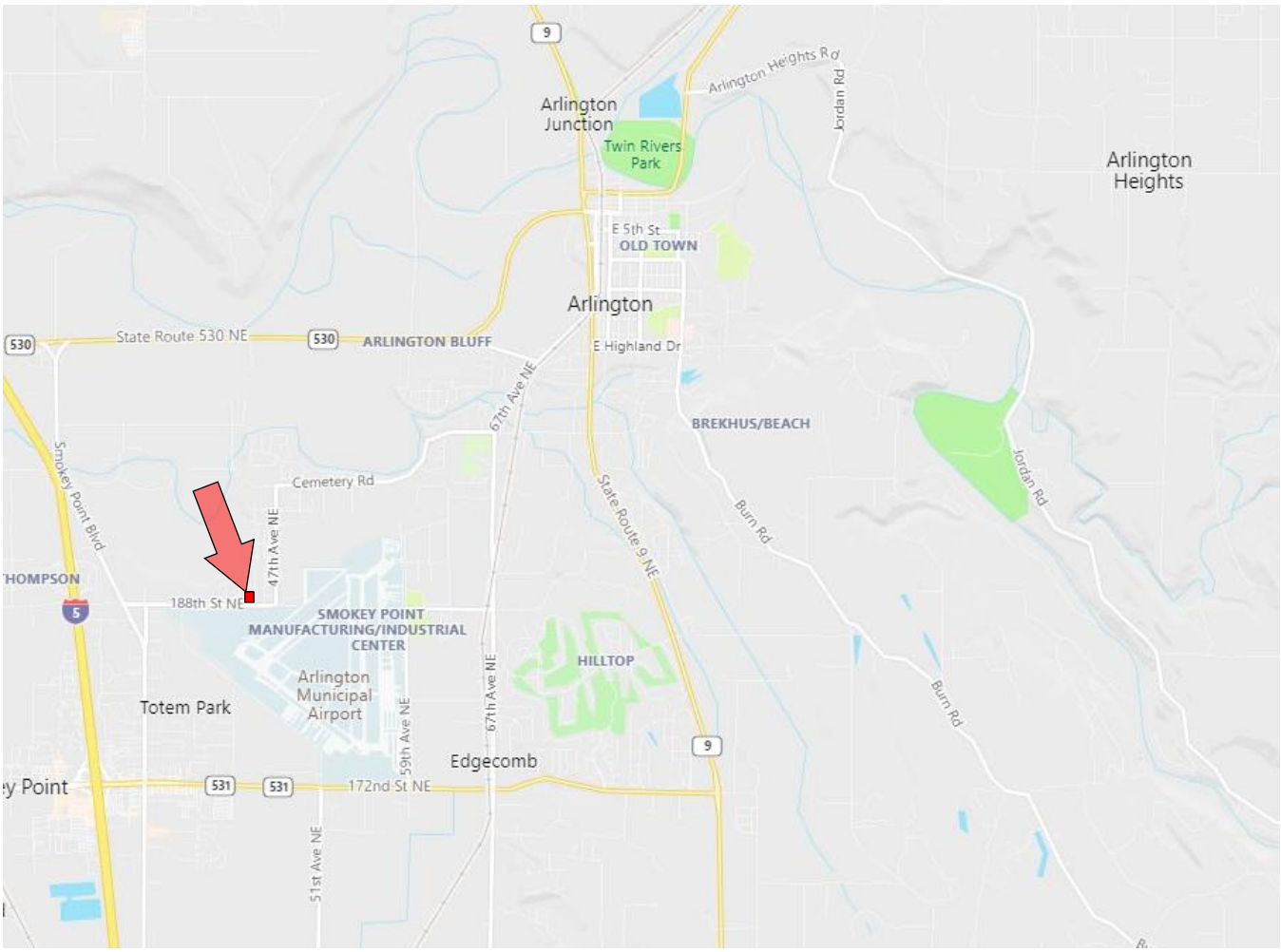
Project Overview

Site Location

The project is located near the intersection of 43rd Dr NE and 188th St NE, on a 1.00-acre site, at 4405 188th St NE, Arlington WA 98223.



Code Compliance

The project will comply with:

- [WSDOT] STANDARD SPECIFICATIONS for ROAD, BRIDGE and MUNICIPAL CONSTRUCTION, WSDOT, 2018 Edition with amendments
- [ADCS] Arlington Design and Construction Standards, dated July 2008
- [AMC] Arlington Municipal Code
- [SWMMWW] 2019 Stormwater Management Manual for Western Washington

Executive Summary

The project will include a 3-lot subdivision for one single-family residence (SFR) lot and two duplex lots. The short plat will include the dedication of right-of-way (ROW) for a public road, and the creation of recreational open space. Stormwater mitigation will be addressed via catch basins, piping, and infiltration systems. For the clearing and grading permit, only the stormwater systems mitigating runoff from the ROW improvements and public road will be installed. The stormwater systems for structures will be installed at the time of building construction. All stormwater runoff will be 100% infiltrated.

Existing Conditions

The site is vegetated with grasses and several variable diameter trees. The site is mostly level to slightly sloping with an overall gradient downward to the north. Total relief across the property is less than three feet and slope magnitudes of generally less than 5 percent. The site currently holds an SFR built in 1928 and several outbuildings. These existing buildings will be demolished, and any septic or well water facilities will be decommissioned. The site is bordered to the east, west, and north by residential properties, and to the south by 188th St NE.

Soils

Geotest Services, Inc. performed a geotechnical exploration of the site on 5/09/23 and completed their report on 6/22/23. Their exploration consisted of 4 exploration pits, going 7.5 to 9.9 ft below existing surface at that time. Existing soils consisted of 0.9-1.0ft of topsoil, underlain by gravelly sand to 2.0 ft, and Marysville Sand outwash soil below that. The groundwater table was not encountered and a well log from a nearby property indicates that groundwater is approximately 40 feet below grade. Grain size analysis of the Marysville Sand was performed on 5 soil samples, giving a design infiltration rate of 10 in/hr. Refer to soils report in Appendix B for additional information.

Proposed Conditions

The project will include a 3-lot subdivision for one single-family residence (SFR) lot and two duplex lots. The short plat will include the dedication of right-of-way (ROW) for a public road, and the creation of recreational open space. Stormwater mitigation will be addressed via catch basins, piping, and infiltration systems.

A single stormwater model was created, and the size of each facility was prorated based on this single model. A summary of the facility prorations and map of corresponding drainage basins is included for reference. The maximum impervious area allowed under AMC was assumed for each lot.

The proposed project will have a public road along the western edge of the subdivision. All stormwater runoff from this road and frontage improvements along 188th St NE will be collected into one infiltration facility. Each lot will contain its own infiltration system.

Pervious/Impervious Areas

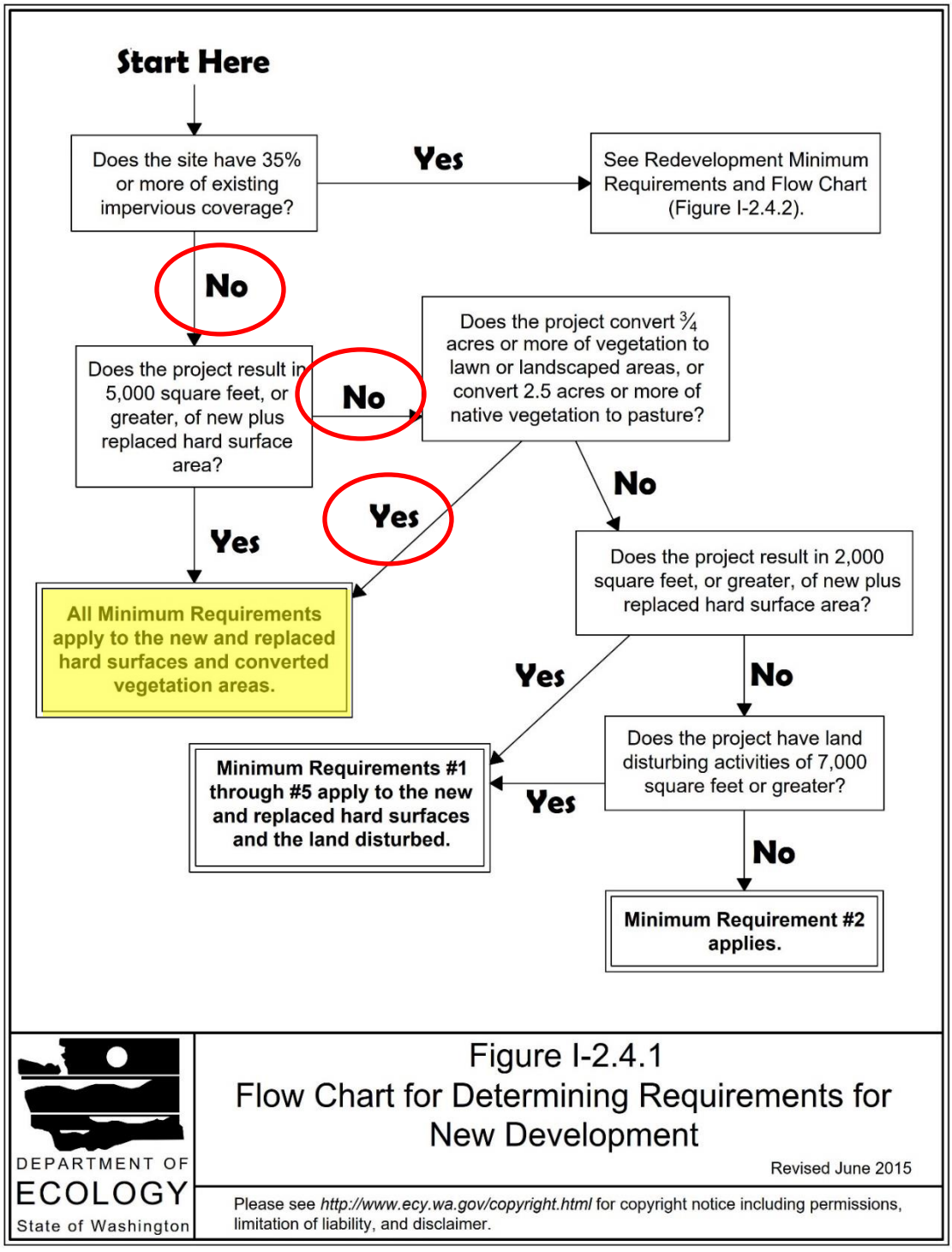
For use in determining stormwater mitigation fees the following areas represent the true pervious/impervious area for the entire site.

Existing Pervious/Impervious Onsite Areas	Area (SF)	Area (AC)
Total Impervious Surface	7,841	0.180
Total Pervious Surface	35,719	0.820
TOTAL SITE AREA	43,560	1.000
Mitigated Pervious/Impervious Onsite Areas	**Area (SF)**	**Area (AC)**
Total Impervious Surface	23,128	0.531
Total Pervious Surface	20,432	0.469
TOTAL SITE AREA	43,560	1.000

Minimum Stormwater Management Requirements

Overview of Minimum Requirements

Minimum requirement 1-9 shall apply to the project.



1-Preparation of Stormwater Site Plans

Stormwater site plans were prepared in accordance with Volume I, Chapter 3 of the SWMMWW.

2-Construction Stormwater Pollution Prevention Plan (SWPPP)

A SWPPP narrative has been prepared and is included in Appendix A and on the plan set. The erosion potential for the site is very low to non-existent. The onsite soils are highly infiltratable so no runoff during construction is anticipated.

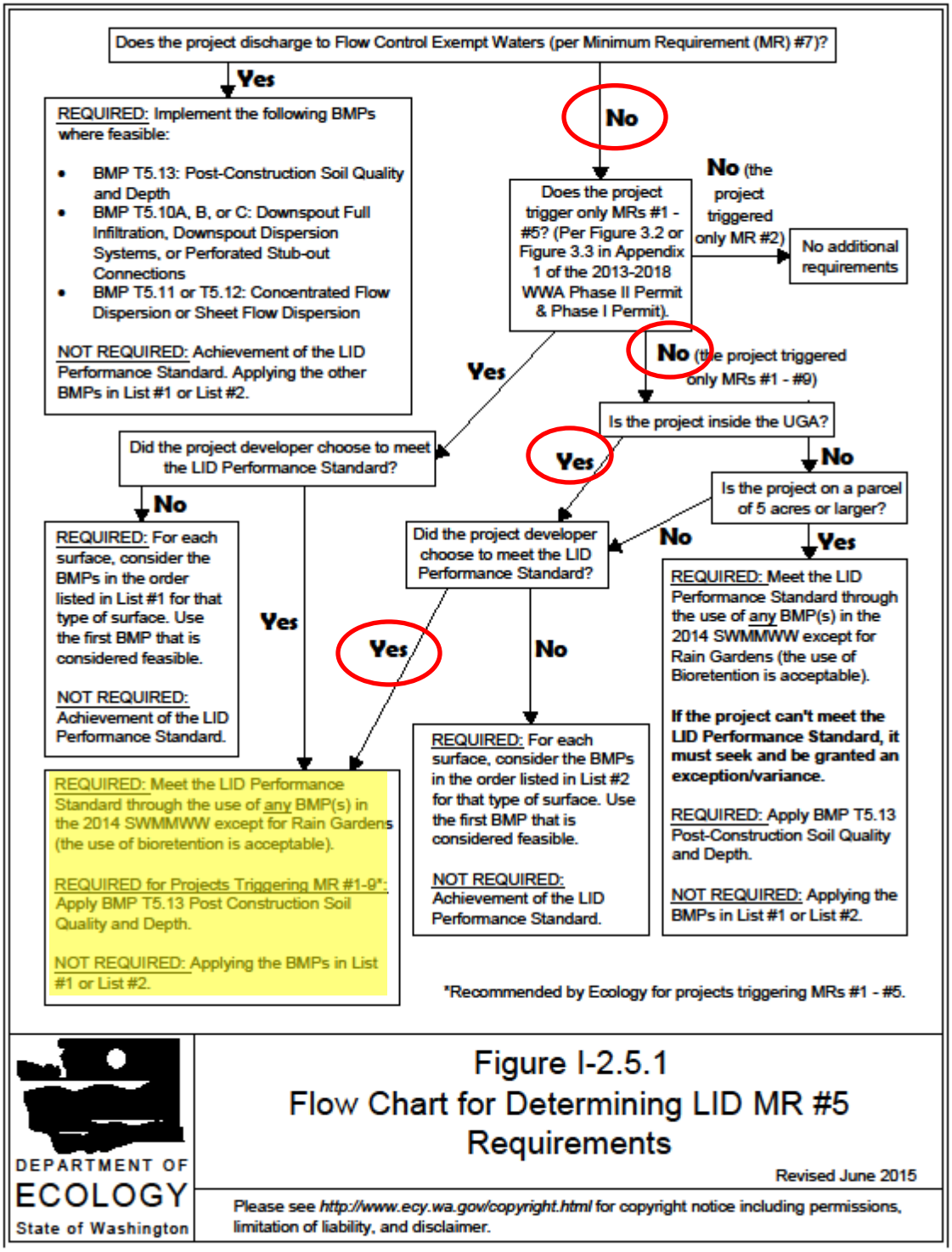
3-Source Control of Pollution

The project will not pose any source of pollution for the site other than concrete for the building foundations. The site is not considered a high use site, however oil/water separators are proposed for the road and parking areas. The SWPPP provided will address the source control of pollution during the construction phase.

4-Preservation of Natural Drainage Systems and Outfalls

Existing regional drainage infiltrates into the soils. Proposed drainage system will also infiltrate, therefore, preservation of natural drainage systems and outfall is being met.

5-Onsite Stormwater Management



A Drainage Summary Sheet and Figure 1 are enclosed detailing the parameters of each drainage system. All drainage systems are designed to infiltrate 100% of the stormwater therefore meeting and exceeding the LID stormwater requirements including other minimum requirements. Detailed drainage calculations

are provided in the appendices. Although the proposed drainage facilities will be of different shapes and sizes, all infiltration facilities will have the same vertical cross section, thus making them identical for modeling purposes.

As each drainage facility is essentially identical to each other in function and calculation methodology, a single gravel infiltration trench was modeled as the basis of the design. Each drainage system onsite was determined based on a proration of the modeled facility. For ease of calculation, the model area was 1-acre with a facility thickness of 2' of drain rock. The model determined that the required size of any infiltration trench/mat for this project would need to be 2,500 sf/acre of tributary area. As shown in the attached Drainage Summary Sheet, 2,500 sf/acre was divided by the proposed width of each tributary area to determine the required minimum length of the individual facility. SSC-4 of the SWMMWW requires that infiltration facilities that are utilized for treatment purposes must document that the water quality design storm volume (indicated by WWHM or MGS Flood, or runoff from a 6-month, 24-hour rain event) can infiltrate through the infiltration basin surface within 48 hours. The infiltration facilities will be designed to infiltrate 100% of the stormwater within depth of the storage layer. The water quality storm, which is less than all storms contained within the model, will also be contained within the storage layer of the infiltration facilities. SSC-4 is therefore met.

Upstream Analysis

The surrounding area has flat topography with high infiltration soils. No stormwater from offsite areas are anticipated to flow onto the project site.

Downstream Analysis

The proposed storm drain mitigation for the project site will infiltrate 100% of the stormwater. Therefore, no impacts to the downstream system are anticipated.

In the event that onsite drainage systems are overwhelmed by excessive rainfall, majority of the stormwater will continue to stay onsite due to the topography of the site.

BMP T5.13: Post-Construction Soil Quality and Depth

BMP T5.13 is required as part of Minimum Requirement #5. The Contractor has the option of stockpiling existing topsoil material or import topsoil material to meet the requirements of BMP T5.13.

6-Runoff Treatment

The site will meet the basic level of treatment, as the project does not meet the thresholds for enhanced treatment, phosphorous removal, or oil treatment as described in Section V-3 of the SWMMWW.

Pollutant generating impervious areas (PGIS) will drain to an infiltration trench that utilizes an 18" layer of sand for filtration, as the existing soils do not meet the site suitability requirements of SSC-6. The sand layer will be below the gravel infiltration trench. The system is similar to that used by permeable pavements for treatment, as part of BMP T5.15, whereby stormwater passes through a gravel storage layer, followed by a sand layer, and then final infiltration into the native soil. The treatment sand layer of the proposed infiltration facilities will have an infiltration rate no lower than 10 inches/hr.

Pretreatment for the infiltration systems within parking and driving areas include the use of sand/oil water separators at each catch basin, in accordance with the City's standard detail SD-120.

7-Flow Control

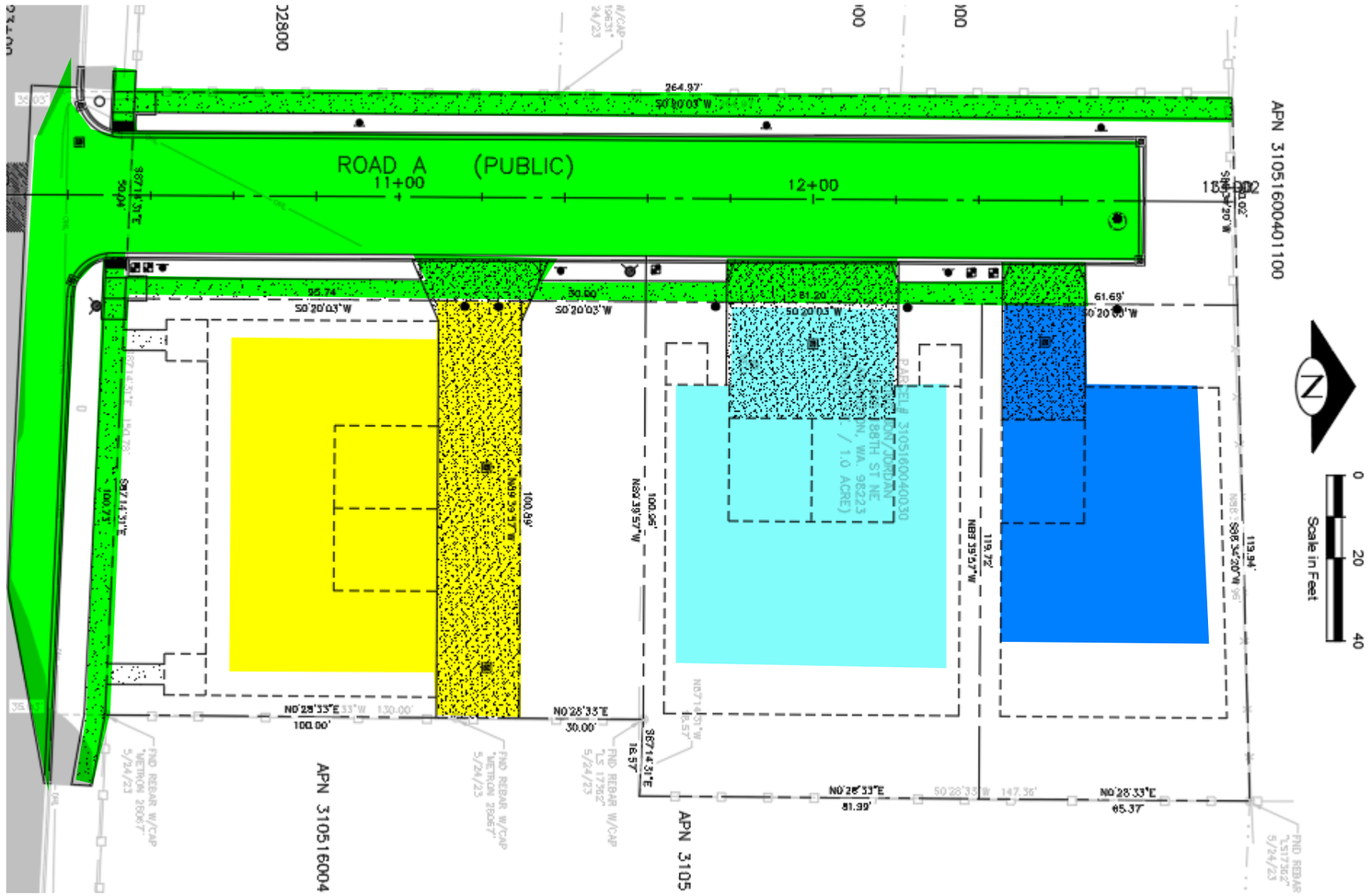
This is being met with 100% infiltration of the stormwater onsite.

8-Wetland Protection

No wetlands are present on the site or within the adjacent downstream area.

9-Operation and Maintenance

Operation and maintenance procedures will be provided with each individual development and are included in Appendix C.



IMPERVIOUS AREA 1

IMPERVIOUS AREA 2

IMPERVIOUS AREA 3

IMPERVIOUS AREA 4

FIG 1: KING SHORT PLAT BASIN MAP

Drainage Information Summary

Project Name:	King Short Plat
Onsite Project Total Area:	1 acres
Offsite Project Total Area:	0.06 acres
Number of Lots (if applicable):	1
Infiltration Proration	2,500 sf/acre @ 2' depth

(Note: For conservatism, subbasins were modeled as 100% imperv.; parking subbasins were modeled as 100% pollutant generating)

Drainage Basin Information		Individual Site Information				Total Site
		1	2	3	4	
	(sf)	6090	5165	3424	11580	
Area of Impact		0.14	0.12	0.08	0.27	0.62
Existing Condition Area (ac)						
Pervious Area		0.14	0.12	0.08	0.27	0.62
Impervious Area						
Proposed Condition Area (ac)						
Pervious Area						
Impervious Area						
Non-pollution Generating		0.09	0.08	0.06	0.06	0.29
Pullution Generating		0.05	0.04	0.02	0.21	0.32
Infiltration Facility Sizing (prorated)						
Thickness (ft)		2	2	2	2	
Width (ft)		6.0	10.0	14.0	3.0	
Min Length (ft)		59	30	15	225	
Pre-developed Runoff Rates		*NA due to infiltration*				
Q (cfs)	2 Year					
	10 year					
	100 year					
Post-developed Runoff Rates		*NA due to infiltration*				
Q (cfs)	2 Year					
	10 year					
	100 year					
Offsite Upstream Area		0	0	0	0	
Type of Storage Proposed		Infilt.	Infilt.	Infilt.	Infilt.	
Approx. Storage Volume (cu-ft)		NA	NA	NA	NA	
Type of Treatment		NA	NA	NA	NA	
Low Impact Development		Yes	Yes	Yes	Yes	

Appendix A

Construction Stormwater Pollution Prevent Plan (SWPPP)

SWPPP ELEMENTS

1 – PRESERVE VEGETATION/MARK CLEARING LIMITS

The land disturbance activities for development requires the consideration to be given to minimize the removal of existing trees, disturbance and compaction of native soils, except as needed for building purposes. The duff layer, native soil and vegetation shall be retained in an undisturbed state to the minimum degree practicable.

Best Management Practices (BMPs) to be used:

- BMP C103: High Visibility Fence

2-ESTABLISH CONSTRUCTION ACCESS

A stabilized construction entrance will be constructed at the existing driveway access to the site.

Best Management Practices (BMPs) to be used:

- BMP C105: Stabilized Construction Entrance

3-CONTROL FLOW RATES

Flow rates will be controlled by using SWPPP Element #4, sediment controls.

4-INSTALL SEDIMENT CONTROLS

Due to the permeability of the site soils, surface flows from the site are expected to be negligible and therefore no sediment controls are needed. If the contractor notices that dirty storm water is leaving the site, then the contractor shall place silt fencing down slope from the disturbed areas as shown on the SWPPP.

Best Management Practices (BMPs) to be used:

- N/A

5-STABILIZED SOILS

If required, all exposed soil and any soil stockpile will be stabilized. The soil stockpile will be located within the disturbed area shown on the SWPPP plan. Any stockpiles will be covered in plastic if left un-worked. No soils shall remain exposed and unworked for more than 2 days between October 1 and April 30. Any land disturbed areas outside of the proposed structure and paving will be permanently seeded.

Best Management Practices (BMPs) to be used:

- CMP C120: Temporary and Permanent Seeding
- BMP C140: Dust Control

6-PROTECT SLOPES

There are no cut or fill slopes with this project.

Best Management Practices (BMPs) to be used:

- None required

7-PROTECT PERMANENT DRAIN INLETS

Existing and proposed storm drain inlets will be protected during construction.

Best Management Practices (BMPs) to be used:

- BMP C220: Storm Drain Inlet Protection

8-STABILIZE CHANNELS AND OUTLETS

There are no existing channels and the proposed construction does not create new channels.

Best Management Practices (BMPs) to be used:

- None Required

9-CONTROL POLLUTANTS

Any and all chemicals, liquid projects, petroleum projects, and other materials that have the potential to pose a threat to human or the environment will be covered, contained and protected from vandalism. All such products will either be locked in a trailer or locked in a leak proof container. Any on-site fueling will have secondary containment to prevent possibility of spills. Any heavy equipment/vehicles will only be on-site temporarily. Any spills will be cleaned immediately. Fertilizers and pesticides will be applied per the manufacturers label requirements for application rate and procedures. No pH modifying sources such as cement kiln dust, fly ash, concrete washing treatment, curing waters, etc. are anticipated; if however they are, we will contain and/or remove the polluted substance from the site per manufacturer's recommendations.

Best Management Practices (BMPs) to be used:

- BMP C151: Concrete Handling
- BMP C152: Sawcutting and Surface Pollution Prevention
- BMP C154: Concrete Washout Area

10-CONTROL DEWATERING

For the proposed building, dewatering is not expected to be required; thus, dewatering control will not be required for this project.

Best Management Practices (BMPs) to be used:

- None Required

11-MAINTAIN BEST MANAGEMENT PRACTICES

BMPs will be inspected and maintained after storms and during construction.

12-MANAGE THE PROJECT

This SWPPP will be implemented at all times and will be modified whenever there is a significant change to the site conditions. The Erosion control BMPs will be implemented in the following sequence:

1. Mark the clearing limits.
2. Establish staging areas for storage and handling polluted materials and BMPs.
3. Install sediment control BMPs.
4. Hand grade and install stabilization measure for disturbed areas
5. Maintain BMPs until final site stabilization, at which time they may be removed.

13-PROTECT ON-SITE STORMWATER BMPS

On-site storm water BMPs, existing and proposed, will be protected at all times from siltation and compaction during construction. The approved plans have both construction sequencing and appropriate SWPPP BMPs to minimize the risk to storm water BMPs.

Best Management Practices (BMPs) to be used:

- None Required

Appendix B

Geotechnical Report

Geotechnical Engineering Report

Proposed 3-Lot Short-Plat
4405 188th Street NE
Arlington, WA 98223
Parcel No. 31051600400300

Prepared For:

Mr. Jon King
6705 67th Drive NE
Marysville, WA 98270

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June 22, 2023
Project No. 23-0276

Mr. Jon King
6705 67th Drive NE
Marysville, WA 98270

Regarding: **Geotechnical Engineering Report**
Proposed 3-Lot Short-Plat
4405 188th Street NW
Arlington, WA 98223
Parcel No. 31051600400300

Dear Mr. King,

As requested, GeoTest Services, Inc. [GeoTest] is pleased to submit the following report summarizing the results of our geotechnical engineering evaluation for the proposed 3-lot short-plat development, located at 4405 188th Street NE in Arlington, WA (see *Vicinity Map*, Figure 1). This report has been prepared in general accordance with the terms and conditions established in our services agreement dated April 18, 2023 and authorized by yourself (Proposal No. 23-252G).

GeoTest appreciates the opportunity to provide geotechnical services on this project and looks forward to assisting you during the construction phase. Should you have any further questions regarding the information contained within the report, or if we may be of service in other regards, please contact the undersigned.

Respectfully,
GeoTest Services, Inc.

GERRY D. BAUTISTA
STATE OF WASHINGTON
51531
REGISTERED
PROFESSIONAL ENGINEER
6/22/23

Gunnar Sterlington, G.I.T.
Staff Geologist

Gerry D. Bautista, Jr., P.E.
Project Geotechnical Engineer

Enclosure: Geotechnical Engineering Report

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PURPOSE AND SCOPE OF SERVICES

The purpose of this evaluation is to establish general subsurface conditions beneath the site from which conclusions and recommendations pertaining to project design can be formulated. Our scope of services includes the following tasks:

- Explore soil and groundwater conditions underlying the site by advancing four test pit explorations with a client-provided tracked excavator.

- Perform laboratory testing on representative samples to classify and evaluate the engineering characteristics of the soils encountered and to assess on-site infiltration capability.

- Provide a written report containing a description of subsurface conditions and exploration logs. The findings and recommendations in this report pertain to site preparation and earthwork, fill and compaction, seismic design, foundation recommendations, concrete slab-on-grade construction, foundation and site drainage, utilities, temporary and permanent slopes, stormwater infiltration feasibility, geotechnical consultation, and/or construction monitoring.

- Assess Geologically Hazardous Areas (if present) per Arlington Municipal Code (AMC).

PROJECT DESCRIPTION

The subject property consists of a level, irregular-shaped, 1-acre parcel. The property is located on the northern side of 188th Street NE in Arlington, WA, on the northern outskirts of the Arlington Municipal Airport. A 1.5-story residence originally constructed in 1938 is currently situated near the center of the subject property. Scattered outbuildings are also located around the existing residence.

GeoTest understands that the existing residence and outbuildings will be demolished, and the parcel will then be divided into three smaller residential lots. No preliminary drawings were available as of the writing of this report. However, GeoTest anticipates that the proposed structures will be wood framed and utilize shallow conventional foundations and slab-on-grade floors. An access driveway will extend from 188th Street NE and will parallel either the eastern or western property line.

We anticipate that stormwater infiltration facilities will be incorporated into the new development. Preliminary information regarding these facilities was not available at the time that this report was written.

SITE CONDITIONS

This section includes a description of the general surface and subsurface conditions observed at the project site during the time of our field investigation. Interpretations of site conditions are based on the results and review of available information, site reconnaissance, subsurface explorations, laboratory testing, and previous experience in the project vicinity.

Surface Conditions

The subject property is located on the northern outskirts of the Arlington Municipal Airport in Arlington, WA. The property is currently occupied by a single-family residence on its southern portion. There is a gravel driveway that enters the property at its southeast corner, travels northwards, and terminates in a gravel parking area on the eastern side of the property. Scattered ornamental trees and large stumps are located along the northern edge of the property. Behind the single-family residence is an outbuilding and dry well. The open space in the northern half of the property is covered with grass.

The proposed development area is situated within a residential neighborhood. Single-family properties border the parcel on the west, north, and east sides.

Image 1: Site photo of the northern half of the property, facing southwest. (Images 1 through 3 taken on May 9, 2023)

Subsurface Soil Conditions

Subsurface conditions were explored by advancing four test pits (TP-1 through TP-4) on May 9, 2023. Our test pit explorations were advanced to depths of between 7.5 and 9.9 feet below ground surface (BGS) using a client-provided, track-mounted excavator. The approximate locations of these explorations have been plotted on the *Site and Exploration Plan* (Figure 2).

The subsurface soils consisted of approximately 0.9 to 1.0 foot of topsoil composed of loose, dark brown, damp, silty sand with organics. This topsoil overlaid a native, loose to medium-dense, reddish to light brown, damp, slightly gravelly to gravelly sand, with trace silt. At approximately 2 feet BGS, these soils became medium-dense with interbedded lenses of sand and gravel, with increased gravel content observed with depth. The medium-dense soils were encountered to the maximum explored depth of the test pits. GeoTest interpreted these soils as recessional outwash, or the Marysville Sand Member of the Recessional Outwash (see following section). For the purposes of this report, the native soils are referred to as 'Marysville Sand'.

Image 2: Test Pit TP-1 displaying subsurface soils comprised of Marysville Sand.

Image 3: Test Pit TP-3 displaying subsurface soils comprised of Marysville Sand.

General Geologic Conditions

Geologic information for the project site was obtained from the *Geologic Map of the Arlington West 7.5 Minute Quadrangle*, Snohomish County, Washington (Minard, 1985), published by the U.S. Geological Survey. According to the referenced map, subsurface soils in the vicinity of the project site consist of Marysville Sand Member of the Recessional Outwash (Qvrm) deposited during the Fraser glaciation event. The Marysville Sand Member generally consists of well-drained, stratified to massive, outwash sand with some pebble gravel with localized areas of silt and clay.

Native soils encountered during our subsurface exploration were generally consistent with the mapped outwash deposits and exhibited an increasing fines content with depth. In this report, we have referred to these soils as 'Marysville Sand'.

Groundwater

Groundwater was not observed within our test pit explorations. The groundwater conditions reported on the exploration logs are for the specific locations and dates indicated, and therefore may not be indicative of other locations and/or times. A review of the Washington State Department of Ecology *Well Log Viewer* indicates that a nearby well at 4617 188th Street NE that was installed in 2003 encountered groundwater at approximately 40 feet BGS at the time of installation.

Groundwater levels are variable and groundwater conditions will fluctuate depending on local subsurface conditions, precipitation, and changes in on-site and off-site use. Seasonal groundwater monitoring is not currently part of our scope and does not apply to this project scope.

Soil Survey

According to the United States Department of Agriculture (USDA) Natural Resource Conservation Service website, soils within the vicinity of the subject property are classified as Lynnwood loamy sand, 0 to 3 percent slopes. Values of K range from 0.02 to 0.69; the higher the value, the more susceptible the soil is to sheet and rill erosion by water. Soils classified as "s" are those soils where the soils have a soil limitation within the rooting zone, such as shallowness of rooting zone, stone, low moisture-holding capacity (USDA, 1961).

Table 1
USDA NRCS Soil Classifications

Map Unit Symbol	30
Map Unit Name	Lynnwood loamy sand, 0 to 3 percent slopes
Landform	Terraces, and outwash plains
Parent Material	Glacial outwash
Land Capability Classification	4s
Hydrologic Soil Group	A
Erosion K Factor, Whole Soil	0.20 (moderate)

Table 1 summarizes the soil properties obtained from the USDA Web Soil Survey website. Native soils observed at the project site appeared to be generally consistent with the *Web Soil Survey* descriptions.

GEOLOGIC HAZARDS

The subject property and surrounding areas are flat. Thus, there does not appear to be Geologic Hazards, as defined by the Arlington Municipal Code Chapter 20.93 Part VI, for landslide hazards. Thus, GeoTest does not have any formal recommendations for mitigating landslide hazards, as these types of hazards are not present on the project site.

Erosion Hazard Areas

The mapped soils within the majority of the subject property are classified as having a moderate erosion potential per the Web Soil Survey. However, the site itself is relatively flat. Thus, it is GeoTest's opinion that the subject property does not contain Erosion Hazards. That said, GeoTest still recommends that the following recommendations be implemented to prevent excessive erosion from occurring:

- All clearing and grading activities for future residence construction will need to incorporate Best Management Practices (BMPs) for erosion control in compliance with current City of Arlington codes and standards.
- GeoTest recommends that appropriate silt fencing be incorporated into the construction plan for erosion control.
- GeoTest recommends that on-site BMPs be implemented during construction. Areas of native vegetation left in place, could also be enhanced by adding additional native plant species and/or other vegetation enhancements.
- All areas disturbed by construction practices should be vegetated or otherwise protected to limit the potential for erosion as soon as practical during and after construction. Areas requiring immediate protection from the effects of erosion should be covered with either plastic, mulch, or erosion control netting/blankets. Areas requiring permanent stabilization should be seeded with an approved grass seed mixture, hydroseeded with an approved seed-mulch-fertilizer mixture or landscaped with a suitable planting design.

In addition to the preceding recommendations, typical erosion control measures during construction will be required. These measures can include a rocked construction entrance or downslope silt fencing, depending on the regulations of the City of Arlington and/or the governing jurisdiction. No other mitigations are required to address erosion hazards on the property.

Seismic Hazard Areas

Seismic Hazard Areas are typically defined as areas that, due to a combination of soil and groundwater conditions, are subject to severe risk of ground shaking, subsidence, or liquefaction of soils during earthquakes. These areas are typically underlain by soft or loose saturated soils (such as alluvium), have a shallow groundwater table, and are typically located on the floors of river valleys.

AMC 20.93.600(b4) describes "Seismic Hazard Areas" as "areas subject to severe risk of earthquake damage as a result of seismic induced settlement, shaking, slope failure or soil liquefaction. These conditions occur in areas underlain by cohesion less soils of low density usually in association with a shallow groundwater table."

Based on a review of information obtained from the Washington State Department of Natural Resources *Geologic Information Portal* and the Snohomish County *PDS Map Portal*, the subject property is mapped as having a "low to moderate" potential for seismic liquefaction. However, these maps only provide an estimate of the likelihood that soils will liquefy as a result of an earthquake and are meant as a general guide to indicates areas potentially susceptible to liquefaction. The *Geologic Information Portal* also illustrates that the nearest active fault trenches and mapped folds are located approximately 9 miles northeast towards Lake Cavanaugh, as part of the Mount Washington Fault Zone.

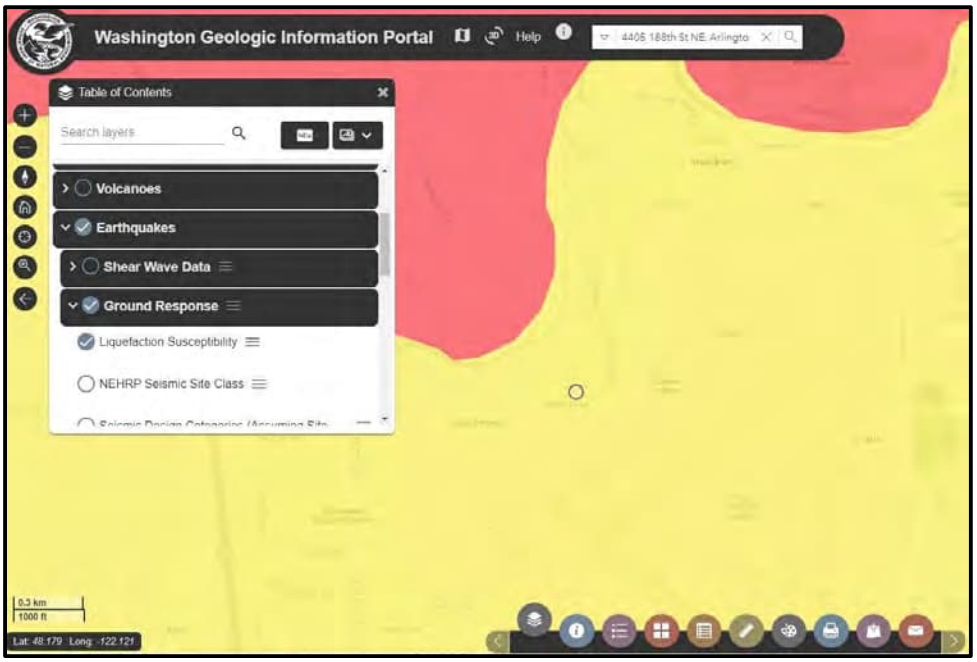

Image 4: Clip from DNR *Geologic Information Portal* showing liquefaction susceptibility. Red is High, Yellow is low to moderate. Note the zone boundaries are approximate. Property denoted by the black circle. Image retrieved on May 30, 2023.

Based on the mapped geology, the proposed development is underlain by native recessional outwash soils (Marysville Sand). It is GeoTest's opinion that the site is in general accordance with the mapped low liquefaction susceptibility and therefore is **not located in a Seismic Hazard Area.** Outside of complying with applicable provisions in the International Building Code (IBC) for seismic design, no mitigations are required to address Seismic Hazards for this site.

CONCLUSIONS AND RECOMMENDATIONS

Based on the evaluation of the data collected during this investigation, it is our opinion that the subsurface conditions at the site are suitable for the proposed development, provided the recommendations contained herein are incorporated into the project design.

Our explorations throughout most of the site exposed approximately 1 foot of organic topsoil overlying native, loose to medium-dense, Marysville Sand soils that became medium-dense at approximately 2 feet BGS. Marysville Sand soils were encountered to the maximum explored depth of the test pits.

The soils within the vicinity of the proposed residence will likely require minimal grading in the proposed building footprint to remove loose, near-surface topsoil, fill (if present) and expose the competent Marysville Sand. Footings can be poured directly on properly prepared, firm and unyielding native soil. Footings may also be placed on compacted Structural Fill overlying firm and unyielding native soil. Qualified geotechnical personnel should carefully observe footing areas prior to placing Structural Fill and/or foundation forms to determine if soil conditions are as expected.

The native Marysville Sand soils encountered in our explorations contain a low percentage of fines and appear to be suitable for conventional stormwater infiltration designs. Perched groundwater was not encountered within the test pits during the time of our explorations.

Site Preparation and Earthwork

The portions of the site proposed for foundations and floor slabs should be prepared by removing existing topsoil, deleterious material, and significant accumulations of organics from the area to be developed. GeoTest anticipates up to 1 foot of excavation to expose suitable subgrade soils for the building foundations.

At a minimum, all subgrades within the proposed areas of development should be recompacted to a firm and unyielding condition and observed by qualified geotechnical personnel. The purpose of this effort is to identify loose or soft soil deposits so that, if feasible, the soil disturbed during site work can be recompacted.

Proof rolling should be carefully observed by qualified geotechnical personnel. Areas exhibiting significant deflection, pumping, or elevated moisture contents that prevent the soil from being adequately compacted should be overexcavated to firm soil. Overexcavated areas should be backfilled with compacted granular material placed in accordance with subsequent recommendations for Structural Fill. During periods of wet weather, proof rolling could damage the exposed subgrade. Under these conditions, GeoTest personnel should observe subgrade conditions to determine if proof rolling is feasible.

Proof rolling may not be feasible for certain locations within excavations, trench areas, or other difficult access zones when using a full-size dump truck or other large machinery. In this situation, we recommend alternate means of verification such as Dynamic Cone Penetrometer (DCP) testing or soil probe methods be employed to verify suitability of field conditions.

Fill and Compaction

Structural Fill must be properly placed and compacted. In most cases, suitable, non-organic, predominantly granular soil may be used for fill material provided the material is properly moisture conditioned prior to placement and compaction, and the specified degree of compaction is obtained. Material containing topsoil, wood, trash, organic material, or construction debris is not suitable for reuse as Structural Fill and should be properly disposed offsite or placed in nonstructural areas. GeoTest generally expects about 1 foot of stripping to remove topsoil and near-surface asphalt/concrete debris prior to the placement of new fill materials.

Soils containing more than approximately 5 percent fines are considered moisture sensitive and are difficult to compact to a firm and unyielding condition when over the optimum moisture content by more than approximately 2 percent. The optimum moisture content is that which allows the greatest dry density to be achieved at a given level of compactive effort.

Reuse of On-Site Soil

The non-organic, native Marysville Sand is suitable for reuse as Structural Fill when placed at or near optimum moisture content, and if allowed for in the plans and specifications. The near-surface, native soils have fines contents of about 5 percent and are considered moisture sensitive. Reuse of moisture sensitive soils could be difficult depending on weather conditions and compaction efforts utilized.

If using on-site materials, the Contractor and Owner should be prepared to manage over optimum moisture content soils. The moisture content of the soils may be difficult to control during periods of wet weather.

Imported Structural Fill

GeoTest recommends that imported Structural Fill for raising site grades consist of clean, well-graded sandy gravel, gravelly sand, or other approved naturally occurring granular material (pit run) or a well-graded crushed rock. We recommend Structural Fill for dry weather construction meet Washington State Department of Transportation (WSDOT) Standard Specification 9-03.14(2) for "Select Borrow" with the added requirement than 100 percent pass a 4-inch-square sieve.

Soil containing more than about 5 percent fines (that portion passing the U.S. No. 200 sieve) cannot consistently be compacted to a dense, non-yielding condition when the water content is greater than optimum. Accordingly, GeoTest recommends that imported Structural Fill for wet weather construction meet WSDOT Standard Specification 9-03.14(1) for "Gravel Borrow" with the added requirement that no more that 5 percent pass the U.S. No. 200 sieve. Due to wet weather or wet site conditions, soil moisture contents could be high enough that it may be very difficult to compact even 'clean' imported select granular fill to a firm and unyielding condition. Soils with over-optimum moisture contents should be scarified and dried back to more suitable moisture contents during periods of dry weather or removed and replaced with fill soils at a more suitable range of moisture contents.

Backfill and Compaction

Structural Fill should be placed in horizontal lifts. The Structural Fill must measure 8 to 10 inches in loose thickness and be thoroughly compacted. All Structural Fill placed under load bearing areas should be compacted to at least 95 percent of the maximum dry density, as determined using test method ASTM D1557. The top of the compacted Structural Fill should extend outside all foundations and other structural improvements a minimum distance equal to the thickness of the fill. We recommend that compaction be tested after placement of each lift in the fill pad.

Wet Weather Earthwork

The upper portions of the Marysville Sand have fines contents on the order of 4 to 5 percent by weight. As such, these soils may be susceptible to degradation during wet weather. If construction takes place during wet weather, GeoTest recommends that Structural Fill consist of imported, clean, well-graded sand or sand and gravel as described above. If fill is to be placed or earthwork is to be performed in wet conditions, the contractor may reduce soil disturbance by:

- Limiting the size of areas that are stripped of topsoil and left exposed
- Accomplishing earthwork in small sections
- Limiting construction traffic over unprotected soil
- Sloping excavated surfaces to promote runoff
- Limiting the size and type of construction equipment used

- Providing gravel 'working mats' over areas of prepared subgrade
- Removing wet surficial soil prior to commencing fill placement each day
- Sealing the exposed ground surface by rolling with a smooth drum compactor or rubber-tired roller at the end of each working day
- Providing up-gradient perimeter ditches or low earthen berms and using temporary sumps to collect runoff and prevent water from ponding and damaging exposed subgrades

Seismic Design Considerations

The Pacific Northwest is seismically active, and the site could be subject to movement from a moderate or major earthquake. Consequently, moderate levels of seismic shaking should be accounted for during the design life of the project, and the proposed structure should be designed to resist earthquake loading using appropriate design methodology.

For structures designed using the seismic design provisions of the 2018 International Building Code, the medium dense Marysville Sand underlying the site is classified as Site Class D, according to ASCE 7-16. The structural engineer should select the appropriate design response spectrum based on Site Class D soil and the geographical location of the proposed construction.

Foundation Support

To provide proper support for house foundations, GeoTest recommends that existing topsoil and existing fill, if present, be removed from beneath the building foundation area. Most of this near-surface material would be removed assuming that the proposed structure will have shallow conventional foundations. Medium dense, native soils are unlikely to require much preparation. Soils disturbed during stripping or footing excavation should be compacted with a large compactor such as a smooth-drum roller, hoe-pack, or a similar piece of construction equipment. Once suitable bearing conditions have been confirmed, foundations can be placed directly on native soils or on properly compacted Structural Fill as described in the *Fill and Compaction* section of this report.

Continuous and isolated spread footings should be founded 18 inches, minimum, below the lowest adjacent final grade for freeze/thaw protection. The footings should be sized in accordance with the structural engineer's prescribed design criteria and seismic considerations.

Allowable Bearing Capacity

Assuming the above foundation support criteria are satisfied, continuous or isolated spread footings founded directly on remedially compacted, native, firm, and unyielding Marysville Sand soils, or on Structural Fill placed atop competent native soils may be proportioned using a net allowable soil bearing pressure of 2,500 pounds per square foot (psf). The 'net allowable bearing

pressure' refers to the pressure that can be imposed on the soil at foundation level. This pressure includes all dead loads, live loads, the weight of the footing, and any backfill placed above the footing. The net allowable bearing pressure may be increased by one-third for transient wind or seismic loads.

Foundation Settlement

Settlement of shallow foundations depends on foundation size and bearing pressure, as well as the strength and compressibility characteristics of the underlying soil. If construction is accomplished as recommended and at the maximum allowable soil bearing pressure, GeoTest estimates the total settlement of building foundations to be less than one inch. Differential settlement between two adjacent load-bearing components supported on competent soil is estimated to be less than one half the total settlement.

Floor Support

Floor slabs for the residential structure can be supported on firm and unyielding, properly prepared native subgrade or on properly placed and compacted Structural Fill placed over firm and unyielding native soil. The native subgrade should be proof rolled as recommended in the *Site Preparation and Earthwork* section of this report.

GeoTest recommends that interior concrete slab-on-grade floors be underlain with at least 6 inches of clean, compacted, free-draining gravel. The gravel should contain less than 3 percent passing the U.S. Standard No. 200 sieve (based on a wet sieve analysis of that portion passing the U.S. Standard No. 4 sieve). The purpose of this gravel layer is to provide uniform support for the slab, provide a capillary break, and act as a drainage layer. To help reduce the potential for water vapor migration through floor slabs, a continuous 10-mil minimum thick polyethylene sheet with tape-sealed joints should be installed below the slab to serve as an impermeable vapor barrier. The vapor barrier should be installed and sealed in accordance with the manufacturer's instructions.

Exterior concrete slabs-on-grade, such as sidewalks, may be supported directly on undisturbed native soil or on properly placed and compacted structural fill; however, long-term performance will be enhanced if exterior slabs are placed on a layer of clean, durable, well-draining granular material.

Foundation and Site Drainage

Positive surface gradients should be provided adjacent to the proposed building to direct surface water away from the building and toward suitable drainage facilities. Roof drainage should not be introduced into the perimeter footing drains but should be separately discharged directly to the stormwater collection system or similar municipality-approved outlet. Pavement and

sidewalk areas, if present, should be sloped and drainage gradients should be maintained to carry surface water away from the building towards an approved stormwater collection system. Surface water should not be allowed to pond and soak into the ground surface near buildings or paved areas during or after construction. Construction excavations should be sloped to drain to sumps where water from seepage, rainfall, and runoff can be collected and pumped to a suitable discharge facility.

To reduce the potential for groundwater and surface water to seep into interior spaces, GeoTest recommends that an exterior footing drain system be constructed around the perimeter of new building foundations as shown in the *Conceptual Footing and Wall Drain Section* (Figure 3) of this report. The drain should consist of a perforated pipe measuring 4 inches in diameter at minimum, surrounded by at least 12 inches of filtering media. The pipe should be sloped to carry water to an approved collection system.

The filtering media may consist of open-graded drain rock wrapped in a nonwoven geotextile fabric such as Mirafi 140N (or equivalent) or wrapped with a graded sand and gravel filter. For foundations supporting retaining walls, drainage backfill should be carried up the back of the wall and be at least 12 inches wide. The drainage backfill should extend from the foundation drain to within approximately 1 foot of the finished grade and consist of open-graded drain rock containing less than 3 percent fines by weight passing the U.S. Standard No. 200 sieve (based on a wet sieve analysis of that portion passing the U.S. Standard No. 4 sieve). The invert of the footing drainpipe should be placed at approximately the same elevation as the bottom of the footing or 12 inches below the adjacent floor slab grade (whichever is deeper) so that water will be contained. This process prevents water from seeping through walls or floor slabs. The drain system should include cleanouts to allow for periodic maintenance and inspection.

Please understand that the above recommendations are intended to assist the design engineer and/or architect in development of foundation and site drainage parameters and are based on our experience with similar projects in the area. The final foundation and site drainage plan that will be incorporated into the project plans is to be determined by the design team.

Resistance to Lateral Loads

The lateral earth pressures that develop against foundation walls will depend on the method of backfill placement, degree of compaction, slope of backfill, type of backfill material, provisions for drainage, magnitude and location of any adjacent surcharge loads, and the degree to which the wall can yield laterally during or after placement of backfill. If the wall can rotate or yield so the top of the wall moves an amount equal to or greater than about 0.001 to 0.002 times its height (a yielding wall), the soil pressure exerted comprises the active soil pressure. When a wall is restrained against lateral movement or tilting (a nonyielding wall), the soil pressure exerted comprises the at rest soil pressure. Wall restraint may develop if a rigid structural network is constructed prior to backfilling or if the wall is inherently stiff.

GeoTest recommends that yielding walls under drained conditions be designed for an equivalent fluid density of 35 pounds per cubic foot (pcf), for Structural Fill in active soil conditions. Nonyielding walls under drained conditions should be designed for an equivalent fluid density of 55 pcf, for Structural Fill in at-rest conditions. GeoTest should be contacted if the final design includes submerged walls, so that we may provide updated recommendations.

Design of walls should include appropriate lateral pressures caused by surcharge loads located within a horizontal distance equal to or less than the height of the wall. For uniform surcharge pressures, a uniformly distributed lateral pressure equal to 35 percent and 50 percent of the vertical surcharge pressure should be added to the lateral soil pressures for yielding and nonyielding walls, respectively. GeoTest also recommends that a seismic surcharge of 8H be included where H is the wall height. The seismic surcharge should be modeled as a rectangular distribution with the resultant applied at the midpoint of the wall.

Passive earth pressures developed against the sides of building foundations, in conjunction with friction developed between the base of the footings and the supporting subgrade, will resist lateral loads transmitted from the structure to its foundation. For design purposes, the passive resistance of well-compacted fill placed against the sides of foundations is equivalent to a fluid with a density of 300 pcf. The recommended value includes a safety factor of about 1.5 and assumes that the ground surface adjacent to the structure is level in the direction of movement for a distance equal to or greater than twice the embedment depth. The recommended value also assumes drained conditions that will prevent the buildup of hydrostatic pressure in the compacted fill. Retaining walls should include a drain system constructed in general accordance with the recommendations presented in the *Foundation and Site Drainage* section of this report. In design computations, the upper 12 inches of passive resistance should be neglected if the soil is not covered by floor slabs or pavement. If future call for the removal of the soil providing resistance, the passive resistance should not be considered.

An allowable coefficient of base friction of 0.35, applied to vertical dead loads only, may be used between the underlying soil and the base of the footing. If passive and frictional resistance are considered together, one half the recommended passive soil resistance value should be used since larger strains are required to mobilize the passive soil resistance as compared to frictional resistance. A safety factor of about 1.5 is included in the base friction design value. GeoTest does not recommend increasing the coefficient of friction to resist seismic or wind loads.

Temporary and Permanent Slopes

The contractor is responsible for construction slope configurations and maintaining safe working conditions, including temporary excavation stability. All applicable local, state, and federal safety codes should be followed. All open cuts should be monitored during and after excavation for any evidence of instability. If instability is detected, the contractor should flatten the side slopes or install temporary shoring.

Temporary excavations in excess of 4 feet should be shored or sloped in accordance with Safety Standards for Construction Work Part N, WAC 296-155-66403.

Temporary unsupported excavations in native Marysville Sand soils encountered at the project site are classified as a Type C soil according to WAC 296-155-66401 and may be sloped as steep as 1.5H :1V (Horizontal: Vertical). Temporary excavations in existing fill soils are classified as Type C soils and may be sloped as steep as 1.5H:1V. All soils encountered are classified as Type C soil in the presence of groundwater seepage and may be sloped as steep as 1.5:1. Flatter slopes or temporary shoring may be required in areas where groundwater flow is present and unstable conditions develop.

Temporary slopes and excavations should be protected as soon as possible using appropriate methods to prevent erosion from occurring during periods of wet weather.

GeoTest recommends that permanent cut or fill slopes be designed for inclinations of 2H: 1V or flatter. Permanent cuts or fills used in earth slopes intended to hold water should be 3H: 1V or flatter. No ponds should be located above or on existing steep slopes. All permanent slopes should be vegetated or otherwise protected to limit the potential for erosion as soon as practical after construction.

Stormwater Infiltration Potential

At the time of our site visit, the near-surface soils in the upper portion of the property consisted of approximately 1 foot of topsoil. Underlying these surficial soils, GeoTest observed poorly graded Marysville Sand soils to the maximum explored depth of the test pits. It is GeoTest's opinion that that the conventional infiltration of on-site stormwater is feasible, given that the bottom of infiltration facilities are placed within native Marysville Sand soils.

Test Pit Gradation Results

From the explorations excavated in the areas of interest, five representative soil samples were selected and mechanically tested for grain size distribution and calculation according to the soil grain size analysis method per the *Stormwater Management Manual for Western Washington* [Manual]. This document is the current stormwater manual adopted by the City of Arlington. A summary of these results is reproduced in Table 2. The rates presented in this table are representative of loose soil conditions and do not take the relative density of the soil into account.

Stormwater infiltration potential is a function of the relative permeability of the site soils, and the separation between the base of the proposed stormwater facility and the groundwater table. For facilities based in the Marysville Sand typically encountered below 1 foot BGS, we recommend a **preliminary design infiltration rate of 10 inches per hour.**

Table 2 Preliminary Infiltration Results Based on Grain Size Analysis		
Boring ID & Depth	**Geologic Unit**	**Preliminary, Corrected K_{sat} Infiltration Rate [in/hr]**
TP-1 (5.4 ft)	Marysville Sand	10.0*
TP-2 (4.2 ft)	Marysville Sand	10.0*
TP-2 (8.7 ft)	Marysville Sand	10.0*
TP-3 (6.8 ft)	Marysville Sand	10.0*
TP-4 (2.5 ft)	Marysville Sand	10.0*
Notes: - Ksat = Initial Saturated Hydraulic Conductivity - Correction Factors Used: CFv = 0.70, CFt = 0.40, CFm =0.90 - Total Correction Factor = 0.252 - Rates presented are representative of loose conditions and do not consider the relative density of the soil *** GeoTest does not recommend a corrected infiltration rate of more than 10 inches per hour.**		

Please note that the rates given in this section are representative of preliminary design infiltration rates. If a higher infiltration rate is required, the design rate would best be established by performing a Pilot Infiltration Test. This testing is outside the scope of work for this project. However, GeoTest can provide a fee estimate for this testing upon request.

Also note that native soil will likely infiltrate at a faster rate than treatment soil, as described in the next section. Thus, the proposed facilities will need to be designed for the media with the slowest infiltration rate. As discussed above, GeoTest does not recommend a corrected infiltration rate of more than 10 inches per hour.

Stormwater Treatment

The stormwater facilities on-site may require some form of pollutant pretreatment with an amended soil prior to on-site infiltration or off-site discharge. The reuse of on-site topsoil is often the most sustainable and cost-effective method for pollutant treatment purposes. Cation exchange capacities, organic contents, and pH of site subsurface soils were also tested to determine possible pollutant treatment suitability.

Cation exchange capacity, organic content, and pH tests were performed by Northwest Agricultural Consultants on two soil samples collected from the explorations shown in Table 3. A summary of the laboratory test results is presented in Table 3 below.

Table 3 Cation Exchange Capacity, Organic Content, and pH Laboratory Test Results				
Boring ID	**Sample Depth (ft)**	**Cation Exchange Capacity (meq/100 grams)**	**Organic Content (%)**	**pH**
TP-1	3.7	2.0	0.58	6.5
TP-3	0.7	12.7	4.93	6.3

Suitability for on-site pollutant treatment is determined in accordance with SSC-6 of the Manual. Soils with an organic content of greater than or equal to 1 percent and a cation exchange capacity of greater than or equal to 5 meq/100 grams are characterized as suitable for stormwater treatment. Based on the results shown in Table 3, the topsoil and near-surface Marysville Sand are expected to be suitable for the treatment of stormwater without amendment, while the soils deeper than about 18 inches are not suitable without amendment.

Geotechnical Consultation and Construction Monitoring

GeoTest recommends that we be involved in the project design review process. The purpose of the review is to verify that the recommendations presented in this report are understood and incorporated in the design and specifications.

We also recommend that geotechnical construction monitoring services be provided. These services should include observation by GeoTest personnel during subgrade preparation operations, Structural Fill placement, and compaction efforts to confirm that design subgrade conditions are obtained beneath the areas of improvement.

Periodic field density testing should be performed to verify that the appropriate degree of compaction is obtained. The purpose of these services is to observe compliance with the design concepts, specifications, and recommendations of this report. If subsurface conditions differ from those anticipated before the start of construction, GeoTest would be pleased to provide revised recommendations appropriate to the conditions revealed during construction.

GeoTest is available to provide a full range of materials testing and special inspection during construction as required by the local building department and the International Building Code. This may include specific construction inspections on materials such as reinforced concrete, reinforced masonry, wood framing, and structural steel. These services are supported by our fully accredited materials testing laboratories.

USE OF THIS REPORT

GeoTest Services, Inc. has prepared this report for the exclusive use of Mr. Jon King, and his design consultants for specific application to the design of the proposed 3-lot short-plat located

at 4405 188th Street NE in Arlington, WA. Use of this report by others is at the user's sole risk. This report is not applicable to other site locations. Our services are conducted in accordance with accepted practices of the geotechnical engineering profession; no other warranty, express or implied, is made as to the professional advice included in this report.

Our site explorations document subsurface conditions at the dates and locations indicated. It is not warranted that these conditions are representative of conditions at other locations and times. The analyses, conclusions, and recommendations contained in this report are based on site conditions to the limited depth and time of our explorations, a geological reconnaissance of the area, and a review of previously published geological information for the site. If variations in subsurface conditions are encountered during construction that differ from those contained within this report, GeoTest should be allowed to review the recommendations and, if necessary, make revisions. If there is a substantial lapse of time between submission of this report and the start of construction, or if conditions change due to construction operations at or adjacent to the project site, we recommend that we review this report to determine the applicability of the conclusions and recommendations contained herein.

The earthwork contractor is responsible to perform all work in conformance with all applicable WISHA/OSHA regulations. GeoTest Services, Inc. is not responsible for job site safety on this project, and this responsibility is specifically disclaimed.

Attachments:	Figure 1	Vicinity Map
	Figure 2	Site and Exploration Plan
	Figure 3	Conceptual Footing and Wall Drain Section
	Figure 4	Soil Classification System and Key
	Figures 5 – 6	Logs of Test Pits
	Figure 7	Grain Size Test Data
	Attached	Northwest Agricultural Consultants Results
	Attached	Report Limitations and Guidelines for its Use

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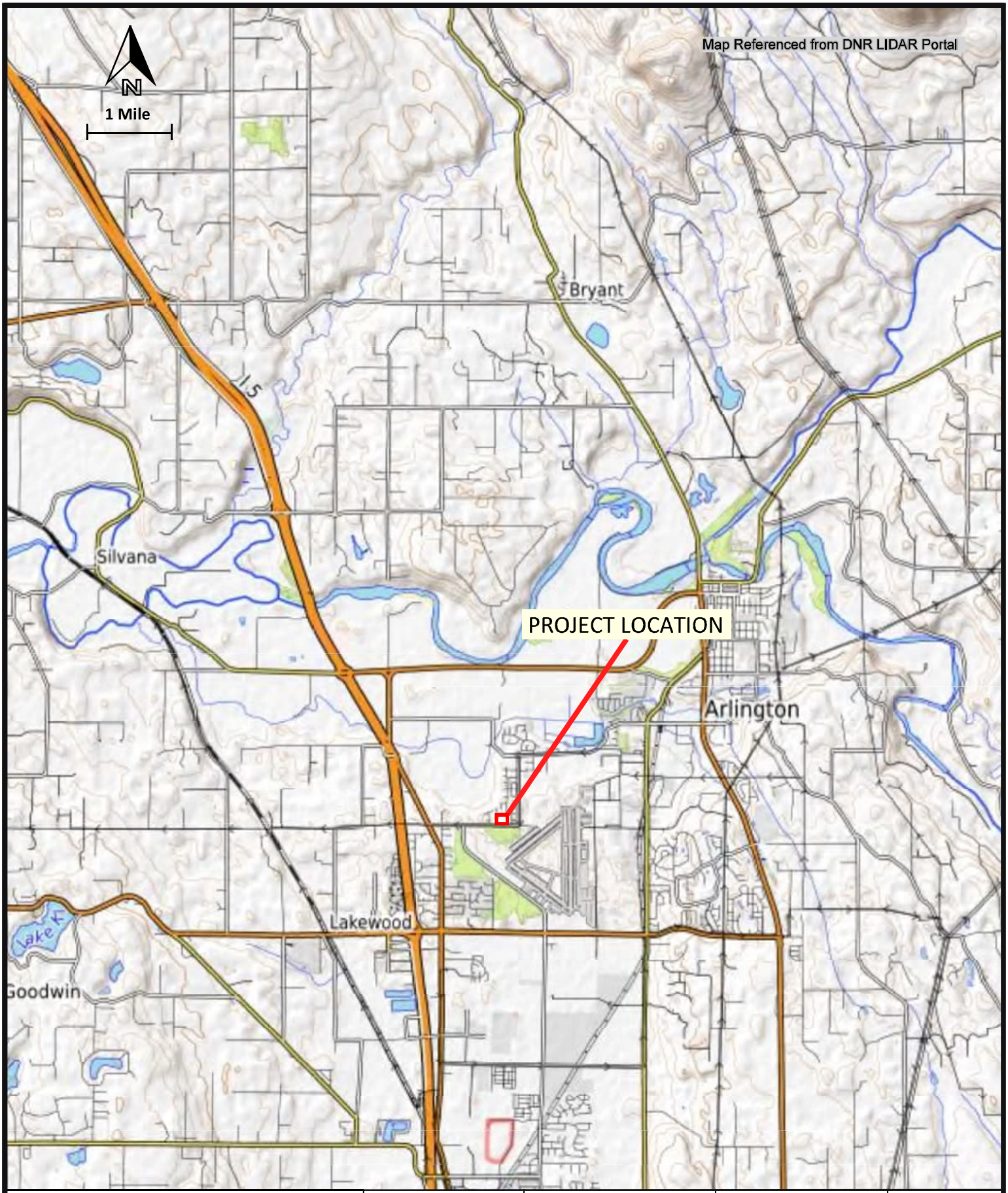


GEOTEST An RMA Company	Date: 6-7-23	By: GS	Scale: As Shown

VICINITY MAP
PROPOSED 3-LOT SHORT-PLAT
4405 188TH STREET NE
ARLINGTON, WA 98223

Project
23-0276

Figure
1

APPROXIMATE TEST PIT LOCATIONS

60 feet

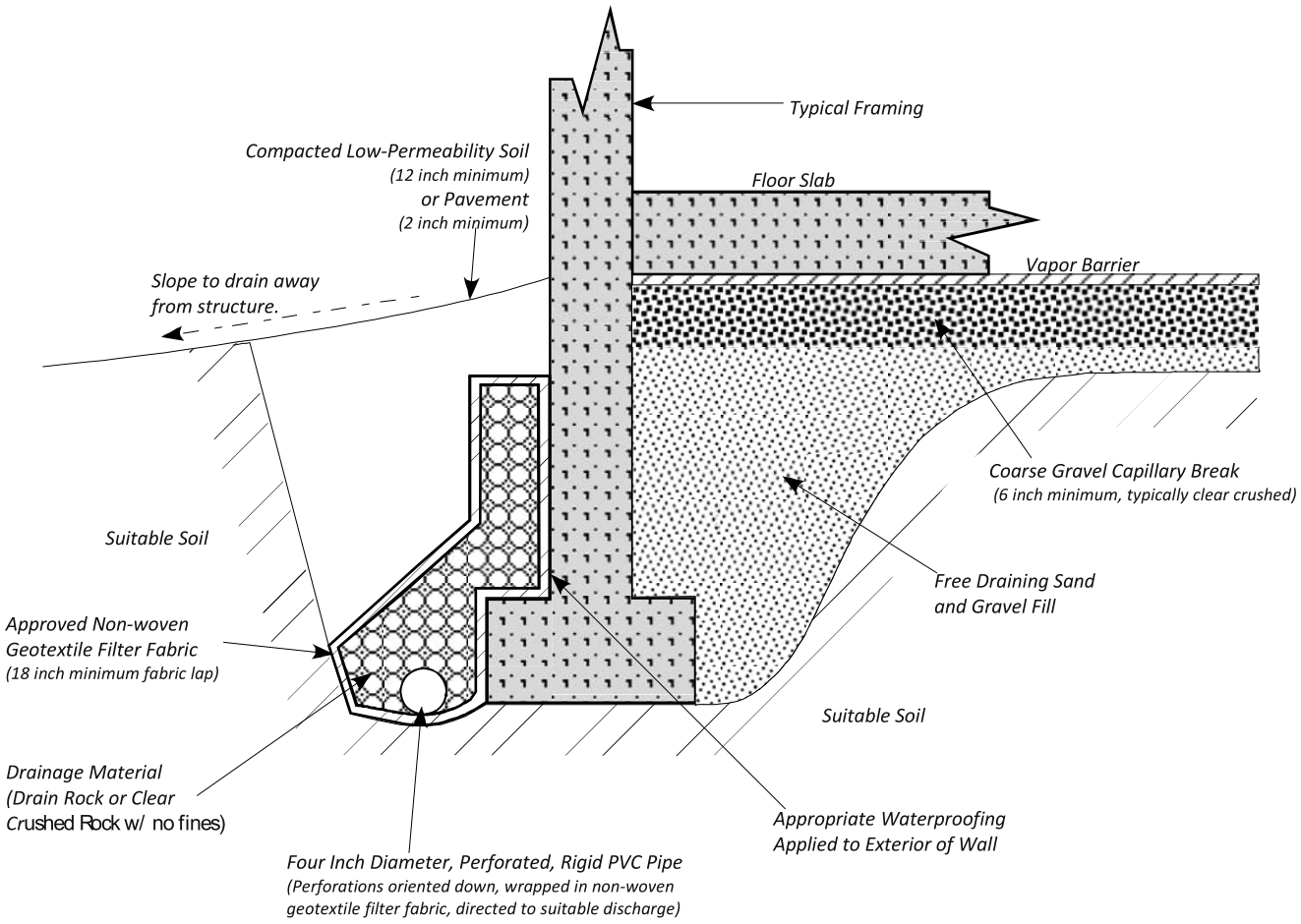
GEOTEST
An RMA Company

Date: 6-12-23	By: GDB	Scale: As Shown	Project 23-0276

SITE AND EXPLORATION PLAN
PROPOSED 3-LOT SHORT-PLAT
4405 188TH STREET NE
ARLINGTON, WA 98223

Figure 2

CONCEPTUAL FOOTINGS WITH INTERIOR SLAB-ON-GRADE



Notes:

This figure is not intended to be representative of a design. This figure is intended to present concepts that can be incorporated into a functional foundation drain designed by a Civil Engineer. In all cases, refer to the Civil plan sheet for drain details and elevations.

Footings should be properly buried for frost protection in accordance with International Building Code or local building codes (Typically 18 inches below exterior finished grades).

The footing drain will need to be modified from this typical drawing to fit the dimensions of the planned footing and slab configuration.

GEOTEST An RMA Company	Date: 6-7-23	By: GDB	Scale: None
	CONCEPTUAL FOOTING & WALL DRAIN SECTION **PROPOSED 3-LOT SHORT-PLAT** **4405 188TH STREET NE** **ARLINGTON, WA 98223**		Project **23-0276** Figure **3**

Soil Classification System

MAJOR DIVISIONS			GRAPHIC SYMBOL	USCS LETTER SYMBOL	TYPICAL DESCRIPTIONS[1][2]
COARSE-GRAINED SOIL (More than 50% of material is larger than No. 200 sieve size)	GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (Little or no fines)		GW	Well-graded gravel; gravel/sand mixture(s); little or no fines
				GP	Poorly graded gravel; gravel/sand mixture(s); little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)		GM	Silty gravel; gravel/sand/silt mixture(s)
				GC	Clayey gravel; gravel/sand/clay mixture(s)
	SAND AND SANDY SOIL (More than 50% of coarse fraction passed through No. 4 sieve)	CLEAN SAND (Little or no fines)		SW	Well-graded sand; gravelly sand; little or no fines
				SP	Poorly graded sand; gravelly sand; little or no fines
		SAND WITH FINES (Appreciable amount of fines)		SM	Silty sand; sand/silt mixture(s)
				SC	Clayey sand; sand/clay mixture(s)
FINE-GRAINED SOIL (More than 50% of material is smaller than No. 200 sieve size)	SILT AND CLAY (Liquid limit less than 50)			ML	Inorganic silt and very fine sand; rock flour; silty or clayey fine sand or clayey silt with slight plasticity
				CL	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay
				OL	Organic silt; organic, silty clay of low plasticity
	SILT AND CLAY (Liquid limit greater than 50)			MH	Inorganic silt; micaceous or diatomaceous fine sand
				CH	Inorganic clay of high plasticity; fat clay
				OH	Organic clay of medium to high plasticity; organic silt
	HIGHLY ORGANIC SOIL			PT	Peat; humus; swamp soil with high organic content

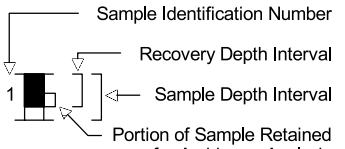
OTHER MATERIALS	GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
PAVEMENT		AC or PC	Asphalt concrete pavement or Portland cement pavement
ROCK		RK	Rock (See Rock Classification)
WOOD		WD	Wood, lumber, wood chips
DEBRIS		DB	Construction debris, garbage

Notes:
1. Soil descriptions are based on the general approach presented in the *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*, as outlined in ASTM D 2488. Where laboratory index testing has been conducted, soil classifications are based on the *Standard Test Method for Classification of Soils for Engineering Purposes*, as outlined in ASTM D 2487.
2. Soil description terminology is based on visual estimates (in the absence of laboratory test data) of the percentages of each soil type and is defined as follows:

Primary Constituent: > 50% - "GRAVEL," "SAND," "SILT," "CLAY," etc.
Secondary Constituents: > 30% and ≤ 50% - "very gravelly," "very sandy," "very silty," etc.
> 12% and ≤ 30% - "gravelly," "sandy," "silty," etc.
Additional Constituents: > 5% and ≤ 12% - "slightly gravelly," "slightly sandy," "slightly silty," etc.
≤ 5% - "trace gravel," "trace sand," "trace silt," etc., or not noted.

Drilling and Sampling Key

SAMPLE NUMBER & INTERVAL



SAMPLER TYPE

Code	Description
a	3.25-inch O.D., 2.42-inch I.D. Split Spoon
b	2.00-inch O.D., 1.50-inch I.D. Split Spoon
c	Shelby Tube
d	Grab Sample
e	Other - See text if applicable
1	300-lb Hammer, 30-inch Drop
2	140-lb Hammer, 30-inch Drop
3	Pushed
4	Other - See text if applicable

Groundwater

▽ ATD — Approximate water elevation at time of drilling (ATD) or on date noted. Groundwater levels can fluctuate due to precipitation, seasonal conditions, and other factors.

Field and Lab Test Data

Code	Description
PP = 1.0	Pocket Penetrometer, tsf
TV = 0.5	Torvane, tsf
PID = 100	Photoionization Detector VOC screening, ppm
W = 10	Moisture Content, %
D = 120	Dry Density, pcf
-200 = 60	Material smaller than No. 200 sieve, %
GS	Grain Size - See separate figure for data
AL	Atterberg Limits - See separate figure for data
GT	Other Geotechnical Testing
CA	Chemical Analysis

GEOTEST

Proposed 3-Lot Short-Plat
4405 188th Street NE
Arlington, WA 98223

Soil Classification System and Key

Figure 4

TP-1

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 137 Excavated By: Client Provided/Logged: GS	
0					SM/OL	Loose, dark brown, damp, silty SAND, abundant grass roots (Topsoil)	Groundwater not encountered.
2	1	d			SP	Loose to medium dense, reddish brown to gray, damp, poorly graded SAND, trace silt, slight mottling (Marysville Sand) -@1.9' BGS becomes medium-dense, brown to gray -Easy to moderate difficulty penetrating test pit side wall with a piece of #4 rebar using a 5lb hammer at 2.5' BGS. -Transition to coarse grained sand with gravel, color grades to gray blue at 5.1' BGS. -Interbedded lenses of gravel and sand from 6' BGS to test pit termination. -Increase in gravel size at 7' BGS.	
4	2	d					
6	3	d					
8	4	d	W = 3 GS				
10	5	d					
	6	d					

Test Pit Completed 05/09/23
Total Depth of Test Pit = 9.8 ft.

TP-2

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 137 Excavated By: Client Provided/Logged: GS	
0					SM/OL	Loose, dark brown, damp, silty SAND, abundant grass roots (Topsoil)	Groundwater not encountered.
2	7	d			SP	Loose to medium dense, reddish brown to gray, damp, poorly graded SAND, trace silt, slight mottling (Marysville Sand) -@2.1' BGS becomes medium-dense, gray/blue, coarse-grained, with gravel -Transition to coarse grained sand with gravel, color grades to gray blue at 2.2' BGS. -Easy to moderate difficulty penetrating test pit side wall with a piece of #4 rebar using a 5lb hammer at 3.3' BGS. -Interbedded lenses of gravel and sand from 6.3' BGS to test pit termination. -Increase in gravel size at 7' BGS.	
4	8	d					
6	9	d	W = 6 GS				
8	10	d					
10	11	d	W = 4 GS				
	12	d					

Test Pit Completed 05/09/23
Total Depth of Test Pit = 9.8 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST
An RMA Company

Proposed 3-Lot Short-Plat 4405 188th Street NE Arlington, WA 98223	Log of Test Pits	Figure 5

TP-3

SAMPLE DATA			SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 137 Excavated By: Client Provided/Logged: GS	
0	13	d	W = 4 GS		SM/ OL	Loose, dark brown, damp, silty SAND, abundant grass roots (Topsoil)	Groundwater not encountered.
2	14	d			SP	Loose to medium dense, reddish brown to gray, damp, gravelly SAND, trace silt, slight mottling (Marysville Sand) -@2' BGS becomes medium-dense, brown, with gravel -Easy to moderate difficulty penetrating test pit side wall with a piece of #4 rebar using a 5lb hammer at 3.3' BGS. -Color grades to gray blue at 5.3' BGS. -Interbedded lenses of gravel and sand from 6' BGS to test pit termination. -Increase in gravel size at 7' BGS.	
4	15	d					
6	16	d					
8	17	d					
10							

Test Pit Completed 05/09/23
Total Depth of Test Pit = 9.9 ft.

TP-4

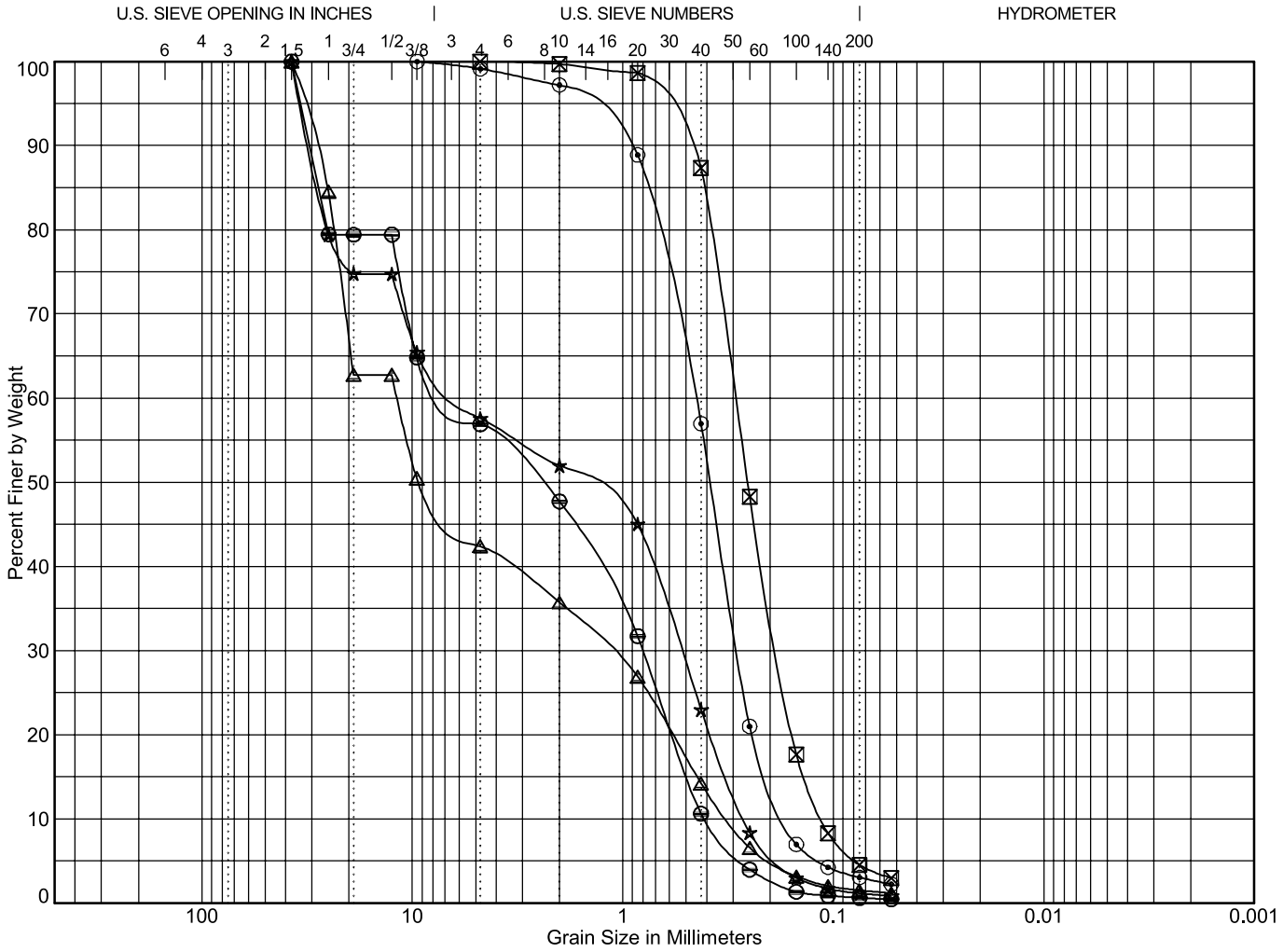
SAMPLE DATA			SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 138 Excavated By: Client Provided/Logged: GS	
0	18	d	W = 6 GS		SM/ OL	Loose, dark brown, damp, silty SAND, abundant grass roots (Topsoil)	Groundwater not encountered.
2	19	d			SP	Loose to medium dense, reddish brown to gray, damp, fine to medium grained SAND, trace silt (Marysville Sand) -@2' BGS becomes medium-dense, brown, with gravel -Easy to moderate difficulty penetrating test pit side wall with a piece of #4 rebar using a 5lb hammer at 3.1' BGS. -Increase in sand grain size and gravel content at approximately 4.1' BGS. -Color grades to gray blue at approximately 4.2' BGS. -Increase in gravel size at 6.0' BGS. -Cave in at 7.2' BGS.	
4	20	d					
6	21	d					
8	22	d					
10							

Test Pit Completed 05/09/23
Total Depth of Test Pit = 7.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST

Proposed 3-Lot Short-Plat 4405 188th Street NE Arlington, WA 98223	Log of Test Pits	Figure 6



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

Point		Depth	Classification	LL	PL	PI	C_c	C_u
⊖	TP-1	5.4	gravelly SAND, trace silt (SP)				0.26	15.42
⊠	TP-2	4.2	poorly graded SAND, trace silt (SP)				1.03	2.60
△	TP-2	8.7	very sandy GRAVEL, trace silt (GP)				0.35	37.04
★	TP-3	6.8	gravelly SAND, trace silt (SP)				0.18	22.12
⊙	TP-4	2.5	poorly graded SAND, trace gravel, and silt (SP)				1.07	2.71

Point		Depth	D_{90}	D_{60}	D_{50}	D_{30}	D_{10}	%Coarse Gravel	% Fine Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Fines
⊖	TP-1	5.4	30.788	6.24	2.479	0.803	0.405	20.6	22.5	9.2	37.1	10.0	0.6
⊠	TP-2	4.2	0.5	0.293	0.256	0.184	0.113	0.0	0.0	0.3	12.3	82.8	4.5
△	TP-2	8.7	28.864	11.757	9.134	1.147	0.317	37.2	20.4	6.7	21.5	12.7	1.5
★	TP-3	6.8	30.796	5.871	1.569	0.53	0.265	25.2	17.2	5.6	29.0	21.8	1.1
⊙	TP-4	2.5	0.952	0.454	0.384	0.286	0.168	0.0	0.9	2.0	40.2	53.9	3.0

*Extrapolated from data

$C_c = D_{30}^2/(D_{60} * D_{10})$

$C_u = D_{60}/D_{10}$

To be well graded: $1 < C_c < 3$ and $C_u > 4$ for GW or $C_u > 6$ for SW

GEOTEST

Proposed 3-Lot Short-Plat
4405 188th Street NE
Arlington, WA 98223

Grain Size Test Data

Figure 7

Northwest Agricultural Consultants

2545 W Falls Avenue
Kennewick, WA 99336
509.783.7450
www.nwag.com
lab@nwag.com

PAP-Accredited
NAPT

GeoTest Services Inc.
741 Marine Drive
Bellingham, WA 98225

Report: 63618-1-1
Date: May 12, 2023
Project No: 23-0276
Project Name: Proposed 3-Lot Plat

Sample ID	pH	Organic Matter	Cation Exchange Capacity
B1 @ 3.7’	6.5	0.58%	2.0 meq/100g
B3 @ 0.7’	6.3	4.93%	12.7 meq/100g
Method	**SM 4500-H^+ B**	**ASTM D2974**	**EPA 9081**

REPORT LIMITATIONS AND GUIDELINES FOR ITS USE[1]

Subsurface issues may cause construction delays, cost overruns, claims, and disputes. While you cannot eliminate all such risks, you can manage them. The following information is provided to help:

Geotechnical Services are Performed for Specific Purposes, Persons, and Projects

At GeoTest our geotechnical engineers and geologists structure their services to meet specific needs of our clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of an owner, a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client. No one except you should rely on your geotechnical engineer who prepared it. And no one – not even you – should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report is Based on a Unique Set of Project-Specific Factors

GeoTest's geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the clients goals, objectives, and risk management preferences; the general nature of the structure involved its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless GeoTest, who conducted the study specifically states otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

1Information in this document is based upon material developed by ASFE, Professional Firms Practicing in the Geosciences(asfe.org)

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed, for example, from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed construction,
- alterations in drainage designs; or
- composition of the design team; the passage of time; man-made alterations and construction whether on or adjacent to the site; or by natural alterations and events, such as floods, earthquakes or groundwater fluctuations; or project ownership.

Always inform GeoTest's geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. Do not rely on the findings and conclusions of this report, whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. Always contact GeoTest before applying the report to determine if it is still relevant. A minor amount of additional testing or analysis will help determine if the report remains applicable.

Most Geotechnical and Geologic Findings are Professional Opinions

Our site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoTest's engineers and geologists review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ – sometimes significantly – from those indicated in your report. Retaining GeoTest who developed this report to provide construction observation is the most effective method of managing the risks associated with anticipated or unanticipated conditions.

1Information in this document is based upon material developed by ASFE, Professional Firms Practicing in the Geosciences(asfe.org)

A Report's Recommendations are Not Final

Do not over-rely on the construction recommendations included in this report. Those recommendations are not final, because geotechnical engineers or geologists develop them principally from judgment and opinion. GeoTest's geotechnical engineers or geologists can finalize their recommendations only by observing actual subsurface conditions revealed during construction. GeoTest cannot assume responsibility or liability for the report's recommendations if our firm does not perform the construction observation.

A Geotechnical Engineering or Geologic Report may be Subject to Misinterpretation

Misinterpretation of this report by other design team members can result in costly problems. Lower that risk by having GeoTest confer with appropriate members of the design team after submitting the report. Also, we suggest retaining GeoTest to review pertinent elements of the design teams plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having GeoTest participate in pre-bid and preconstruction conferences, and by providing construction observation.

Do not Redraw the Exploration Logs

Our geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors of omissions, the logs included in this report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable; but recognizes that separating logs from the report can elevate risk.

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but preface it with a clearly written letter of transmittal. In that letter, consider advising the contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with GeoTest and/or to conduct additional study to obtain the specific types of information they need or prefer. A pre-bid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might you be in a position to give contractors the best information available, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

1Information in this document is based upon material developed by ASFE, Professional Firms Practicing in the Geosciences(asfe.org)

In addition, it is recommended that a contingency for unanticipated conditions be included in your project budget and schedule.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering or geology is far less exact than other engineering disciplines. This lack of understanding can create unrealistic expectations that can lead to disappointments, claims, and disputes. To help reduce risk, GeoTest includes an explanatory limitations section in our reports. Read these provisions closely. Ask questions and we encourage our clients or their representative to contact our office if you are unclear as to how these provisions apply to your project.

Environmental Concerns Are Not Covered in this Geotechnical or Geologic Report

The equipment, techniques, and personnel used to perform an environmental study differ significantly from those used to perform a geotechnical or geologic study. For that reason, a geotechnical engineering or geologic report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated containments, etc. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk management guidance. Do not rely on environmental report prepared for some one else.

Obtain Professional Assistance to Deal with Biological Pollutants

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts biological pollutants from growing on indoor surfaces. Biological pollutants includes but is not limited to molds, fungi, spores, bacteria and viruses. To be effective, all such strategies should be devised for the express purpose of prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional biological pollutant prevention consultant. Because just a small amount of water or moisture can lead to the development of severe biological infestations, a number of prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of this study, the geotechnical engineer or geologist in charge of this project is not a biological pollutant prevention consultant; none of the services preformed in connection with this geotechnical engineering or geological study were designed or conducted for the purpose of preventing biological infestations.

1Information in this document is based upon material developed by ASFE, Professional Firms Practicing in the Geosciences(asfe.org)

Appendix C

Operation and Maintenance

The following maintenance standards are as described in Volume V, Section 4.6.6, Table 5.3 of the SWMMWW.

Table V-4.5.2(2)			
Maintenance Standards - Infiltration			
Maintenance Component	**Defect**	**Conditions When Maintenance Is Needed**	**Results Expected When Maintenance Is Performed**
General	Trash & Debris	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Poisonous/Noxious Vegetation	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Contaminants and Pollution	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Rodent Holes	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
Storage Area	Sediment	Water ponding in infiltration pond after rainfall ceases and appropriate time allowed for infiltration. Treatment basins should infiltrate Water Quality Design Storm Volume within 48 hours, and empty within 24 hours after cessation of most rain events	Sediment is removed and/or facility is cleaned so that infiltration system works according to design.

		(A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. Test every 2 to 5 years. If two inches or more sediment is present, remove).	
Filter Bags (if applicable)	Filled with Sediment and Debris	Sediment and debris fill bag more than 1/2 full.	Filter bag is replaced or system is redesigned.
Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Gravel in rock filter is replaced.
Side Slopes of Pond	Erosion	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
Emergency Overflow Spillway and Berms over 4 feet in height.	Tree Growth	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Piping	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
Emergency Overflow Spillway	Rock Missing	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Erosion	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
Pre-settling Ponds and Vaults	Facility or sump filled with Sediment and/or debris	6" or designed sediment trap depth of sediment.	Sediment is removed.

Table V-4.5.2(5)			
Maintenance Standards - Catch Basins			
Maintenance Component	**Defect**	**Conditions When Maintenance Is Needed**	**Results Expected When Maintenance Is Performed**
General	Trash and Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No Trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.

	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch (Intent is to make sure no material is running into basin).	Top slab is free of holes and cracks
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.

	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present
	Contamination and Pollution	See "Detention Ponds" (No. 1).	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Latter Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate Opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

Table V-4.5.2(18)			
Maintenance Standards - Catchbasin Inserts			
Maintenance Component	**Defect**	**Conditions When Maintenance Is Needed**	**Results Expected When Maintenance is Performed**
General	Sediment Accumulation	When sediment forms a cap over the insert media of the insert and/or unit.	No sediment cap on the insert media and its unit.
	Trash and Debris Accumulation	Trash and debris accumulates on insert unit creating a blockage/restriction.	Trash and debris removed from insert unit. Runoff freely flows into catch basin.
	Media Insert Not Removing Oil	Effluent water from media insert has a visible sheen.	Effluent water from media insert is free of oils and has no visible sheen.
	Media Insert Water Saturated	Catch basin insert is saturated with water and no longer has the capacity to absorb.	Remove and replace media insert.
	Media Insert-Oil Saturated	Media oil saturated due to petroleum spill that drains into catch basin.	Remove and replace media insert.
	Media Insert Use Beyond Normal Product Life	Media has been used beyond the typical average life of media insert product.	Remove and replace media at regular intervals, depending on insert product.

Appendix D

WWHM Calculations

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	King SP Infiltration
Site Name:	KING SHORT PLAT
Site Address:	4405 188TH ST NE
City:	ARLINGTON
Report Date:	12/12/2023
Gage:	Everett
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.200
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

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Flat	1
Pervious Total	1
Impervious Land Use	acre
Impervious Total	0
Basin Total	1

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	1
Impervious Total	1
Basin Total	1

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 1	Gravel Trench Bed 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Gravel Trench Bed 1

Bottom Length:	250.00 ft.
Bottom Width:	10.00 ft.
Trench bottom slope 1:	0.001 To 1
Trench Left side slope 0:	0.001 To 1
Trench right side slope 2:	0.001 To 1
Material thickness of first layer:	2
Pour Space of material for first layer:	0.33
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	10
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	192.873
Total Volume Through Riser (ac-ft.):	0.007
Total Volume Through Facility (ac-ft.):	192.88
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	1.9 ft.
Riser Diameter:	12 in.
Element Flows To:	
Outlet 1	Outlet 2

Gravel Trench Bed Hydraulic Table

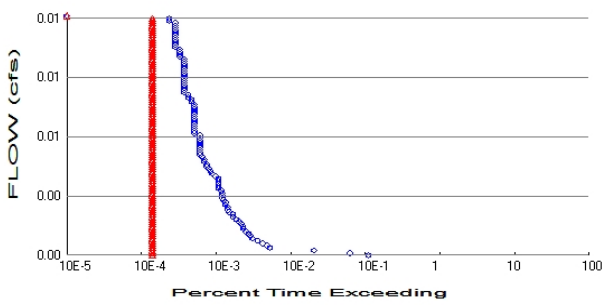
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.057	0.000	0.000	0.000
0.0222	0.057	0.000	0.000	0.578
0.0444	0.057	0.000	0.000	0.578
0.0667	0.057	0.001	0.000	0.578
0.0889	0.057	0.001	0.000	0.578
0.1111	0.057	0.002	0.000	0.578
0.1333	0.057	0.002	0.000	0.578
0.1556	0.057	0.002	0.000	0.578
0.1778	0.057	0.003	0.000	0.578
0.2000	0.057	0.003	0.000	0.578
0.2222	0.057	0.004	0.000	0.578
0.2444	0.057	0.004	0.000	0.578
0.2667	0.057	0.005	0.000	0.578
0.2889	0.057	0.005	0.000	0.578
0.3111	0.057	0.005	0.000	0.578
0.3333	0.057	0.006	0.000	0.578
0.3556	0.057	0.006	0.000	0.578
0.3778	0.057	0.007	0.000	0.578
0.4000	0.057	0.007	0.000	0.578
0.4222	0.057	0.008	0.000	0.578
0.4444	0.057	0.008	0.000	0.578
0.4667	0.057	0.008	0.000	0.578
0.4889	0.057	0.009	0.000	0.578
0.5111	0.057	0.009	0.000	0.578

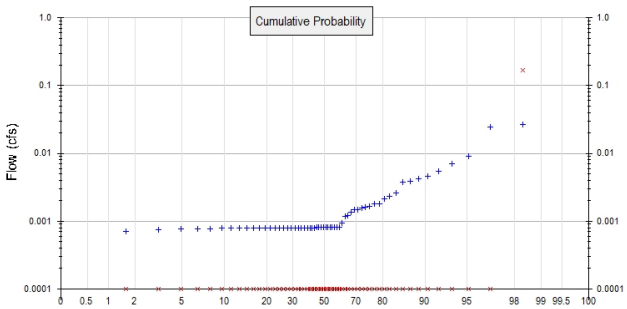
0.5333	0.057	0.010	0.000	0.578
0.5556	0.057	0.010	0.000	0.578
0.5778	0.057	0.010	0.000	0.578
0.6000	0.057	0.011	0.000	0.578
0.6222	0.057	0.011	0.000	0.578
0.6444	0.057	0.012	0.000	0.578
0.6667	0.057	0.012	0.000	0.578
0.6889	0.057	0.013	0.000	0.578
0.7111	0.057	0.013	0.000	0.578
0.7333	0.057	0.013	0.000	0.578
0.7556	0.057	0.014	0.000	0.578
0.7778	0.057	0.014	0.000	0.578
0.8000	0.057	0.015	0.000	0.578
0.8222	0.057	0.015	0.000	0.578
0.8444	0.057	0.016	0.000	0.578
0.8667	0.057	0.016	0.000	0.578
0.8889	0.057	0.016	0.000	0.578
0.9111	0.057	0.017	0.000	0.578
0.9333	0.057	0.017	0.000	0.578
0.9556	0.057	0.018	0.000	0.578
0.9778	0.057	0.018	0.000	0.578
1.0000	0.057	0.018	0.000	0.578
1.0222	0.057	0.019	0.000	0.578
1.0444	0.057	0.019	0.000	0.578
1.0667	0.057	0.020	0.000	0.578
1.0889	0.057	0.020	0.000	0.578
1.1111	0.057	0.021	0.000	0.578
1.1333	0.057	0.021	0.000	0.578
1.1556	0.057	0.021	0.000	0.578
1.1778	0.057	0.022	0.000	0.578
1.2000	0.057	0.022	0.000	0.578
1.2222	0.057	0.023	0.000	0.578
1.2444	0.057	0.023	0.000	0.578
1.2667	0.057	0.024	0.000	0.578
1.2889	0.057	0.024	0.000	0.578
1.3111	0.057	0.024	0.000	0.578
1.3333	0.057	0.025	0.000	0.578
1.3556	0.057	0.025	0.000	0.578
1.3778	0.057	0.026	0.000	0.578
1.4000	0.057	0.026	0.000	0.578
1.4222	0.057	0.026	0.000	0.578
1.4444	0.057	0.027	0.000	0.578
1.4667	0.057	0.027	0.000	0.578
1.4889	0.057	0.028	0.000	0.578
1.5111	0.057	0.028	0.000	0.578
1.5333	0.057	0.029	0.000	0.578
1.5556	0.057	0.029	0.000	0.578
1.5778	0.057	0.029	0.000	0.578
1.6000	0.057	0.030	0.000	0.578
1.6222	0.057	0.030	0.000	0.578
1.6444	0.057	0.031	0.000	0.578
1.6667	0.057	0.031	0.000	0.578
1.6889	0.057	0.032	0.000	0.578
1.7111	0.057	0.032	0.000	0.578
1.7333	0.057	0.032	0.000	0.578
1.7556	0.057	0.033	0.000	0.578
1.7778	0.057	0.033	0.000	0.578
1.8000	0.057	0.034	0.000	0.578

1.8222	0.057	0.034	0.000	0.578
1.8444	0.057	0.034	0.000	0.578
1.8667	0.057	0.035	0.000	0.578
1.8889	0.057	0.035	0.000	0.578
1.9111	0.057	0.036	0.012	0.578
1.9333	0.057	0.036	0.064	0.578
1.9556	0.057	0.037	0.138	0.578
1.9778	0.057	0.037	0.229	0.578
2.0000	0.057	0.037	0.333	0.578

Analysis Results

POC 1





\+ Predeveloped x Mitigated

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

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

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.001148
5 year	0.002489
10 year	0.003993
25 year	0.006974
50 year	0.010306
100 year	0.014949

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.001	0.000
1950	0.002	0.000
1951	0.002	0.000
1952	0.001	0.000
1953	0.001	0.000
1954	0.006	0.000
1955	0.004	0.000
1956	0.001	0.000
1957	0.001	0.000
1958	0.001	0.000

1959	0.002	0.000
1960	0.001	0.000
1961	0.004	0.170
1962	0.001	0.000
1963	0.001	0.000
1964	0.003	0.000
1965	0.001	0.000
1966	0.001	0.000
1967	0.002	0.000
1968	0.001	0.000
1969	0.001	0.000
1970	0.001	0.000
1971	0.004	0.000
1972	0.001	0.000
1973	0.001	0.000
1974	0.002	0.000
1975	0.001	0.000
1976	0.002	0.000
1977	0.001	0.000
1978	0.001	0.000
1979	0.002	0.000
1980	0.001	0.000
1981	0.001	0.000
1982	0.001	0.000
1983	0.001	0.000
1984	0.001	0.000
1985	0.001	0.000
1986	0.007	0.000
1987	0.005	0.000
1988	0.001	0.000
1989	0.001	0.000
1990	0.001	0.000
1991	0.001	0.000
1992	0.001	0.000
1993	0.001	0.000
1994	0.001	0.000
1995	0.001	0.000
1996	0.009	0.000
1997	0.025	0.000
1998	0.001	0.000
1999	0.001	0.000
2000	0.001	0.000
2001	0.001	0.000
2002	0.001	0.000
2003	0.001	0.000
2004	0.001	0.000
2005	0.001	0.000
2006	0.027	0.000
2007	0.001	0.000
2008	0.001	0.000
2009	0.001	0.000

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0266	0.1700
2	0.0248	0.0000
3	0.0090	0.0000

4	0.0070	0.0000
5	0.0055	0.0000
6	0.0046	0.0000
7	0.0042	0.0000
8	0.0039	0.0000
9	0.0038	0.0000
10	0.0026	0.0000
11	0.0023	0.0000
12	0.0021	0.0000
13	0.0018	0.0000
14	0.0018	0.0000
15	0.0017	0.0000
16	0.0016	0.0000
17	0.0016	0.0000
18	0.0015	0.0000
19	0.0015	0.0000
20	0.0013	0.0000
21	0.0012	0.0000
22	0.0012	0.0000
23	0.0009	0.0000
24	0.0008	0.0000
25	0.0008	0.0000
26	0.0008	0.0000
27	0.0008	0.0000
28	0.0008	0.0000
29	0.0008	0.0000
30	0.0008	0.0000
31	0.0008	0.0000
32	0.0008	0.0000
33	0.0008	0.0000
34	0.0008	0.0000
35	0.0008	0.0000
36	0.0008	0.0000
37	0.0008	0.0000
38	0.0008	0.0000
39	0.0008	0.0000
40	0.0008	0.0000
41	0.0008	0.0000
42	0.0008	0.0000
43	0.0008	0.0000
44	0.0008	0.0000
45	0.0008	0.0000
46	0.0008	0.0000
47	0.0008	0.0000
48	0.0008	0.0000
49	0.0008	0.0000
50	0.0008	0.0000
51	0.0008	0.0000
52	0.0008	0.0000
53	0.0008	0.0000
54	0.0008	0.0000
55	0.0008	0.0000
56	0.0008	0.0000
57	0.0008	0.0000
58	0.0008	0.0000
59	0.0007	0.0000
60	0.0007	0.0000
61	0.0006	0.0000

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0006	2353	3	0	Pass
0.0007	1324	3	0	Pass
0.0008	437	3	0	Pass
0.0009	112	3	2	Pass
0.0010	102	3	2	Pass
0.0011	89	3	3	Pass
0.0012	77	3	3	Pass
0.0013	66	3	4	Pass
0.0014	61	3	4	Pass
0.0015	58	3	5	Pass
0.0016	54	3	5	Pass
0.0017	50	3	6	Pass
0.0018	49	3	6	Pass
0.0019	47	3	6	Pass
0.0020	43	3	6	Pass
0.0020	40	3	7	Pass
0.0021	36	3	8	Pass
0.0022	36	3	8	Pass
0.0023	32	3	9	Pass
0.0024	31	3	9	Pass
0.0025	31	3	9	Pass
0.0026	29	3	10	Pass
0.0027	29	3	10	Pass
0.0028	27	3	11	Pass
0.0029	26	3	11	Pass
0.0030	26	3	11	Pass
0.0031	26	3	11	Pass
0.0032	25	3	12	Pass
0.0033	23	3	13	Pass
0.0034	23	3	13	Pass
0.0035	23	3	13	Pass
0.0036	23	3	13	Pass
0.0037	23	3	13	Pass
0.0038	21	3	14	Pass
0.0039	19	3	15	Pass
0.0040	18	3	16	Pass
0.0041	17	3	17	Pass
0.0042	16	3	18	Pass
0.0043	16	3	18	Pass
0.0044	15	3	20	Pass
0.0045	15	3	20	Pass
0.0046	14	3	21	Pass
0.0047	13	3	23	Pass
0.0048	13	3	23	Pass
0.0049	13	3	23	Pass
0.0050	13	3	23	Pass
0.0051	13	3	23	Pass
0.0052	13	3	23	Pass
0.0053	13	3	23	Pass
0.0054	13	3	23	Pass
0.0055	13	3	23	Pass
0.0056	11	3	27	Pass
0.0057	11	3	27	Pass

0.0058	11	3	27	Pass
0.0059	11	3	27	Pass
0.0060	11	3	27	Pass
0.0061	11	3	27	Pass
0.0062	11	3	27	Pass
0.0063	11	3	27	Pass
0.0064	11	3	27	Pass
0.0065	11	3	27	Pass
0.0066	11	3	27	Pass
0.0067	11	3	27	Pass
0.0068	11	3	27	Pass
0.0069	10	3	30	Pass
0.0070	10	3	30	Pass
0.0071	9	3	33	Pass
0.0072	9	3	33	Pass
0.0073	8	3	37	Pass
0.0074	8	3	37	Pass
0.0075	8	3	37	Pass
0.0076	8	3	37	Pass
0.0077	8	3	37	Pass
0.0078	8	3	37	Pass
0.0078	8	3	37	Pass
0.0079	8	3	37	Pass
0.0080	8	3	37	Pass
0.0081	8	3	37	Pass
0.0082	8	3	37	Pass
0.0083	8	3	37	Pass
0.0084	8	3	37	Pass
0.0085	8	3	37	Pass
0.0086	8	3	37	Pass
0.0087	7	3	42	Pass
0.0088	7	3	42	Pass
0.0089	7	3	42	Pass
0.0090	7	3	42	Pass
0.0091	6	3	50	Pass
0.0092	6	3	50	Pass
0.0093	6	3	50	Pass
0.0094	6	3	50	Pass
0.0095	6	3	50	Pass
0.0096	6	3	50	Pass
0.0097	6	3	50	Pass
0.0098	6	3	50	Pass
0.0099	6	3	50	Pass
0.0100	6	3	50	Pass
0.0101	6	3	50	Pass
0.0102	5	3	60	Pass
0.0103	5	3	60	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

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

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Gravel Trench Bed 1 POC	☐	175.52			☐	100.00			
Total Volume Infiltrated		175.52	0.00	0.00		100.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

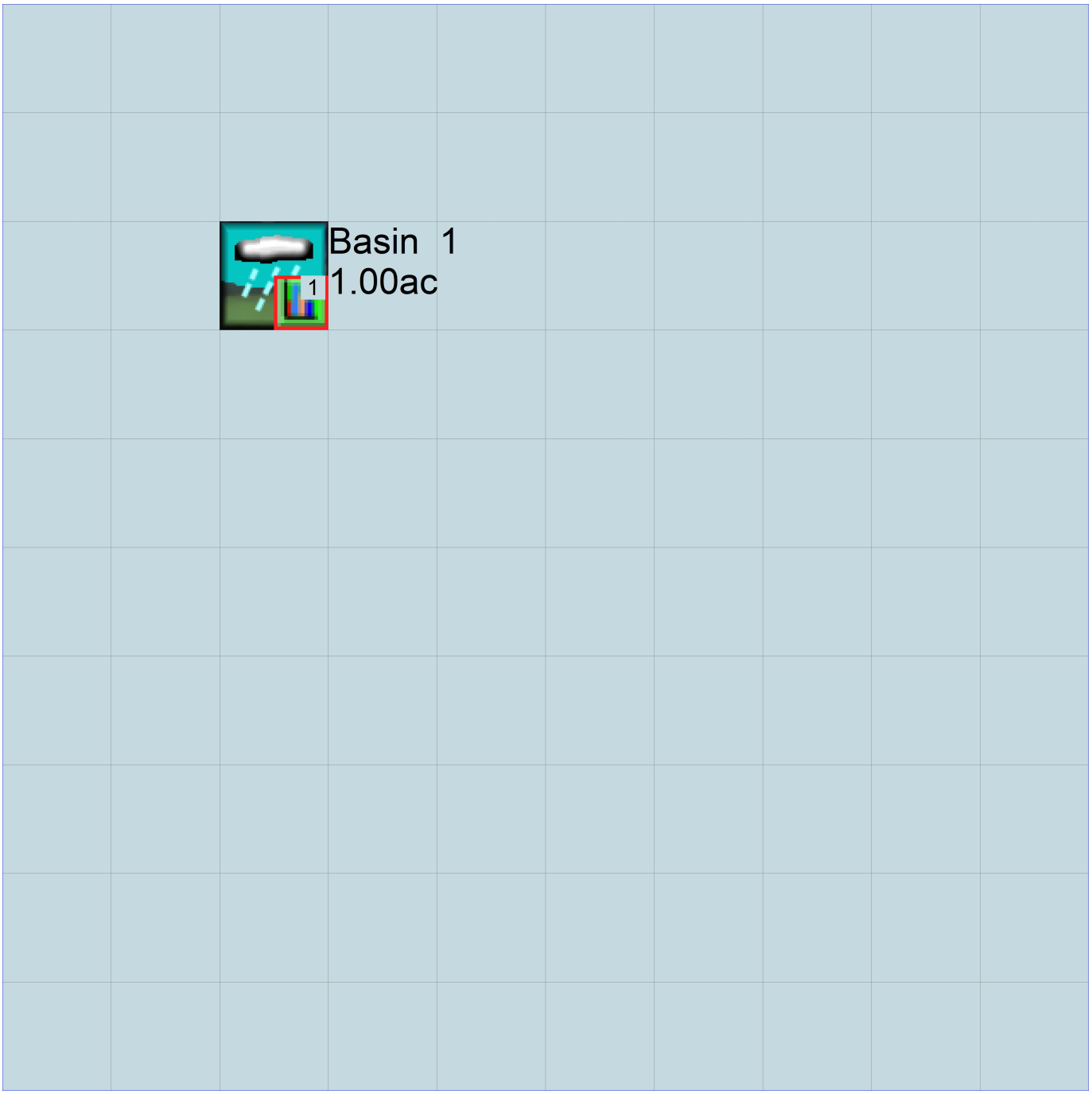
PERLND Changes

No PERLND changes have been made.

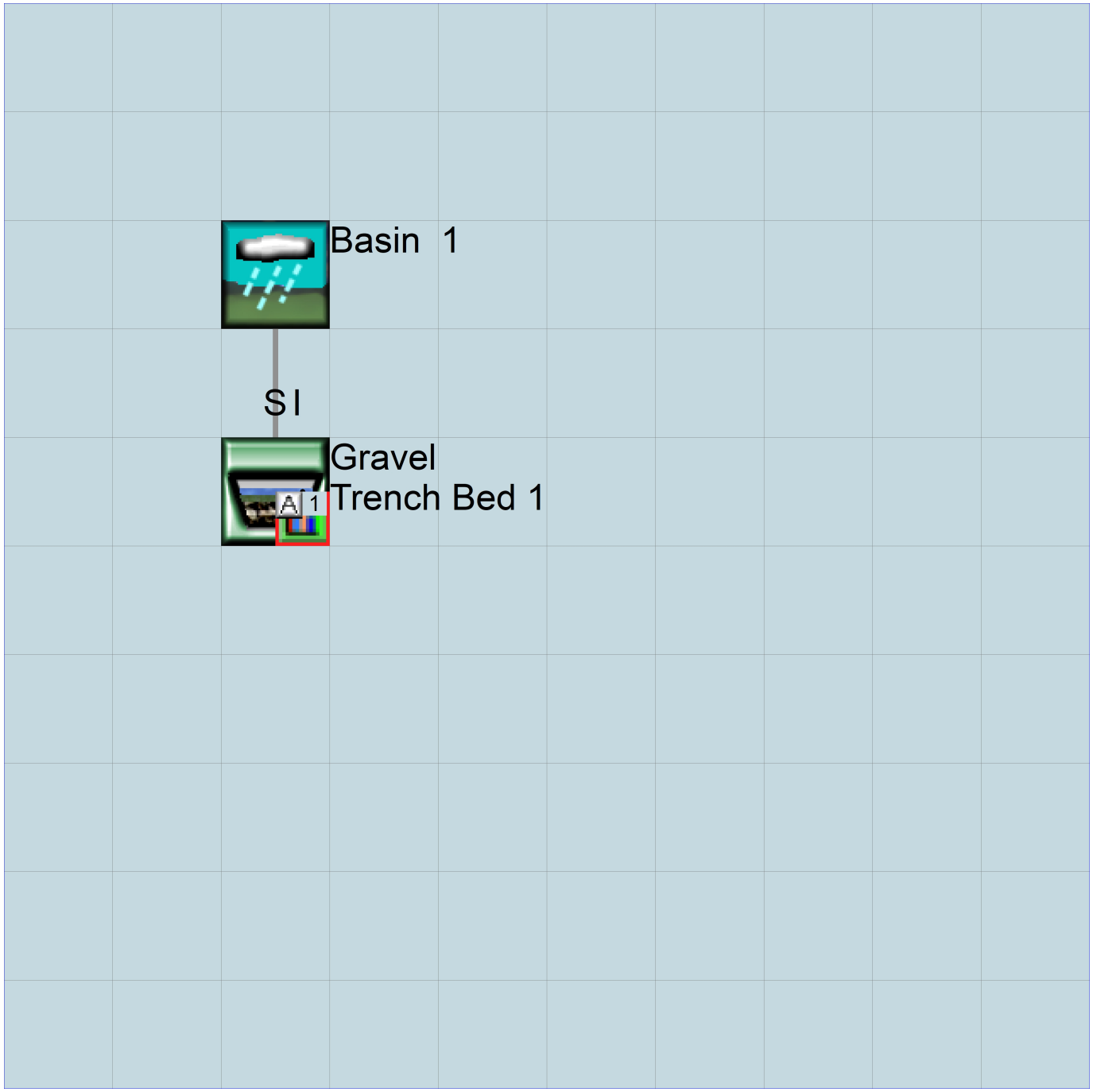
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 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   King SP Infiltration.wdm
MESSU       25   PreKing SP Infiltration.MES
            27   PreKing SP Infiltration.L61
            28   PreKing SP Infiltration.L62
            30   POCKing SP Infiltration1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                      in  out           ***
    1     A/B, 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 ***
    1         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  *********
    1         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 ***
    1         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
    1              0         5         2       400      0.05       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    1              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    1          0.2       0.5      0.35         0       0.7       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
    1              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
  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   1                          1      COPY   501     12
PERLND   1                          1      COPY   501     13

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

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



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

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

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.2            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.2            IMPLND   1 999 EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

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

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

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


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 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   King SP Infiltration.wdm
MESSU       25   MitKing SP Infiltration.MES
            27   MitKing SP Infiltration.L61
            28   MitKing SP Infiltration.L62
            30   POCKing SP Infiltration1.dat
END FILES

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

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

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

  PWAT-PARM1
```

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

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

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

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

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    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***
IMPLND   1                          1     RCHRES   1      5

******Routing******
IMPLND   1                          1     COPY     1     15
RCHRES   1                          1     COPY   501     17
END SCHEMATIC

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



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

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<----------------><---> User T-series  Engl Metr LKFG             ***
                                      in  out                               ***
    1     Gravel Trench Be-005    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

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

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

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

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1             1      0.05       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
           *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
```

FTABLES
FTABLE 1
92 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.057392	0.000000	0.000000	0.000000		
0.022222	0.057392	0.000421	0.000000	0.578704		
0.044444	0.057393	0.000842	0.000000	0.578704		
0.066667	0.057393	0.001263	0.000000	0.578704		
0.088889	0.057393	0.001684	0.000000	0.578704		
0.111111	0.057393	0.002104	0.000000	0.578704		
0.133333	0.057394	0.002525	0.000000	0.578704		
0.155556	0.057394	0.002946	0.000000	0.578704		
0.177778	0.057394	0.003367	0.000000	0.578704		
0.200000	0.057394	0.003788	0.000000	0.578704		
0.222222	0.057395	0.004209	0.000000	0.578704		
0.244444	0.057395	0.004630	0.000000	0.578704		
0.266667	0.057395	0.005051	0.000000	0.578704		
0.288889	0.057396	0.005472	0.000000	0.578704		
0.311111	0.057396	0.005892	0.000000	0.578704		
0.333333	0.057396	0.006313	0.000000	0.578704		
0.355556	0.057396	0.006734	0.000000	0.578704		
0.377778	0.057397	0.007155	0.000000	0.578704		
0.400000	0.057397	0.007576	0.000000	0.578704		
0.422222	0.057397	0.007997	0.000000	0.578704		
0.444444	0.057397	0.008418	0.000000	0.578704		
0.466667	0.057398	0.008839	0.000000	0.578704		
0.488889	0.057398	0.009260	0.000000	0.578704		
0.511111	0.057398	0.009681	0.000000	0.578704		
0.533333	0.057398	0.010102	0.000000	0.578704		
0.555556	0.057399	0.010522	0.000000	0.578704		
0.577778	0.057399	0.010943	0.000000	0.578704		
0.600000	0.057399	0.011364	0.000000	0.578704		
0.622222	0.057400	0.011785	0.000000	0.578704		
0.644444	0.057400	0.012206	0.000000	0.578704		
0.666667	0.057400	0.012627	0.000000	0.578704		
0.688889	0.057400	0.013048	0.000000	0.578704		
0.711111	0.057401	0.013469	0.000000	0.578704		
0.733333	0.057401	0.013890	0.000000	0.578704		
0.755556	0.057401	0.014311	0.000000	0.578704		
0.777778	0.057401	0.014732	0.000000	0.578704		
0.800000	0.057402	0.015153	0.000000	0.578704		
0.822222	0.057402	0.015574	0.000000	0.578704		
0.844444	0.057402	0.015995	0.000000	0.578704		
0.866667	0.057402	0.016416	0.000000	0.578704		
0.888889	0.057403	0.016837	0.000000	0.578704		
0.911111	0.057403	0.017258	0.000000	0.578704		
0.933333	0.057403	0.017678	0.000000	0.578704		
0.955556	0.057404	0.018099	0.000000	0.578704		
0.977778	0.057404	0.018520	0.000000	0.578704		
1.000000	0.057404	0.018941	0.000000	0.578704		
1.022222	0.057404	0.019362	0.000000	0.578704		
1.044444	0.057405	0.019783	0.000000	0.578704		
1.066667	0.057405	0.020204	0.000000	0.578704		
1.088889	0.057405	0.020625	0.000000	0.578704		
1.111111	0.057405	0.021046	0.000000	0.578704		
1.133333	0.057406	0.021467	0.000000	0.578704		
1.155556	0.057406	0.021888	0.000000	0.578704		
1.177778	0.057406	0.022309	0.000000	0.578704		
1.200000	0.057406	0.022730	0.000000	0.578704		
1.222222	0.057407	0.023151	0.000000	0.578704		
1.244444	0.057407	0.023572	0.000000	0.578704		
1.266667	0.057407	0.023993	0.000000	0.578704		
1.288889	0.057407	0.024414	0.000000	0.578704		
1.311111	0.057408	0.024835	0.000000	0.578704		
1.333333	0.057408	0.025256	0.000000	0.578704		
1.355556	0.057408	0.025677	0.000000	0.578704		
1.377778	0.057409	0.026098	0.000000	0.578704		
1.400000	0.057409	0.026519	0.000000	0.578704		
1.422222	0.057409	0.026940	0.000000	0.578704		

```
  1.444444  0.057409  0.027361  0.000000  0.578704
  1.466667  0.057410  0.027782  0.000000  0.578704
  1.488889  0.057410  0.028203  0.000000  0.578704
  1.511111  0.057410  0.028624  0.000000  0.578704
  1.533333  0.057410  0.029045  0.000000  0.578704
  1.555556  0.057411  0.029466  0.000000  0.578704
  1.577778  0.057411  0.029887  0.000000  0.578704
  1.600000  0.057411  0.030308  0.000000  0.578704
  1.622222  0.057411  0.030729  0.000000  0.578704
  1.644444  0.057412  0.031150  0.000000  0.578704
  1.666667  0.057412  0.031571  0.000000  0.578704
  1.688889  0.057412  0.031992  0.000000  0.578704
  1.711111  0.057413  0.032413  0.000000  0.578704
  1.733333  0.057413  0.032834  0.000000  0.578704
  1.755556  0.057413  0.033255  0.000000  0.578704
  1.777778  0.057413  0.033676  0.000000  0.578704
  1.800000  0.057414  0.034097  0.000000  0.578704
  1.822222  0.057414  0.034518  0.000000  0.578704
  1.844444  0.057414  0.034939  0.000000  0.578704
  1.866667  0.057414  0.035360  0.000000  0.578704
  1.888889  0.057415  0.035781  0.000000  0.578704
  1.911111  0.057415  0.036202  0.012432  0.578704
  1.933333  0.057415  0.036624  0.064540  0.578704
  1.955556  0.057415  0.037045  0.138729  0.578704
  1.977778  0.057416  0.037466  0.229424  0.578704
  2.000000  0.057416  0.037887  0.333520  0.578704
  2.022222  0.057416  0.039163  0.448641  0.578704
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.2            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.2            IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           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***
RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      1 1        1      WDM   1001 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      2 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1003 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

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

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

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


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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