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CITY OF MUKILTEO

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Stormwater Site Plan

Carrik Court

City of Mukilteo, Washington

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01/28/2022

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STORMWATER SITE PLAN

FOR

CARRIK COURT

CITY OF MUKILTEO, WA

TABLE OF CONTENTS

SECTION 1 – PROJECT OVERVIEW

This Storm Drainage Report (SDR) describes the engineering analysis of the surface water conditions, proposed development improvements, and required storm drainage facilities for the *Carrik Court* project located in Mukilteo, Washington. The report summarizes the design criteria for the storm drainage collection systems, associated flow control (i.e. detention) and water quality facilities, and temporary construction Best Management Practices (BMPs) proposed for the project. Figure 1 (Vicinity Map) illustrates the general location of the project site. Figures 2 and 3 of this report (see *Figures* section) illustrate the existing (i.e., pre-developed) and proposed developed conditions of the project area, respectively.

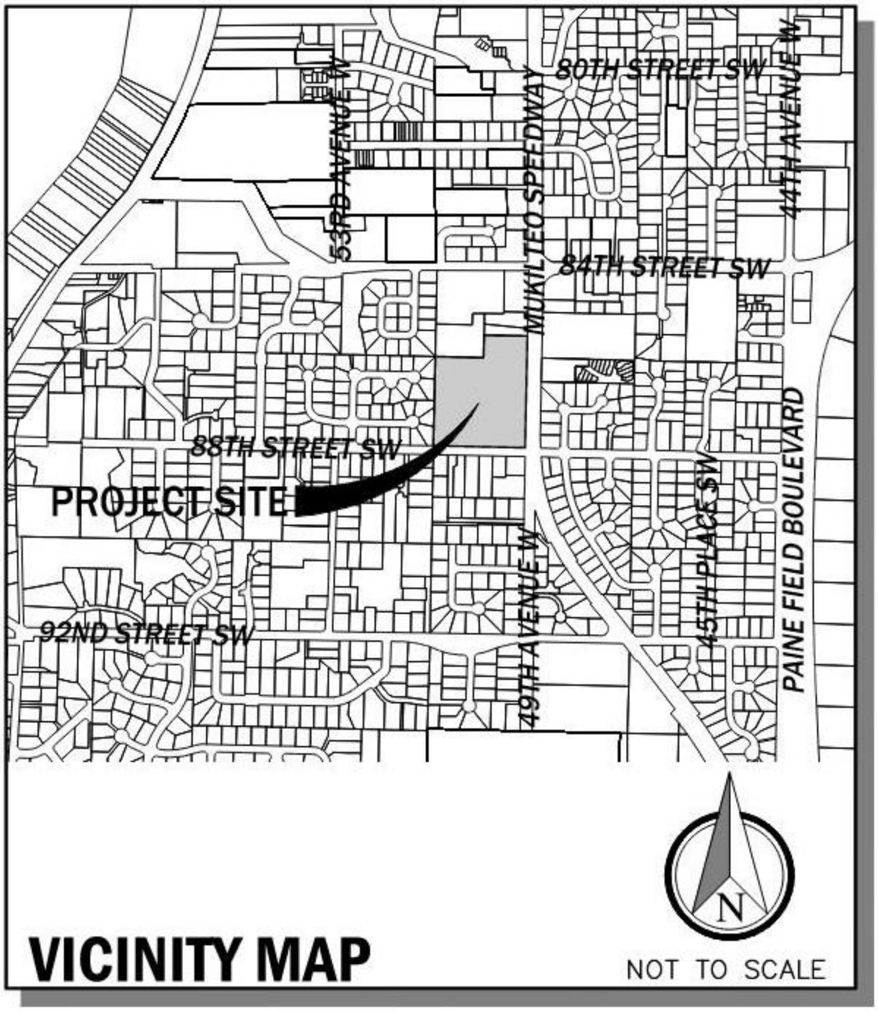

Figure 1 - Vicinity Map

Carrik Court is an urban residential community proposed with 114 new single-family residential townhome units and 16 live/work townhome residences on an approximately 9.6-acre site in the north-central portion of the City of Mukilteo. The site plan and residential buildings have been thoughtfully configured around contiguous common open space areas conveniently connected by a system of sidewalks and trails with a variety of active and passive recreation amenities for the residents. The live/work residential units have been sited along the frontage of Mukilteo Speedway consistent with the mixed-use provisions of Mukilteo Municipal Code (MMC) 17.25C.030.B.2b.

Private roads and/or drive aisles will provide access to the individual residential townhome buildings. Two separate commercial driveway approaches will connect these onsite roads/drives to the west right-of-way of SR525. The frontage of SR525 is expected to require pavement widening along with continuous curb, gutter, sidewalk, and landscape improvements to meet City standard. The extent/scope of frontage improvements for the project are expected to be known following the pre-application meeting with the City.

The current site plan includes more than twice the minimum required open space, including a large natural area in the south that will incorporate a wetland and stream and their associated buffers. This natural open space amenity will be accessible to the residents of the community via an improved trail system that will include viewpoints and passive recreation facilities such as benches, tables, and potentially interpretive signage. Later sections of this narrative and the accompanying reports provide additional details regarding these onsite critical area resources, including enhancements related to their partial relocation onsite.

SECTION 2 – EXISTING CONDITIONS SUMMARY

The project site is comprised of three real tax parcels (Snohomish County Parcel No. 00611600013402, 00611600013500, and 00611600013600) with a total area of approximately 9.6 acres. The western and southern approximately 6.5-acre portion of the site are zoned Planned Community Business (PCB) and the remaining north and northeast frontages are zoned Community Business (CB). The existing parcels currently contain two residential buildings and associated outbuildings. The site is bordered to the north and west by developed parcels, to the south by 88th Street Southwest, with access provided by Mukilteo Speedway via a concrete driveway at its easterly frontage.

The property is underlain by medium dense to dense glacial till deposits and isolated areas of fill. The general soil classification of the developable portion of the site is characterized by the Natural Resources Conservation Service (NRCS) as Vashon glacial till with Alderwood-Urban land complex and Alderwood gravelly sandy loam as the primary soil underlying the project site. The hydrogeologic and geotechnical reports along with the NRCS Web Soil Survey data are provided in Appendix A.

The northern and southern portions of the site are mostly undeveloped. The central, approximately 3 acres of the site was historically cleared and graded and is currently covered by mostly pasture grass and some maintained landscape and paved areas. This sparsely developed portion of the site contains an existing detached single-family residence, private gravel and asphalt paved driveways and parking areas, and associated outbuildings. The Existing topography has approximately 40 feet of elevation relief from the northeast corner of the site towards the southwest corner of the site. Critical areas comprised of one Category IV wetland and an unnamed Type 5 stream exist on the southern portion of the site.

SECTION 3 – OFFSITE ANALYSIS

The existing offsite land use and storm drainage conditions were evaluated using a variety of available online resources including the City's Stormwater Network Viewer, aerial imagery, GIS information, and Snohomish County Planning and Development Services (PDS) Map Portal. The project survey data and agency record drawings were additional sources of information for this offsite analysis. The following narrative of the offsite drainage conditions is also illustrated by Figure 7, *Offsite Drainage Conditions*.

Upstream Analysis

There are two threshold discharge areas (TDAs) and separate upstream contributing storm drainage basins for the project. The north TDA receives runoff as sheet and shallow concentrated flows from the roadway pavement of SR525 (Mukilteo Speedway) north from about midway along the east boundary. The majority of this contributing offsite, upstream basin is collected by a biofiltration swale located within the lower, very western margin of the SR525 right-of-way. It discharges treated storm water to an onsite drainage course. This drainage course is sparsely vegetated with an earthen bottom over a good portion of its length. It is primarily formed by the natural topography that falls and flows to the northwest toward the angle point ("notch") in the northwest boundary. A recent townhome project—the *Courtyard Townhomes*—developed the property immediately adjacent to this northwest boundary and installed a 12-inch culvert to collect and continue the offsite, downstream conveyance of the flows from this drainage course to the west.

The south TDA for the site is currently a mix of undeveloped forested areas in the southern limits and cleared, graded, and sparsely vegetated pasture with some paved areas and residential structures. Offsite upstream areas contribute runoff to the site's south TDA as sheet and shallow concentrated runoff from the shoulder and paved surfaces of both SR525 and 88th Street SW. The street drainage system on the north side of the intersection of SR525 and 88th Street SW collects a sizable upstream subbasin and discharges to the existing onsite Type 5 stream via an 18-inch concrete culvert. The land use cover within this upstream subbasin is comprised of mostly residential subdivisions of moderate density with associated roadways improvements. The roadway sections vary in this upstream contributing area with some having full curb, gutter, and sidewalk and below-grade street drainage systems and others have narrow shoulders with open conveyance ditches and culverts.

Downstream Analysis

The conveyance systems that collect the site's north TDA are comprised of culverts, below grade pipes, open channels, and a wetland. The 12-inch culvert that collects runoff from the onsite drainage at the "notch" at the northwest boundary drains into a short reach of below grade pipes and catch basins that discharge to the buffer of a Category IV wetland. This wetland overflows to Naketa Beach Creek approximately 0.04 miles (220 feet) north of the northwest boundary of the site. Naketa Beach Creek is a narrow urban stream that meanders and flows north and west along the perimeter of commercial sites and through several residential yards within the Smugglers Cove subdivision. A culvert of unknown size and material conveys Naketa Beach Creek under Smugglers Cove Lane. This culvert discharges to a daylight portion of Naketa Beach Creek that flows north along the side yard of a residential lot (8465 Smugglers Cove Lane) into a forested, approximately 370-foot reach of open channel in the open space adjacent to the south right-of-way of 84th Street SW. A culvert located approximately 0.25 miles downstream of the project site just east of the intersection of 53rd Avenue West and 84th

Street SW collects the flows from Naketa Beach Creek and continues its conveyance north and west via the public road drainage system.

The south TDA of the site drains generally west to a complex of Class IV wetlands and a Type 5 stream. These areas ultimately discharge and converge to an earthen and vegetated roadside ditch within the 88th Street SW right-of-way. This ditch continues to flow west from the project's point of compliance (POC2) at the southwest corner of the site toward a culvert located approximately 0.09 miles (460 feet) downstream of the site. The existing culvert drains south into the existing street drainage system located along the south side of 88th Street SW where it then flows east for approximately 0.03 miles (140 feet) to a connection with another City drainage system that flows south presumably in easements over several private properties. This public storm drainage reach system is comprised of approximately 0.07 miles (365 feet) of below grade pipe that outlets to the upstream end of an approximately 0.04 miles (235 feet) of an unnamed open channel drainage course. The drainage course appears to occur within a heavily vegetated ravine over private property up to a confluence with Smuggler's Gulch Creek approximately 0.24 miles downstream of the project site. Smuggler's Gulch Creek continues to flow west as an open channel, natural drainage course though residential yard areas from this point for about another 0.06 miles (290 feet) where it is collected by a culvert in the street drainage system along the east side of 53rd Avenue West.

SECTION 4 – Permanent Stormwater Control Plan

Performance Standards, Goals and Facility Proposals

The storm drainage analysis and facilities design for this project are proposed in general accordance with the 2012 Department of Ecology Stormwater Management Manual for Western Washington (SMMWW), as amended in December 2014. The project is classified as New Development and will result in greater than 5,000 square-feet of new impervious surface, therefore all nine Minimum Requirements for stormwater management specified by the manual are applicable.

The hydrologic analysis of the runoff conditions for the project site was performed using the Western Washington Hydrologic Model 2012 (WWHM) software to generate peak design flow rates and volumes. A detention vault and detention chambers are proposed in the west and southwest portion of the site to treat and detain runoff. Appendix B contains the WWHM model results for the proposed stormwater system.

Pre-developed Site Hydrology

Table 4.1 shows the pre-developed land use inputs used in the WWHM model and Table 4.2-4.3 summarizes the resulting peak design runoff rates. See Figure 4 for pre-developed drainage basins.

Table 4.1 – Pre-developed Drainage Subbasins

Basin	Land Use Area (ac)			
	Forest	Lawn	Impervious	Total
North Basin (POC 1)	3.42	0.000	0.000	3.42
Upstream North Basin (POC 1)	0.000	0.000	0.277	0.277
South Basin (POC 2)	0.394	0.000	0.000	0.394
Upstream South Basin (POC 2)	0.000	0.000	0.095	0.095
Drive G Basin (POC 2)	0.580	0.000	0.000	0.580

Table 4.2 –Pre-developed Peak Flows (POC 1)

Event	Flow Rate (cfs)
2-yr	0.1246
10-yr	0.1709
25-yr	0.2526
50-yr	0.2911
100-yr	0.3325

Table 4.3 –Pre-developed Peak Flows (POC 2)

Event	Flow Rate (cfs)
2-yr	0.0808
10-yr	0.1218
25-yr	0.1530
50-yr	0.2338
100-yr	0.2735

On-Site Stormwater Management

Minimum Requirement #5 addresses the application of on-site stormwater management BMPs with the intent to "infiltrate, disperse, and retain stormwater runoff on-site to the extent feasible without causing flooding or erosion impacts." Requirements for this project are specified on Table I-2.5.1 and Figure I-2.5.1. These are included here with the relevant text highlighted.

The feasibility of the BMPs in DOE List #2 have been evaluated for the *Carrik Court* project as a new development inside the UGA. BMPs listed were considered for each type of surface to determine if their use/application for this project was feasible based on the following criteria:

1. Design criteria, limitations, and infeasibility criteria identified for each BMP in this manual; and
2. Competing Need Criteria listed in Chapter V-5 – On-Site Stormwater Management.

Lawn and landscaped areas:

1. **Post-Construction Soil Quality and Depth in accordance with BMP T5.13**

   This BMP is feasible. All soils in lawn and landscaped areas will meet the design guidelines of BMP T5.13. This will be accomplished through one or more of the following implementation methods identified in the manual:

   a. retention of undisturbed native vegetation and soil, or
   b. amendment of existing site topsoil, or
   c. stockpiling and reuse of existing topsoil or import of approved topsoil mix.

Roofs:

1. **Full Dispersion in accordance with BMP T5.30, or Downspout Full Infiltration Systems in accordance with BMP T5.10A**

   These BMPs are not feasible as there are no feasible locations on site where the required vegetated flow path length can be accommodated. The glacial till soil on site exhibits low permeability and is not a suitable receptor for infiltration or retention facilities.

2. **Bioretention facilities in accordance with BMP T7.30**

   This BMP is not feasible. The glacial till soil on site exhibits low permeability and is not a suitable receptor for infiltration or retention facilities.

3. **Downspout Dispersion Systems in accordance with BMP T5.10B**

   This BMP is not feasible. The proposed lots, designed in accordance with City of Mukilteo PRD requirements, are not large enough to accommodate the vegetated flow path required for dispersion.

4. **Perforated Stub-out Connections in accordance with BMP T5.10C**

   This BMP is feasible except where un-weathered glacial till soil is exposed that will likely interfere with the trench bottom.

Other Hard Surfaces:

1. **Full Dispersion in accordance with BMP T5.30**

   This BMP is not feasible. The site does not have any critical areas and flooding or erosion impacts are not anticipated. There are also no feasible locations on site where the required vegetated flow path length can be accommodated.

2. **Permeable Pavement in accordance with BMP T5.156**

   This BMP is not feasible. The glacial till soil on site exhibits low permeability and is not a suitable receptor for infiltration or retention facilities.

3. **Bioretention facilities in accordance with BMP T7.30**

   This BMP is not feasible. The glacial till soil on site exhibits low permeability and is not a suitable receptor for infiltration or retention facilities.

4. **Sheet Flow Dispersion in accordance with BMP T5.12, or Concentrated Flow Dispersion in accordance with BMP T5.11**

   This BMP is not feasible. The proposed lots are not large enough to accommodate the vegetated flow path required for dispersion.

The geotechnical report (Appendix A) provides additional confirmation that infiltration stormwater management BMPs are not practically feasible based on in-situ soil conditions.

Developed Site Hydrology

The Standard Flow Control Requirement, part of Minimum Requirement #7, will be applied and states that, "Stormwater discharges shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow."

Developed site conditions (Figure 3) within the area were modeled based on the basin configuration shown in Figure 5 and the land use covers summarized in Table 4.4 and Appendix C. Impervious road and sidewalk surface, both on-site and frontage, was calculated from the proposed footprint shown on the improvement plans.

There are two threshold discharge areas on the site. The north basin collects, conveys, and discharges flows with no flow control standards to a point of compliance #1 (POC 1). This threshold discharge area (North Basin) meets the LID performance standards. This basin is mainly comprised of pervious surfaces.

The second threshold discharge area (south basin) is located adjacent to the north basin. The developed basins are shown and detailed in Figure 5. There is one sub-basin referred to as Drive G basin that is located within the south basin. The Drive G basin shares the same point of compliance #2 (POC 2) as the south basin but will have localized detention chambers in drive aisles. There is a portion of proposed pollution generating impervious surface along the Mukilteo Speedway frontage that will not be collected, however, an approximately equivalent area of existing roadway upstream will be collected and conveyed to the stormwater vault (Figure 5). Similarly, there will be a water quality treatment swap located on the frontage of 88th Street southwest. A bypass area west of the Drive A entrance will not be collected and treated. A larger area of existing pollution generating surface that extends from the Drive A entrance east to the intersection of 88th Street southwest and Mukilteo Speedway will be collected and treated (Figure 6).

An infiltration detention vault and a localized detention chamber facility is proposed for the project. The vault and the chambers have controlled discharge to the same existing wetland area at the southwest corner of the site. The vault provides flow control by utilizing an 18-inch diameter riser with a 2-orifice design to meet the applicable standards and will discharge at the southwest corner of the project site. The 50-year stage storage volume for the vault is 2.78 acre-feet. The vault has been designed and modeled to infiltrate at a rate of 0.04 inches/hour. This long-term design infiltration rate was recommended in the infiltration report seen in Appendix A.

The chamber facility located in the drive aisles of Drive G, provides flow control with a 12-inch diameter riser has a diameter with a 1-orifice design used to meet the applicable standards and will discharge at the southwest corner of the project site.

Table 4.4 shows the developed land use inputs used in the WWHM model. Tables 4.5 and 4.6 summarizes the mitigated peak design flow rates.

Table 4.4 - Developed Drainage Sub-basins

Basin	Land Use Area (ac)				
	Forrest	Pasture	Lawn	Impervious	Total
Developed (North)	0.000	0.360	0.000	0.210	0.570
Upstream Basin North	0.000	0.000	0.000	0.118	0.118
North Bypass Basin	0.000	0.000	0.000	0.043	0.043
Drive G Basin	0.000	0.195	0.000	0.385	0.580
Developed (South)	0.000	2.336	0.000	4.950	7.286
Offsite South	0.000	0.377	0.000	0.184	0.561
South Bypass Basin	0.000	0.059	0.000	0.349	0.408

Table 4.5 – Developed Peak Flows (POC 1)

Event	Flow Frequency Return Periods at Point of Compliance (cfs)
2-yr	0.1110
10-yr	0.1792
25-yr	0.2188
50-yr	0.2508
100-yr	0.2850

Table 4.6 – Developed Peak Flows (POC 2)

Event	Flow Frequency Return Periods at Point of Compliance (cfs)
2-yr	0.0403
10-yr	0.1159
25-yr	0.1859
50-yr	0.2588
100-yr	0.3548

Conveyance System Analysis and Design

The project proposes to collect on-site runoff and convey it to either the stormwater vault or detention chambers prior to release offsite. The majority of the site runoff will be conveyed to the vault. Surface runoff will be collected by roof drains, roadway and yard inlets, and a system of below grade pipes on the site. These systems convey runoff to either the onsite detention vault or detention chamber facility for flow control and treatment. Along the 88th Street southwest frontage, pipe conveyance is proposed to collect surface flows from pollution generating surfaces and direct them to a water quality facility located along the curb at the entrance of Drive A. A duplex pump station facility is proposed immediately following the control structure of the vault. Flows the vault, by way of the control structure, and flows from the chambers combine at the pump station. From here the combined flows are conveyed to the main onsite water quality facility.

Water Quality Treatment

Basic water quality treatment, per Minimum Requirement #6, is required for surface water runoff from all new pollution generating surfaces created with development of the site. Onsite water quality treatment is proposed by utilizing a Contech ZPG Stormfilter downstream of the detention vault and chamber facilities. The water quality facilities will receive mitigated flows from both the vault and chambers. This shared water quality facility is located off the southeast corner of the detention vault. The media filter facility has been sized to treat the cumulative 2-year mitigated release rate from the two flow control facilities (Q=0.403 cfs). A detail of the media filter design is included in Appendix D. A separate, standalone Contech ZPG StormFilter water quality facility is proposed along the 88th Street southwest frontage near the entrance of Drive A (see Figure 6 and Appendix D).

SECTION 5 – Construction Stormwater Pollution Prevention Plan

Storm Water Pollution Prevention Plan (SWPPP)

1. *Mark Clearing Limits*

   To prevent disturbance of project areas not designated for construction, a construction clearing limits fence or silt fence will be installed by the Contractor along the perimeter of the project site to protect existing native area outside of the mitigation area. These fences will be installed in accordance with the details and specifications provided in the Plans prior to any clearing and grading activities. All sensitive areas and buffers shall also be fenced prior to construction activities.

2. *Establish Construction Access*

   The contractor shall employ appropriate BMP measures to prevent transport of sediment offsite by motor vehicles.

3. *Control Flow Rates*

   The contractor will be responsible for installing temporary erosion control BMP's to control the release rate and water quality of surface water from active construction areas.

4. *Install Sediment Controls*

   On-site sediment retention will be controlled by a combination of silt fences, temporary interceptor trenches, and the proposed detention pond as shown on the Plans. The contractor shall inspect and provide regular maintenance of these facilities throughout the duration of construction to ensure maximum sediment control.

5. *Stabilize Soils*

   Temporary and permanent cover measures will be provided by the Contractor to protect disturbed areas. Straw mulching is typically used to provide temporary protection from erosion at exposed soil areas. Plastic covering may also be used in order to protect cut and fill slopes, and/or to encourage grass growth in newly seeded areas. Disturbed areas that remain unworked for at least 7 days will be seeded and mulched to provide permanent cover measure and to limit erosion potential.

   Water will be used by the Contractor as allowed by local agency regulations and applicable SWMM standards to prevent wind transport of exposed soils. Exposed soils will be sprayed until wet and re-sprayed as needed during dry weather periods.

6. *Protect Slopes*

   The project does not require any disturbance of soils within steep slope or erosion hazard areas. Temporary and permanent seeding to stabilize exposed soil areas is expected to be sufficient for protecting on-site slopes—whether constructed or at disturbed native areas. Plastic covering may also be used to protect cut and fill slopes if seasonal limitations warrant and/or to encourage grass growth in newly seeded areas. The contractor shall take all practical efforts including installation of temporary interceptor ditches to direct potential storm water runoff away from the top of on-site slopes.

7. *Protect Drain Inlet*
   All storm drain inlets made operable during construction or otherwise existing in the vicinity of work areas shall be protected using pre-manufactured filter fabric catch basin inserts to protect against construction storm water runoff entering the conveyance system. The Contractor will be responsible for maintenance of all temporary sediment control BMP's during construction, including removal of accumulated sediment, as well as for the ultimate removal of these controls and remaining accumulated sediment upon completion of construction.

8. *Stabilize Channels and Outlets*
   Methods of protection may include silt fence installation and maintenance, catch basin inserts, and temporary interceptor ditches. Vegetated areas shall be maintained whenever possible or practical to provide for natural filtration of construction storm water discharges.

9. *Control Pollutants*
   Special provisions shall be taken to reduce the risk of pollutant contamination from the construction access, concrete handling/wash areas, and sawcutting/surfacing activities. No water used in or contacting areas of construction shall be allowed to drain directly towards on-site buffer areas or wetlands without prior treatment. Vehicle maintenance shall only be performed at approved on-site areas and only after proper containment devices are in place downstream of those areas. Any flammable or otherwise hazardous liquids shall be stockpiled only at the approved construction staging area.

10. *Control Dewatering*
    Temporary dewatering efforts may be required to facilitate some elements of construction such as storm drainage and utilities installation. Any such dewatering volumes encountered will be collected and controlled using pumps and sediment traps or tanks. Discharge from these controlled onsite facilities will be dispersed to approved areas of native vegetation or otherwise treated using setting tanks or other mechanical filtration facilities prior to release to downstream systems as required to conform with General Construction Stormwater permit standards.

11. *Maintain BMPs*
    All TESC measures will be inspected and maintained on a regular basis following the maintenance requirements identified for each in the Plans and/or the project's Storm Water Pollution Prevention Plan (SWPPP). An ESC supervisor will be designated by the Contractor and the name, address and phone number of the ESC supervisor will be given to the regulatory jurisdiction prior to the start of construction.

    The ESC supervisor will inspect the site at least once a month during the dry season, weekly during the wet season, and within 24 hours of each runoff-producing storm event. An ESC maintenance report will be used as a written record of all maintenance in accordance with the project SWPPP

12. *Manage the Project*

    The Contractor will be responsible for the phasing of erosion and sediment controls during construction so that they are adequately coordinated with all construction activities. The Contractor will be responsible for maintenance of all temporary sediment control BMP's during construction, including removal of accumulated sediment, as well as for the ultimate removal of these controls and cleaning of existing permanent storm drainage facilities upon completion of construction.

13. *Protect Low Impact Development BMPs*

    The project geotechnical engineer determined that the onsite soils are not favorable for infiltrative BMPs. As such, no low impact development BMPs are proposed with this project. No special protection is required.

FIGURES

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FIGURE 2- EXISTING SITE CONDITIONS

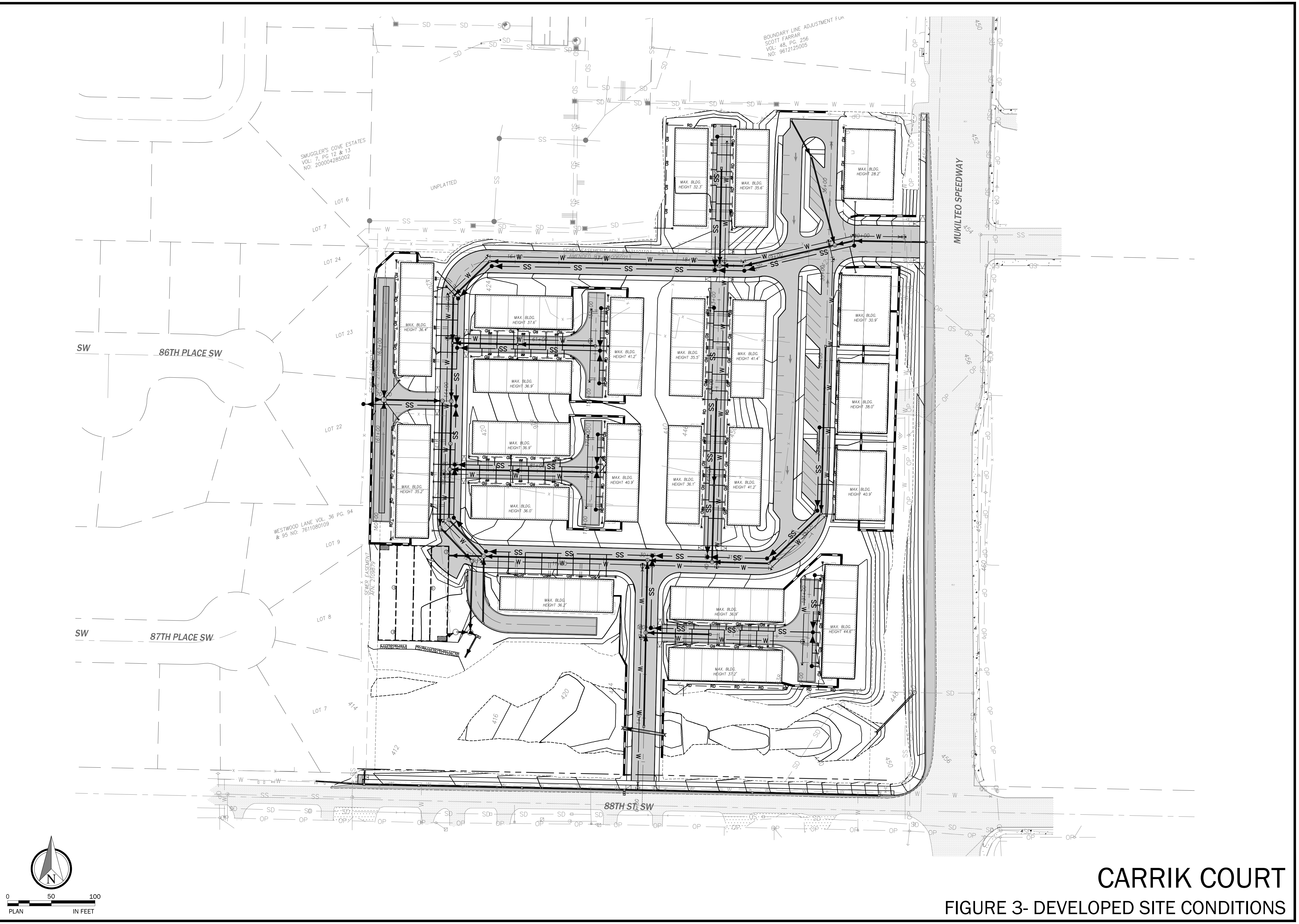

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FIGURE 3- DEVELOPED SITE CONDITIONS

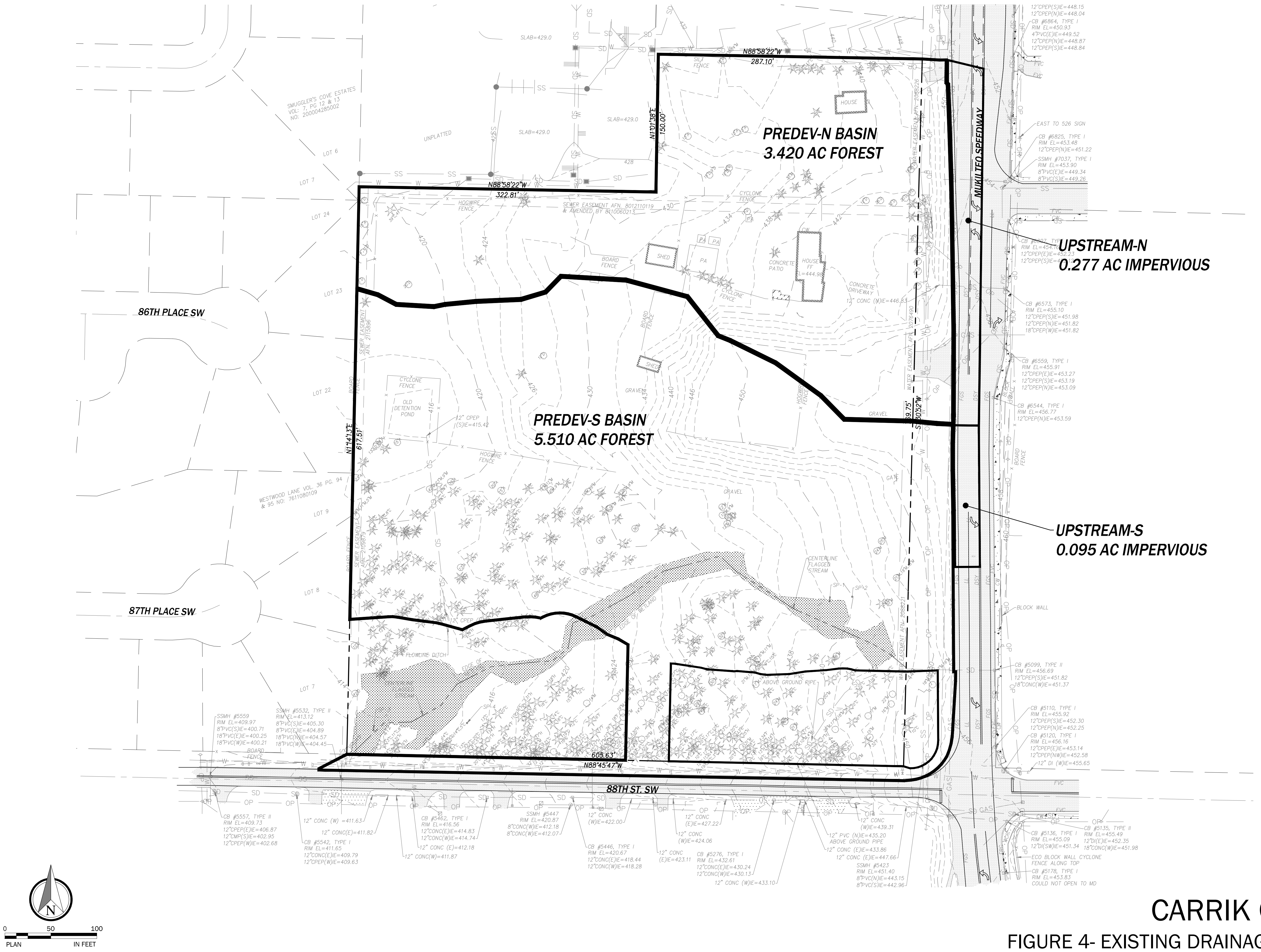

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FIGURE 4- EXISTING DRAINAGE BASINS

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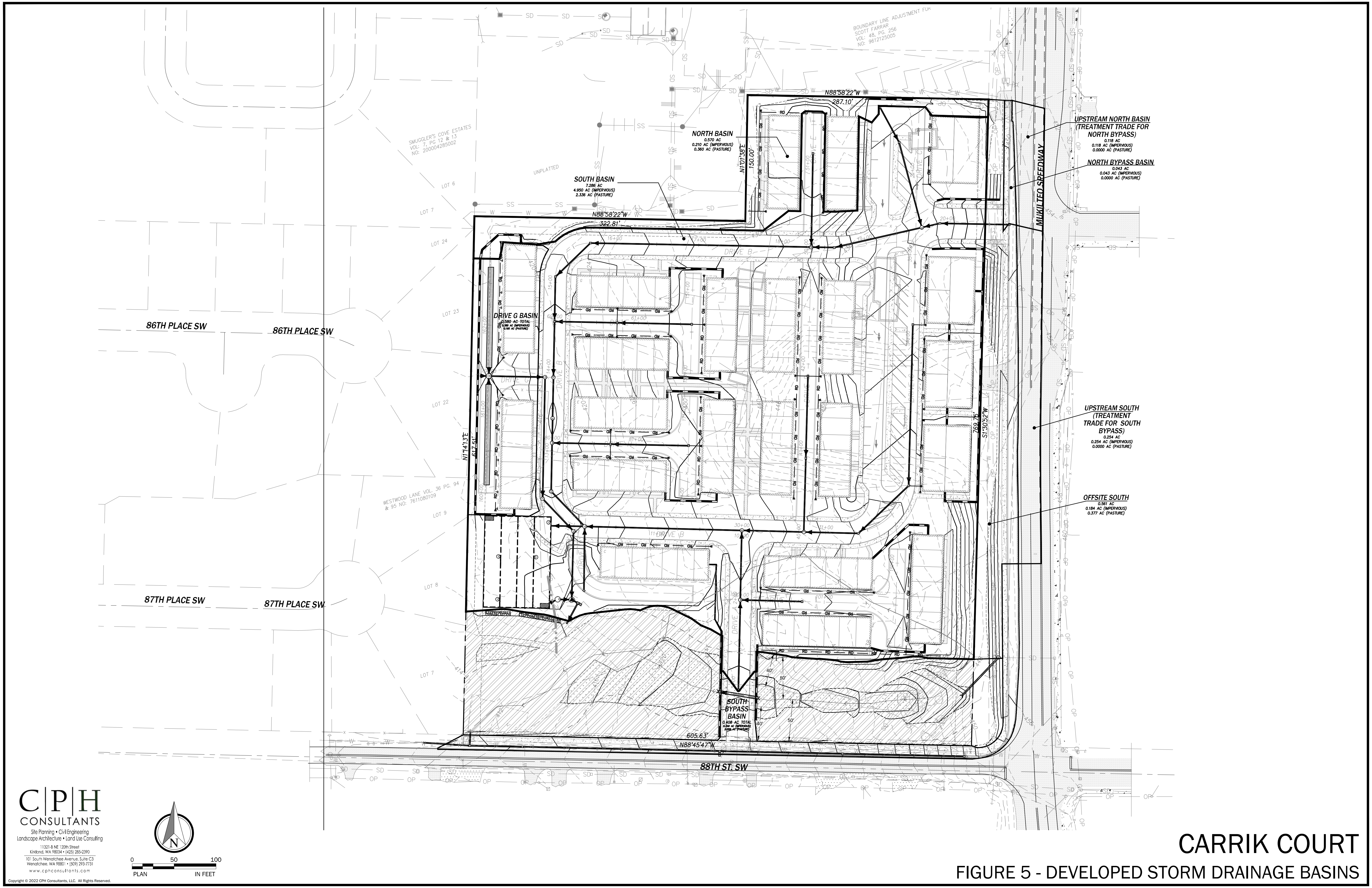

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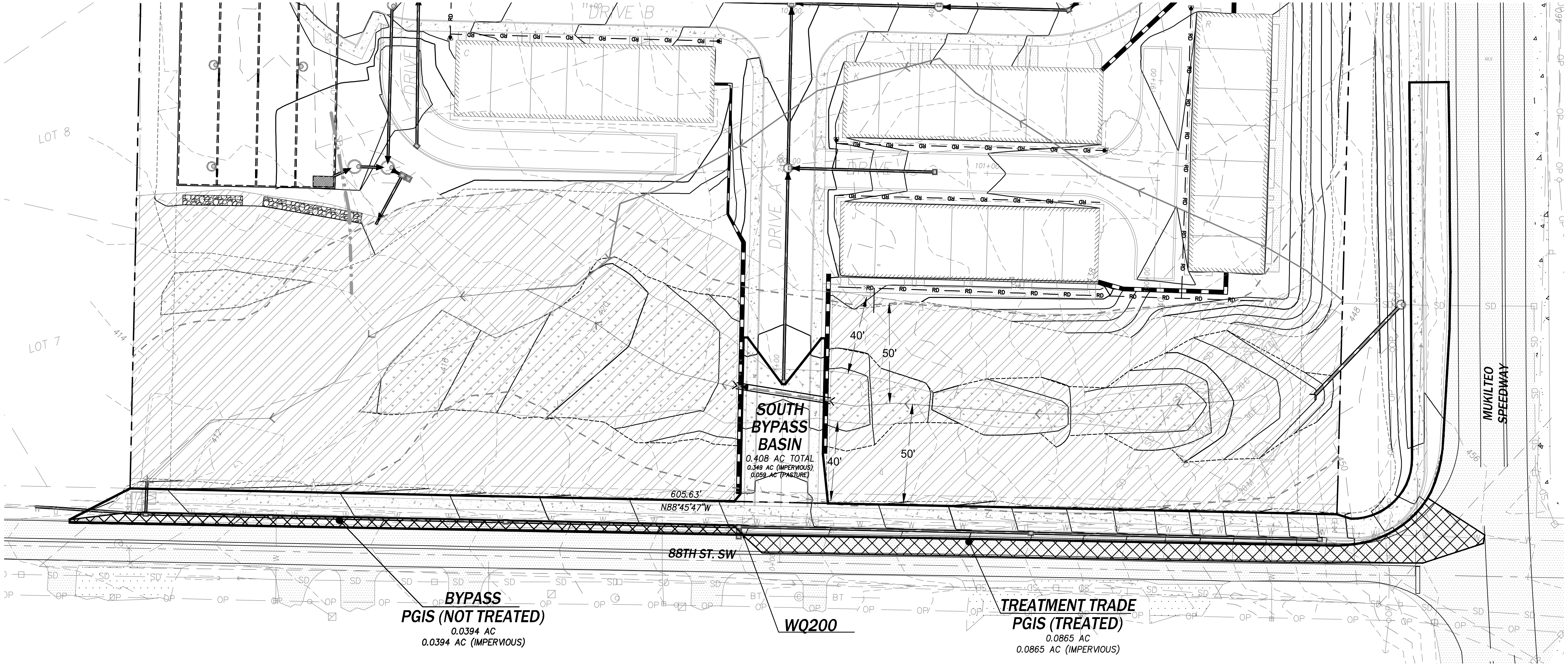
FIGURE 5 - DEVELOPED STORM DRAINAGE BASINS



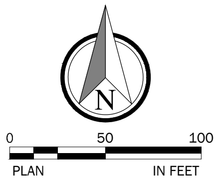


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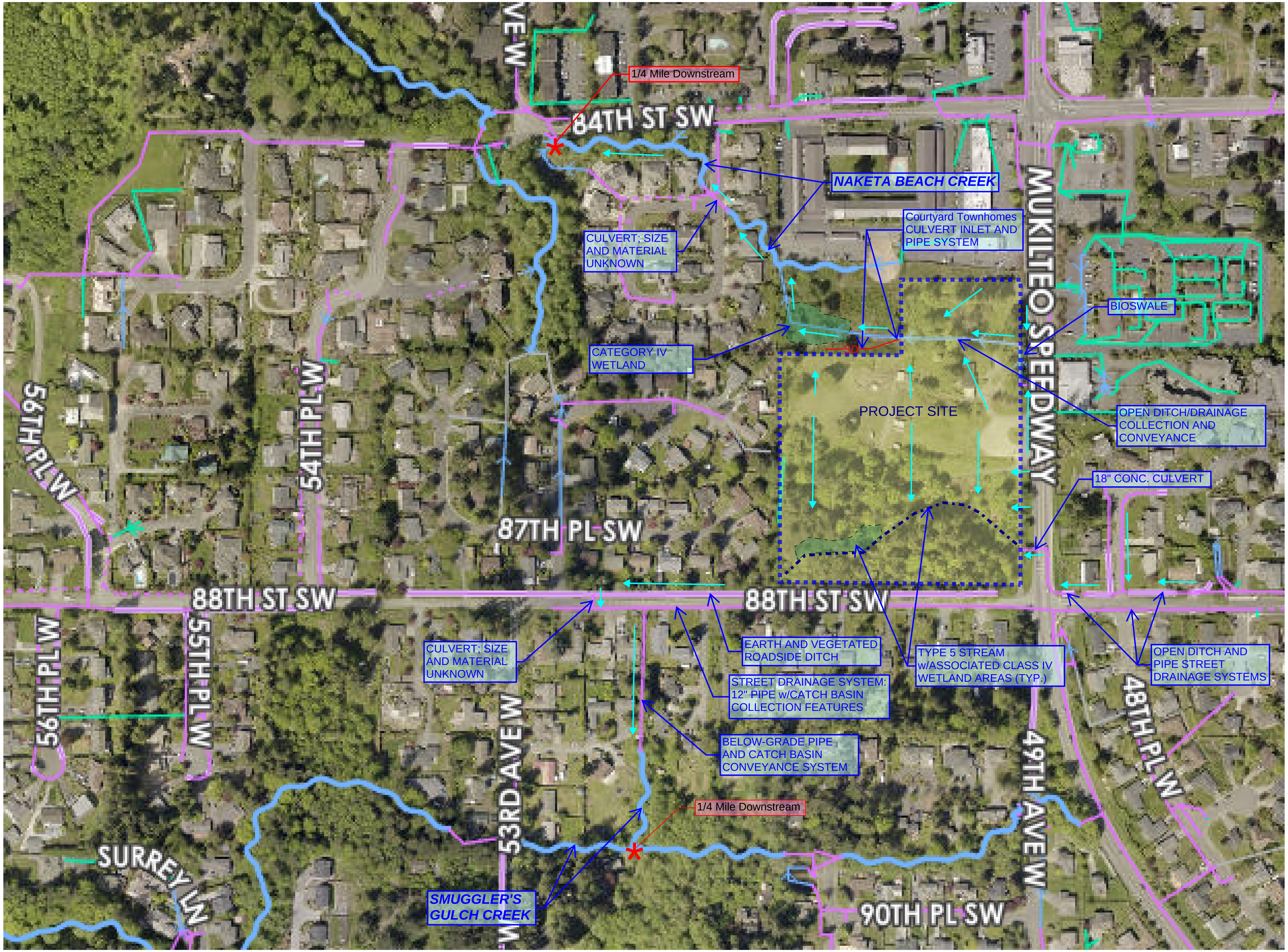
FIGURE 6 - 88TH STREET WATER QUALITY



→ Surface Water Flow Path

SOURCE: STORMWATER NETWORK VIEWER,
CITY OF MUKILTEO SURFACE WATER UTILITY.

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FIGURE 7 - OFFSITE DRAINAGE CONDITIONS

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1/24/2022 10:48 AM KYLE BELLER

C|P|H
CONSULTANTS

APPENDIX A

NRCS SOILS DATA, INFILTRATION & GEOTECHNICAL REPORT

Site Planning
Civil Engineering
Land Use Consulting
Project Management
Landscape Architecture

United States
Department of
Agriculture

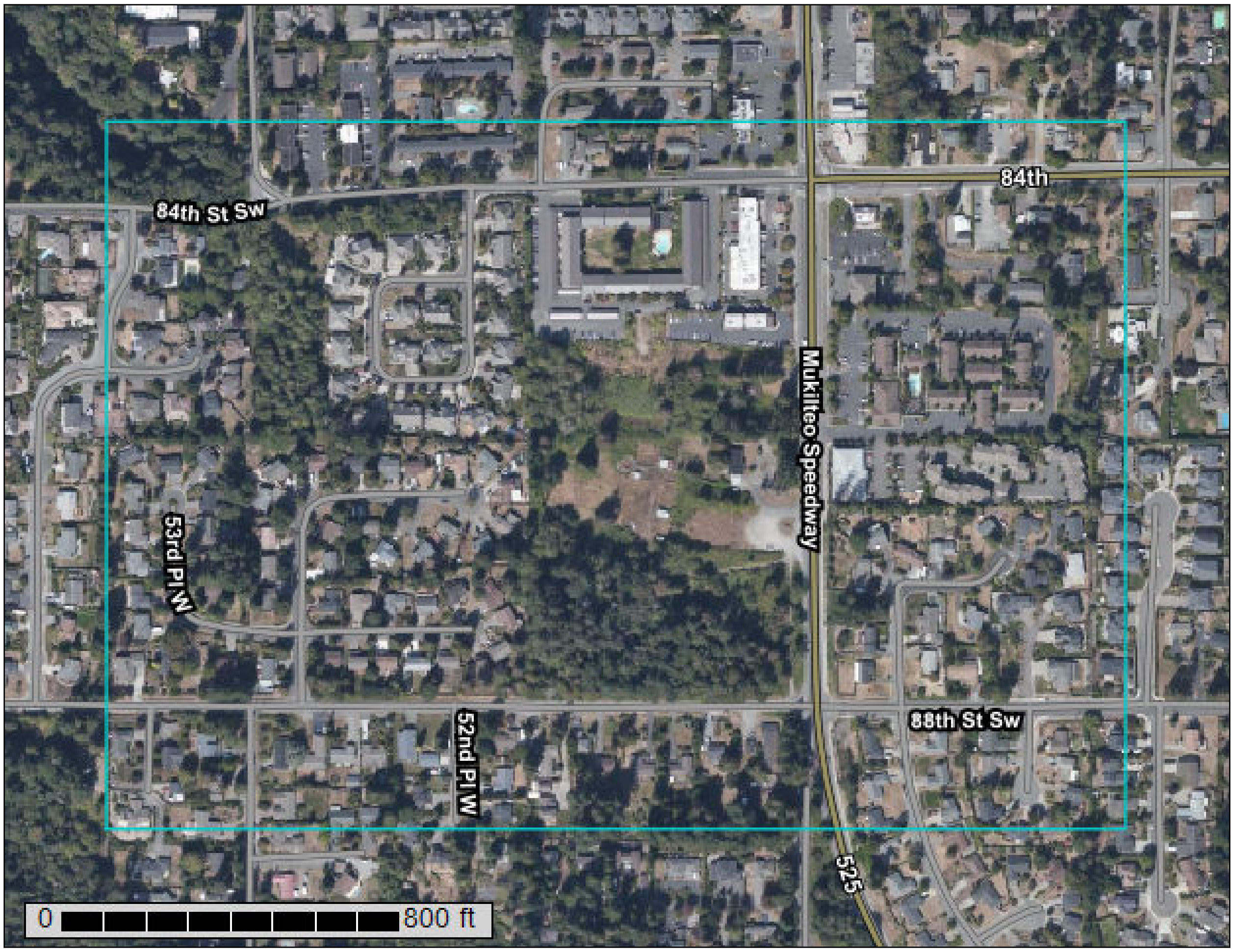
NRCS

Natural
Resources
Conservation
Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for
Snohomish County Area, Washington

Carrik Court



January 17, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:4,330 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

□ Area of Interest (AOI)

Soils

□ Soil Map Unit Polygons

〰 Soil Map Unit Lines

■ Soil Map Unit Points

Special Point Features

◉ Blowout

⊠ Borrow Pit

✱ Clay Spot

◇ Closed Depression

✕ Gravel Pit

∴ Gravelly Spot

⊛ Landfill

Λ Lava Flow

ψ Marsh or swamp

⚒ Mine or Quarry

◎ Miscellaneous Water

○ Perennial Water

∨ Rock Outcrop

+ Saline Spot

⁙ Sandy Spot

⊖ Severely Eroded Spot

◈ Sinkhole

⊳ Slide or Slip

∅ Sodic Spot

≣ Spoil Area

● Stony Spot

∞ Very Stony Spot

ψ Wet Spot

△ Other

‐‐ Special Line Features

Water Features

∼ Streams and Canals

Transportation

┼┼┼ Rails

∼ Interstate Highways

∼ US Routes

∼ Major Roads

∼ Local Roads

Background

🟩 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Snohomish County Area, Washington
Survey Area Data: Version 23, Aug 31, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 2, 2018—Sep 25, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
4	Alderwood-Everett gravelly sandy loams, 25 to 70 percent slopes	0.6	0.6%
5	Alderwood-Urban land complex, 2 to 8 percent slopes	45.0	47.9%
6	Alderwood-Urban land complex, 8 to 15 percent slopes	47.2	50.3%
34	Mukilteo muck	1.1	1.1%
Totals for Area of Interest		**93.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Snohomish County Area, Washington

4—Alderwood-Everett gravelly sandy loams, 25 to 70 percent slopes

Map Unit Setting

National map unit symbol: 2hyy
Elevation: 50 to 800 feet
Mean annual precipitation: 25 to 60 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 180 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Alderwood and similar soils: 60 percent
Everett and similar soils: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Alderwood

Setting

Landform: Till plains
Parent material: Basal till

Typical profile

H1 - 0 to 7 inches: gravelly ashy sandy loam
H2 - 7 to 35 inches: very gravelly ashy sandy loam
H3 - 35 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 25 to 70 percent
Depth to restrictive feature: 20 to 40 inches to densic material
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Ecological site: F002XA004WA - Puget Lowlands Forest
Hydric soil rating: No

Description of Everett

Setting

Landform: Plains, terraces
Parent material: Glacial outwash

Typical profile

H1 - 0 to 6 inches: gravelly ashy sandy loam
H2 - 6 to 18 inches: very gravelly ashy sandy loam

H3 - 18 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 25 to 70 percent
Depth to restrictive feature: 14 to 20 inches to strongly contrasting textural stratification
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: F002XA004WA - Puget Lowlands Forest
Hydric soil rating: No

Minor Components

Mckenna

Percent of map unit: 5 percent
Landform: Depressions
Other vegetative classification: Wet Soils (G002XN102WA)
Hydric soil rating: Yes

Norma, undrained

Percent of map unit: 5 percent
Landform: Depressions
Other vegetative classification: Wet Soils (G002XN102WA)
Hydric soil rating: Yes

Terric medisaprists, undrained

Percent of map unit: 5 percent
Landform: Depressions
Other vegetative classification: Wet Soils (G002XN102WA)
Hydric soil rating: Yes

5—Alderwood-Urban land complex, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2hz9
Elevation: 50 to 800 feet
Mean annual precipitation: 25 to 60 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 180 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Alderwood and similar soils: 60 percent
Urban land: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Alderwood

Setting

Landform: Till plains
Parent material: Basal till

Typical profile

H1 - 0 to 7 inches: gravelly ashy sandy loam
H2 - 7 to 35 inches: very gravelly ashy sandy loam
H3 - 35 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: 20 to 40 inches to densic material
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Limited Depth Soils (G002XN302WA)
Other vegetative classification: Limited Depth Soils (G002XN302WA)
Hydric soil rating: No

Minor Components

Norma, undrained

Percent of map unit: 5 percent
Landform: Depressions
Other vegetative classification: Wet Soils (G002XN102WA)
Hydric soil rating: Yes

Mckenna

Percent of map unit: 5 percent
Landform: Depressions
Other vegetative classification: Wet Soils (G002XN102WA)
Hydric soil rating: Yes

Terric medisaprists, undrained

Percent of map unit: 5 percent
Landform: Depressions
Other vegetative classification: Wet Soils (G002XN102WA)
Hydric soil rating: Yes

6—Alderwood-Urban land complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2hzn
Elevation: 50 to 800 feet
Mean annual precipitation: 25 to 60 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 180 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Alderwood and similar soils: 60 percent
Urban land: 25 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Alderwood

Setting

Landform: Till plains
Parent material: Basal till

Typical profile

H1 - 0 to 7 inches: gravelly ashy sandy loam
H2 - 7 to 35 inches: very gravelly ashy sandy loam
H3 - 35 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 40 inches to densic material
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Limited Depth Soils (G002XN302WA)
Other vegetative classification: Limited Depth Soils (G002XN302WA)
Hydric soil rating: No

Minor Components

Norma, undrained

Percent of map unit: 5 percent
Landform: Drainageways
Other vegetative classification: Wet Soils (G002XN102WA)
Hydric soil rating: Yes

34—Mukilteo muck

Map Unit Setting

National map unit symbol: 2hyr
Elevation: 0 to 1,000 feet
Mean annual precipitation: 40 to 70 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 150 to 250 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Mukilteo, drained, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mukilteo, Drained

Setting

Landform: Depressions
Parent material: Herbaceous organic material

Typical profile

Oa - 0 to 4 inches: muck
Oe - 4 to 35 inches: mucky peat
Oe2 - 35 to 54 inches: mucky peat
H4 - 54 to 60 inches: fine sandy loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very high (about 25.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D

Ecological site: R002XA003WA - Puget Lowlands Bogs and Fens
Forage suitability group: Soils with Few Limitations (G002XN502WA)
Other vegetative classification: Soils with Few Limitations (G002XN502WA)
Hydric soil rating: Yes

Minor Components

Orcas

Percent of map unit: 5 percent
Landform: Depressions
Other vegetative classification: Wet Soils (G002XN102WA)
Hydric soil rating: Yes

Mukilteo, undrained

Percent of map unit: 5 percent
Other vegetative classification: Wet Soils (G002XN102WA)
Hydric soil rating: Yes

Terric medisaprists, undrained

Percent of map unit: 5 percent
Landform: Depressions
Other vegetative classification: Wet Soils (G002XN102WA)
Hydric soil rating: Yes

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Kindred Hydro

Technical Memorandum

Project: Carrik Court Infiltration Testing
Location: Mukilteo Speedway and 88th Street, SW, Mukilteo, WA
Job#: WES-20-1
Date: September 22, 2020

Westcott Holding, Inc.
1010 Market Street
Kirkland, Washington 98033
Attn: Ryan Appleby

Dear Mr. Appleby:

I am pleased to submit this technical memorandum providing the results of infiltration testing for stormwater infiltration design.

Background

An aerial photograph of the site is shown on Figure 1. The proposed project is located at the corner of Mukilteo Speedway and 88th Street SW in Mukilteo, Washington and covers the following parcels: 00611600013402, 00611600013500, and 00611600013600, with a total area of approximately 10 acres. There are two houses and several small out-buildings on the project site. The northern and southern portions of the site are forested and the central portion of the site is pasture and a gravel parking pad.

Based on the preliminary site plan, the project is expected to include approximately 125 townhomes with 16 live/work units along Mukilteo Speedway.

The purpose of this work was to evaluate the potential for stormwater infiltration and provide preliminary infiltration rates for feasibility assessment.

Topography, Mapped Geology, Slope Hazards, Wetlands

The site is generally sloping to the west with an elevation of approximately 445-450 feet above sea level along the east side and an elevation of approximately 415-420 feet above sea level along the west side.

The geologic map for Mukilteo[1] indicates that the site is mapped as glacial till, a dense mixture of silt sand and gravel that is generally poor for infiltration.

Based on a steep slope assessment conducted for a previous project (not publicly available) there are no slopes steeper than 40 percent on the property and in the immediate vicinity of the property. There are slopes steeper than 40 percent approximately 400 feet west of the site.

A wetland has been identified in the southern portion of the site.

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[1] Minard, J.P., 1982, Distribution and Description of Geologic Units in the Mukilteo Quadrangle, Washington, USGS, Miscellaneous Field Studies, MAP MF-1438.

Borings and Testpit Explorations

Earth Solutions NW, LLC conducted borings and test pit explorations on the site. Final results of this work are not yet available but preliminary results were reviewed for this infiltration assessment.

Three borings, ranging in depth from 90 to 135 feet, were completed at the site. All three borings encountered glacial till or other low-permeability soils to the full depth of the explorations. There were no significant permeable soil horizons that were suitable for deep infiltration.

Following the deep explorations, nine test pits were excavated across the site to observe shallow soil and groundwater conditions. Most of these test pits encountered weathered glacial till to a depth of 3-4 feet and unweathered glacial till below the shallow weathered zone. Two test pits excavated just west of the gravel parking area encountered fill soils over glacial till. Some of the test pits were left open for infiltration testing.

Infiltration Testing

Shallow infiltration testing was conducted in six test pits left open during the test pit exploration program. These tests were conducted at locations shown in Figure 1 using the small-scale pilot infiltration test (PIT) method provided in the 2014 Stormwater Management Manual for Western Washington (SMMWW).

Before each infiltration test a soil sample was collected from the bottom of each PIT excavation and delivered to Amtest Laboratory in Redmond, Washington for grainsize analysis. The results are provided in Attachment A and summarized in Table 1. All six samples were well sorted silty sands with 1 to 14 percent gravel and a United States Classification System (USCS) designation of SM.

Table 1: Summary of Grainsize Analyses and Infiltration Testing Results

Location	Depth (ft)	% Gravel	% Sand	% Silt	USCS Class	Coefficient of Uniformity	Moisture Content	Design Infiltration Rate (in./hr)
IT-2	4.0	9	70	21	SM	9.8	12%	0.25
IT-3	4.5	6	69	26	SM	16	10%	0.18
IT-4	4.0	14	61	25	SM	13	10%	0.04
IT-5	4.0	6	63	31	SM	11	11%	0.03
IT-7	4.0	1	73	27	SM	7.0	11%	0.24
IT-9	4.0	5	66	30	SM	11	9%	0.12

The details of the infiltration test procedures and the test data are provided in Attachment B. For very low infiltration tests such as these, it can be difficult to obtain an accurate steady state infiltration rate. Therefore, the falling head infiltration rate is considered more reliable and were used to estimate the design infiltration rates. Note that the falling head infiltration rate declines as the depth of water decreases in the test pit and is always less than the steady state infiltration rate, so using the falling head rate provides an extra factor of safety.

As specified in the SMMWW, the design infiltration rate is determined by multiplying the measured infiltration rate by the total correction factor. The total correction factor was calculated using the following correction factors:

- Site variability and number of locations tested (Cf_v) = 0.9 (Ecology recommends 0.33-1.0)
- Test Method (Cf_t) = 0.5 (Small-Scale PIT)
- Degree of influent control to prevent siltation and bio-buildup (Cf_m) = 0.9

The total correction factor (CF_t) = CF_v x CF_t x CF_m = 0.4. The design infiltration rates for each test are summarized in Table 1.

Recommendations

Two of the three infiltration tests in the southern portion of the site (IT-4 and IT-5) provided significantly lower design infiltration rates (0.03 to 0.04 inches/hour) than the remaining test locations, which provided design infiltration rates ranging from 0.12 to 0.25 inches/hour. These lower test results may be associated with the wetland located in the southern portion of the site. Excluding IT-4 and IT-5, the average design infiltration rate is 0.2 inches/hour. For evaluation of dispersed infiltration facilities outside of the southern portion of the site, I recommend using a design rate of 0.2 inches/hour. For the southern portion of the site, I recommend using a design rate of 0.04 inches/hour.

A design rate of 0.2 inches per hour is sufficient for permeable pavement as long as the permeable pavement section is flat or designed with internal check dams to create storage during large storms. This infiltration design rate may be sufficient for infiltration trenches and bioretention swales underlain by a sufficient reservoir of clean crushed drain rock. These facilities should be equipped with overflow pipes to ensure excess water can be conveyed downstream.

Dispersed infiltration in small facilities has been effective at sites underlain by glacial till. During wet periods, when the ground is most saturated, infiltrating stormwater has an opportunity to spread horizontally before infiltrating. Large infiltration facilities provide less opportunity for horizontal spreading and can be less effective in till soils during wet periods. For this reason, we recommend reliance on small dispersed infiltration facilities rather than large centralized infiltration facilities.

Once locations of infiltration facilities have been identified, additional infiltration testing will be necessary to confirm the design infiltration rate. In addition, groundwater mounding analysis may be necessary to evaluate the combined affect of multiple infiltration facilities across the site.

We recommend having Kindred Hydro, Inc. on site during construction to observe the following:

- The base of any excavation for infiltration BMP's: This inspection allows us to confirm that the soils and groundwater conditions are consistent with our expectations and that the bottom of the excavation is free of silt or other contamination that might clog the facility.
- Samples of any aggregate materials used in the construction of the BMPs to confirm that they meet specifications on the plans.
- Placement of materials during construction of the BMP's to ensure that they conform with the design drawings and specifications.

Limitations and Closure

Work for this project was performed and this report prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of Westcott Holding, Inc. for specific application to the referenced matter. No other warranty, expressed or implied, is made.

If you have any questions or concerns, please contact the undersigned.

Sincerely,

J Scott Kindred

J. Scott Kindred, PE
President
Kindred Hydro, Inc.
Date: ___September 22, 2020

J. SCOTT KINDRED
STATE OF WASHINGTON
27425
REGISTERED
PROFESSIONAL ENGINEER

State of Washington
Hydrogeologist
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Licensed Geologist
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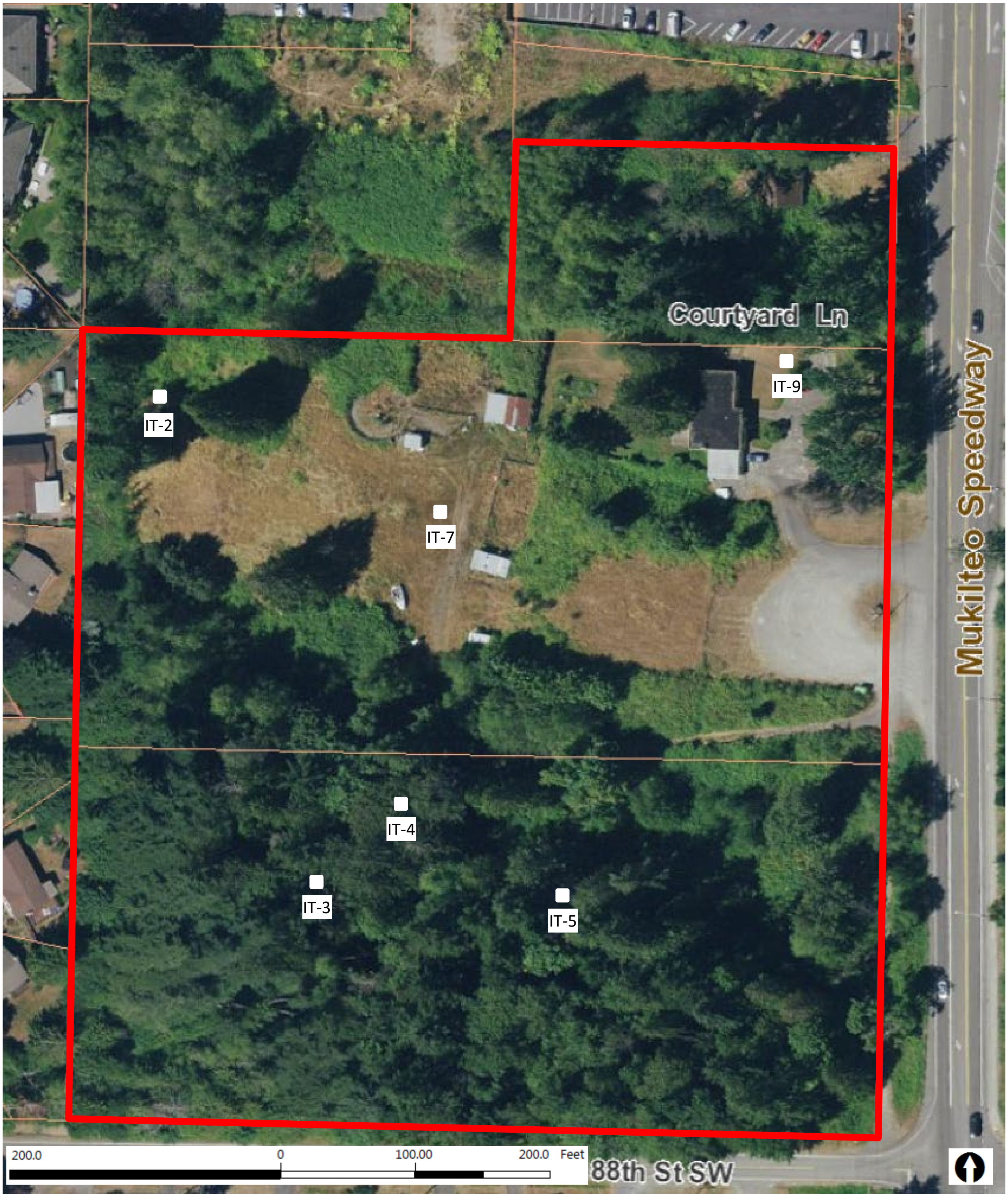


Figure 1: Aerial Photograph of the Site and Infiltration Test Locations

Attachment A:

Grain Size Distribution Results

Table A-1 (pg. 1 of 2): Grain Size Distributions

Project Name		Carrik Court		Carrik Court		Carrik Court	
Sample Name		IT-2-4.0		IT-3-4.5		IT-4-4.0	
Sample Date		8/24/2020		8/24/2020		8/24/2020	
Solids Content (by weight) %		90%		91%		91%	
Water Content (by weight) %		12%		10%		10%	
Sieve Size	**Sieve Size (mm)**	% Retained	Cumulative % Passing	% Retained	Cumulative % Retained	% Retained	Cumulative % Retained
1.5"	38.1	0	100	0	100	0	100
1"	25.4	0	100	0	100	0	100
3/4"	19.05	0	100	0	100	4.4	96
1/2"	12.7	2.4	98	2.9	97	4.2	91
3/8"	9.5	1.3	96	0.5	97	0.7	91
#4	4.75	5.4	91	2.2	94	4.4	86
#10	2	6.8	84	4.4	90	5.1	81
#20	0.85	6.7	77	4.3	86	4.9	76
#40	0.425	15.2	62	15.2	71	13.8	63
#60	0.25	17.5	45	19.5	51	17.5	45
#100	0.15	11.8	33	14.3	37	9.5	36
#140	0.105	9.5	23	8.5	28	8.1	27
#200	0.075	2.7	21	2.6	26	2.1	25
#270	0.053	5.7	15	3.5	22	5.5	20
<#270		15		22.1		19.8	
% Gravel		9		6		14	
%Sand		70		69		61	
% Silt		21		26		25	
USCS Class		SM		SM		SM	
% Coarse Gravel		0.0		0.0		32.1	
% Fine Gravel		100.0		100.0		67.9	
% Coarse Sand		9.7		6.4		8.4	
% Medium Sand		31.2		28.3		30.7	
% Fine Sand		59.1		65.3		61.0	
Grain Size at 60% Passing (D60)		0.39		0.31		0.39	
Grain Size at 10% Passing (D10)		0.04		0.02		0.030	
Coefficient of Uniformity (D60/D10)		9.8		16		13	
Description (USCS)		well-graded, slightly gravelly, silty, fine-medium SAND		well-graded, slightly gravelly, silty, fine-medium SAND		well-graded, slightly gravelly, silty, fine-medium SAND	

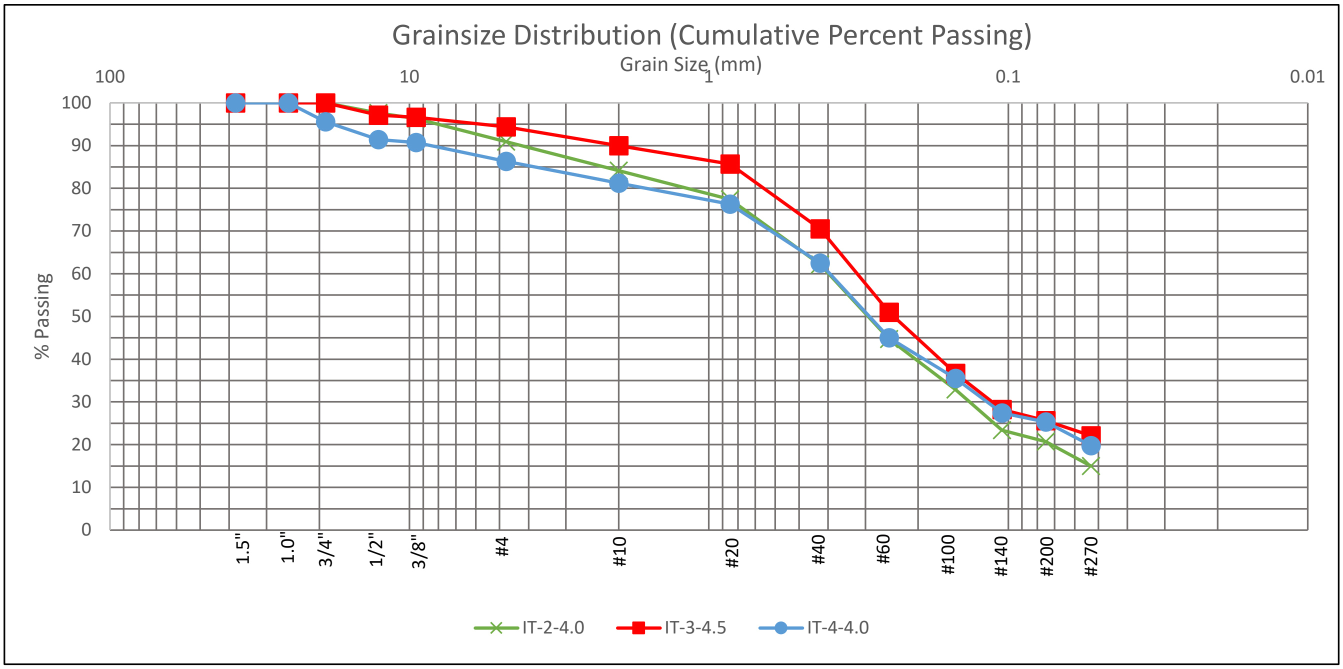
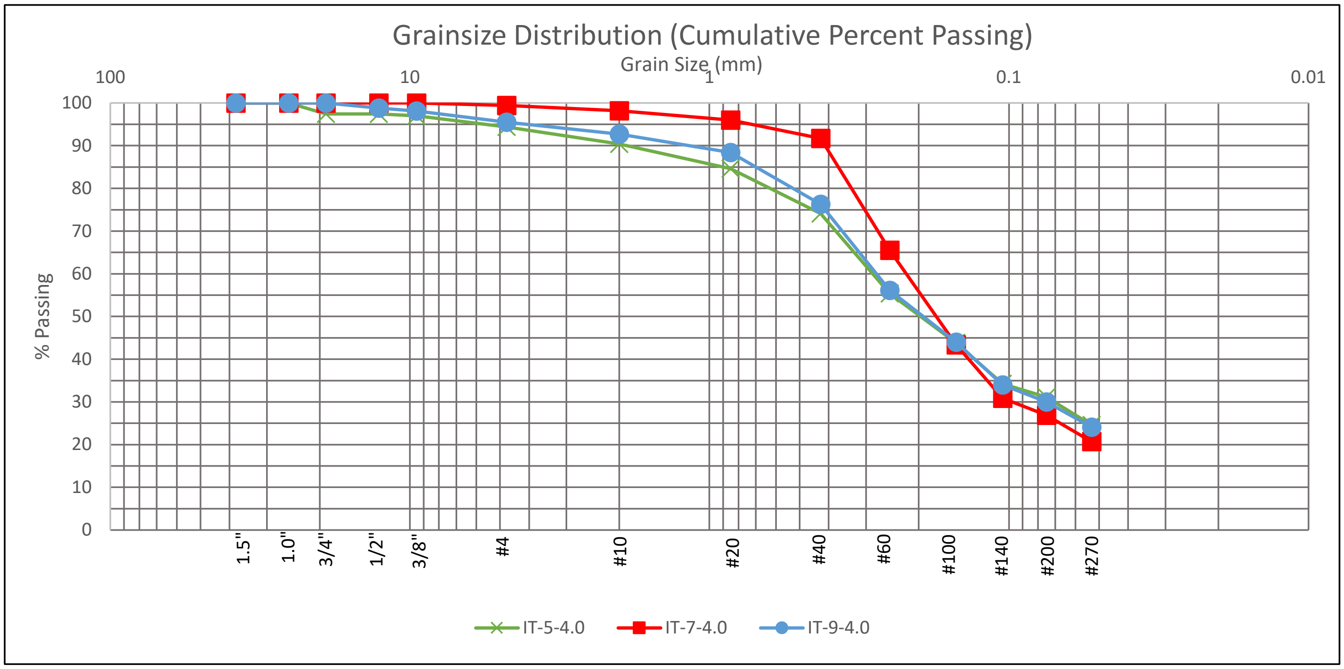


Table A-1 (pg. 2 of 2): Grain Size Distributions

Project Name		Carrik Court		Carrik Court		Carrik Court	
Sample Name		IT-5-4.0		IT-7-4.0		IT-9-4.0	
Sample Date		8/24/2020		8/24/2020		8/24/2020	
Solids Content (by weight) %		90%		90%		92%	
Water Content (by weight) %		11%		11%		9%	
Sieve Size	**Sieve Size (mm)**	% Retained	Cumulative % Retained	% Retained	Cumulative % Retained	% Retained	Cumulative % Retained
1.5"	38.1	0	100	0	100	0	100
1"	25.4	0	100	0	100	0	100
3/4"	19.05	2.6	97	0	100	0	100
1/2"	12.7	0	97	0	100	1.2	99
3/8"	9.5	0.4	97	0	100	0.7	98
#4	4.75	2.6	94	0.6	99	2.6	96
#10	2	4	90	1.2	98	2.8	93
#20	0.85	5.8	85	2.2	96	4.3	88
#40	0.425	10.5	74	4.3	92	12.1	76
#60	0.25	18.7	55	26.2	66	20.2	56
#100	0.15	11.6	44	22.1	43	12.1	44
#140	0.105	9.6	34	12.5	31	10	34
#200	0.075	3.1	31	4	27	4	30
#270	0.053	6.5	25	6.2	21	5.9	24
<#270		24.6		20.7		24.1	
% Gravel		6		1		5	
%Sand		63		73		66	
% Silt		31		27		30	
USCS Class		SM		SM		SM	
% Coarse Gravel		46.4		0.0		0.0	
% Fine Gravel		53.6		100.0		100.0	
% Coarse Sand		6.3		1.7		4.3	
% Medium Sand		25.8		9.0		25.0	
% Fine Sand		67.9		89.4		70.7	
Grain Size at 60% Passing (D60)		0.28		0.21		0.28	
Grain Size at 10% Passing (D10)		0.025		0.030		0.025	
Uniformity Coefficient (D60/D10)		11		7.0		11	
Description (USCS)		well-graded, slightly gravelly, very silty, fine-medium SAND		well graded, silty, fine SAND, trace gravel		well-graded, very silty, slightly gravelly, fine-medium SAND	



Attachment B:

Infiltration Testing Procedures and Results

Kindred Hydro

Small-Scale Pilot Infiltration Test Procedure

Infiltration testing was conducted in general accordance with the small-scale pilot infiltration test (PIT) method provided in the 2014 Stormwater Management Manual for Western Washington (SMMWW). Key elements of the PIT methodology, along with any significant deviations from the SWWMM procedures, are provided below:

1) The test pits were excavated to a depth of 4.0 to 4.5 feet. This depth was through the weathered glacial till zone and into the unweathered glacial till, which is expected to provide a conservative estimate of infiltration across the site.

2) The horizontal surface area of the bottom of the test pits ranged from 13.5 to 16.2 square feet.

3) The depth of water in the pit was measured using both a vertical measuring rod marked in inches and tenths of an inch and a pressure transducer. The data shown on the data sheets is based on the transducer data.

4) Water was conveyed into the pits using slotted PVC pipe to reduce erosion and disturbance of the bottom soils.

5) Due to the very low infiltration rates, it was not possible to measure the flow rate that would maintain a constant water level in the pits (usually less than 0.1 gallons/minute). Instead, the water level was maintained between a depth of approximately 12 and 14 inches by adding water periodically during the pre-soak period. The pre-soak period lasted at least 6 hours.

6) Once the pre-soak period was ended, the water level was allowed to fall below 12 inches. The steady-state infiltration rate was assumed to equal the falling head rate approximately one hour after the pre-soak period was complete. Using the falling head rate at the end of the hour was more accurate than adding water at a fixed rate to maintain a constant head for an hour.

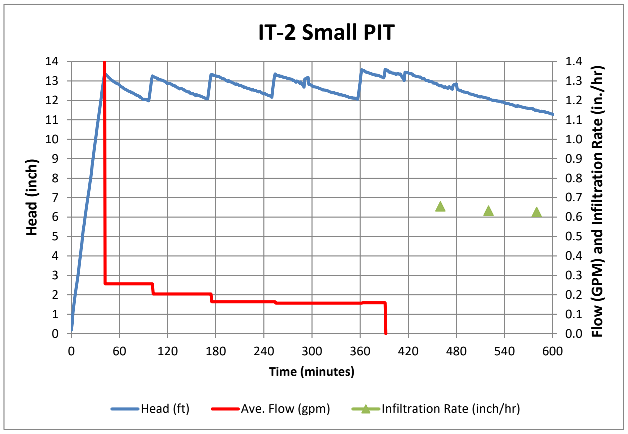
7) The falling head rate was assumed to equal the falling head rate approximately 60 to 160 minutes after the steady state portion of the test was complete.

8) Due to the slow infiltration rates none of the pits were dry when we returned the next day. Therefore, it was not necessary to over-excavate the pits to see if the test water was mounded on a shallow restrictive layer.

The results of each test are provided on the attached datasheets.

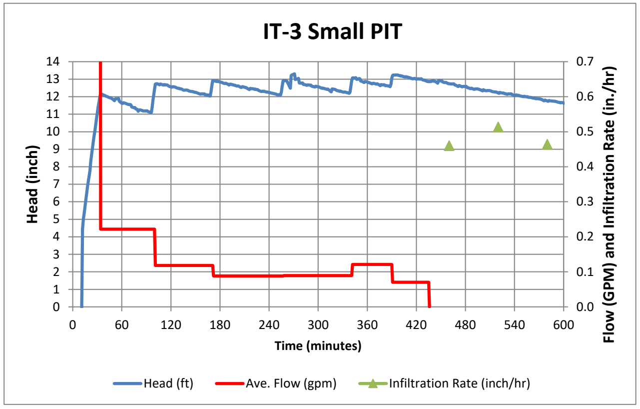
Location:	Carrik Ct.	IT-2	Corr:	0.060		
Date and Time	Time (min.)	Ave. Flow (gpm)	Head (ft)	Corr. Head (inch)	Cumulative Volume (gal)	Infiltration Rate (inch/hr)
8/25/20 9:14	0.0	3.444	0.076	0.192		
8/25/20 9:15	1.0	3.444	0.106	0.557		
8/25/20 9:16	2.0	3.444	0.149	1.064		
8/25/20 9:17	3.0	3.444	0.179	1.424		
8/25/20 9:18	4.0	3.444	0.207	1.763		
8/25/20 9:19	5.0	3.444	0.233	2.076		
8/25/20 9:20	6.0	3.444	0.257	2.365		
8/25/20 9:21	7.0	3.444	0.280	2.642		
8/25/20 9:22	8.0	3.444	0.304	2.929		
8/25/20 9:23	9.0	3.444	0.332	3.258	31.00	
8/25/20 9:24	10.0	2.857	0.364	3.649		
8/25/20 9:25	11.0	2.857	0.390	3.958		
8/25/20 9:26	12.0	2.857	0.421	4.333		
8/25/20 9:27	13.0	2.857	0.449	4.664		
8/25/20 9:28	14.0	2.857	0.478	5.018		
8/25/20 9:29	15.0	2.857	0.509	5.384		
8/25/20 9:30	16.0	2.857	0.530	5.638		
8/25/20 9:31	17.0	2.857	0.558	5.970		
8/25/20 9:32	18.0	2.857	0.583	6.277		
8/25/20 9:33	19.0	2.857	0.608	6.577		
8/25/20 9:34	20.0	2.857	0.632	6.859		
8/25/20 9:35	21.0	2.857	0.656	7.147		
8/25/20 9:36	22.0	2.857	0.678	7.421		
8/25/20 9:37	23.0	2.857	0.705	7.734		
8/25/20 9:38	24.0	2.857	0.727	8.008		
8/25/20 9:39	25.0	2.857	0.752	8.304		
8/25/20 9:40	26.0	2.857	0.783	8.677		
8/25/20 9:41	27.0	2.857	0.808	8.981		
8/25/20 9:42	28.0	2.857	0.837	9.318		
8/25/20 9:43	29.0	2.857	0.864	9.652		
8/25/20 9:44	30.0	2.857	0.890	9.955	91.00	
8/25/20 9:45	31.0	5.167	0.915	10.254		
8/25/20 9:46	32.0	5.167	0.943	10.597		
8/25/20 9:47	33.0	5.167	0.968	10.890		
8/25/20 9:48	34.0	5.167	0.994	11.203		
8/25/20 9:49	35.0	5.167	1.018	11.492		
8/25/20 9:50	36.0	5.167	1.044	11.807	122.00	
8/25/20 9:51	37.0	2.832	1.069	12.106		
8/25/20 9:52	38.0	2.832	1.094	12.403		
8/25/20 9:53	39.0	2.832	1.118	12.691		
8/25/20 9:54	40.0	2.832	1.142	12.984		
8/25/20 9:55	41.0	2.832	1.167	13.279	136.16	
8/25/20 9:56	42.0	0.257	1.171	13.332		
8/25/20 9:57	43.0	0.257	1.172	13.342		
8/25/20 9:58	44.0	0.257	1.167	13.278		
8/25/20 9:59	45.0	0.257	1.164	13.249		
8/25/20 10:00	46.0	0.257	1.160	13.195		
8/25/20 10:01	47.0	0.257	1.157	13.160		
8/25/20 10:02	48.0	0.257	1.153	13.114		
8/25/20 10:03	49.0	0.257	1.151	13.087		
8/25/20 10:04	50.0	0.257	1.148	13.054		
8/25/20 10:05	51.0	0.257	1.146	13.027		
8/25/20 10:06	52.0	0.257	1.143	12.992		
8/25/20 10:07	53.0	0.257	1.140	12.960		
8/25/20 10:08	54.0	0.257	1.138	12.934		
8/25/20 10:09	55.0	0.257	1.136	12.907		
8/25/20 10:10	56.0	0.257	1.134	12.884		
8/25/20 10:11	57.0	0.257	1.132	12.864		
8/25/20 10:12	58.0	0.257	1.131	12.846		
8/25/20 10:13	59.0	0.257	1.129	12.823		
8/25/20 10:14	60.0	0.257	1.126	12.793		
8/25/20 10:15	61.0	0.257	1.121	12.737		
8/25/20 10:16	62.0	0.257	1.118	12.698		
8/25/20 10:17	63.0	0.257	1.117	12.688		
8/25/20 10:18	64.0	0.257	1.115	12.664		
8/25/20 10:19	65.0	0.257	1.112	12.620		
8/25/20 10:20	66.0	0.257	1.110	12.600		
8/25/20 10:21	67.0	0.257	1.108	12.571		
8/25/20 10:22	68.0	0.257	1.107	12.562		
8/25/20 10:23	69.0	0.257	1.104	12.533		
8/25/20 10:24	70.0	0.257	1.102	12.505		
8/25/20 10:25	71.0	0.257	1.100	12.478		
8/25/20 10:26	72.0	0.257	1.099	12.464		
8/25/20 10:27	73.0	0.257	1.098	12.458		
8/25/20 10:28	74.0	0.257	1.096	12.434		
8/25/20 10:29	75.0	0.257	1.093	12.396		

PIT Test Characteristics	
Date of Test	8/25/2020
Depth of Test PIT (ft)	4.0
Test Pit Width (ft)	3.0
Test Pit Length (ft)	5.4
Test Pit Area (sf)	16.2
Totalizer Flow (gal)=	201
End of Constant Head Test (420 min >12 in.) (min.)	460
Constant Head Infiltration Rate (at 460 min.)	**0.66**
Falling Head Infiltration Rate (at 580 min.)	**0.63**



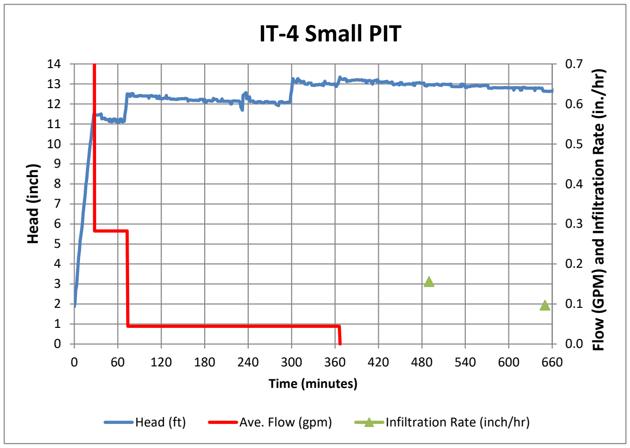
Location:	Carrik Ct.	IT-3	Corr:	0.090		
Date and Time	Time (min.)	Ave. Flow (gpm)	Head (ft)	Corr. Head (inch)	Cumulative Volume (gal)	Infiltration Rate (inch/hr)
8/24/20 9:08	0.0	2.782	0.076	-0.164		
8/24/20 9:09	1.0	2.782	0.078	-0.144		
8/24/20 9:10	2.0	2.782	0.074	-0.194		
8/24/20 9:11	3.0	2.782	0.075	-0.186		
8/24/20 9:12	4.0	2.782	0.074	-0.190		
8/24/20 9:13	5.0	2.782	0.075	-0.184		
8/24/20 9:14	6.0	2.782	0.075	-0.179		
8/24/20 9:15	7.0	2.782	0.072	-0.214		
8/24/20 9:16	8.0	2.782	0.073	-0.206		
8/24/20 9:17	9.0	2.782	0.073	-0.203		
8/24/20 9:18	10.0	2.782	0.073	-0.208		
8/24/20 9:19	11.0	2.782	0.070	-0.244		
8/24/20 9:20	12.0	2.782	0.459	4.432		
8/24/20 9:21	13.0	2.782	0.507	4.999		
8/24/20 9:22	14.0	2.782	0.535	5.341		
8/24/20 9:23	15.0	2.782	0.567	5.724		
8/24/20 9:24	16.0	2.782	0.600	6.119		
8/24/20 9:25	17.0	2.782	0.630	6.480		
8/24/20 9:26	18.0	2.782	0.662	6.858		
8/24/20 9:27	19.0	2.782	0.689	7.187		
8/24/20 9:28	20.0	2.782	0.713	7.478		
8/24/20 9:29	21.0	2.782	0.740	7.805		
8/24/20 9:30	22.0	2.782	0.778	8.260		
8/24/20 9:31	23.0	2.782	0.810	8.642		
8/24/20 9:32	24.0	2.782	0.841	9.013		
8/24/20 9:33	25.0	2.782	0.871	9.368		
8/24/20 9:34	26.0	2.782	0.901	9.734		
8/24/20 9:35	27.0	2.782	0.925	10.014		
8/24/20 9:36	28.0	2.782	0.954	10.373		
8/24/20 9:37	29.0	2.782	0.985	10.738		
8/24/20 9:38	30.0	2.782	1.014	11.083		
8/24/20 9:39	31.0	2.782	1.042	11.420		
8/24/20 9:40	32.0	2.782	1.063	11.680		
8/24/20 9:41	33.0	2.782	1.090	11.999	91.80	
8/24/20 9:42	34.0	0.222	1.103	12.157		
8/24/20 9:43	35.0	0.222	1.102	12.139		
8/24/20 9:44	36.0	0.222	1.102	12.144		
8/24/20 9:45	37.0	0.222	1.099	12.106		
8/24/20 9:46	38.0	0.222	1.097	12.083		
8/24/20 9:47	39.0	0.222	1.096	12.074		
8/24/20 9:48	40.0	0.222	1.094	12.052		
8/24/20 9:49	41.0	0.222	1.092	12.023		
8/24/20 9:50	42.0	0.222	1.091	12.007		
8/24/20 9:51	43.0	0.222	1.089	11.983		
8/24/20 9:52	44.0	0.222	1.087	11.966		
8/24/20 9:53	45.0	0.222	1.085	11.941		
8/24/20 9:54	46.0	0.222	1.085	11.934		
8/24/20 9:55	47.0	0.222	1.084	11.924		
8/24/20 9:56	48.0	0.222	1.081	11.891		
8/24/20 9:57	49.0	0.222	1.078	11.858		
8/24/20 9:58	50.0	0.222	1.075	11.822		
8/24/20 9:59	51.0	0.222	1.071	11.776		
8/24/20 10:00	52.0	0.222	1.080	11.881		
8/24/20 10:01	53.0	0.222	1.080	11.884		
8/24/20 10:02	54.0	0.222	1.080	11.875		
8/24/20 10:03	55.0	0.222	1.081	11.891		
8/24/20 10:04	56.0	0.222	1.082	11.902		
8/24/20 10:05	57.0	0.222	1.068	11.737		
8/24/20 10:06	58.0	0.222	1.065	11.699		
8/24/20 10:07	59.0	0.222	1.062	11.664		
8/24/20 10:08	60.0	0.222	1.059	11.627		
8/24/20 10:09	61.0	0.222	1.057	11.609		
8/24/20 10:10	62.0	0.222	1.062	11.662		
8/24/20 10:11	63.0	0.222	1.060	11.645		
8/24/20 10:12	64.0	0.222	1.059	11.632		
8/24/20 10:13	65.0	0.222	1.057	11.608		
8/24/20 10:14	66.0	0.222	1.056	11.593		
8/24/20 10:15	67.0	0.222	1.055	11.578		
8/24/20 10:16	68.0	0.222	1.053	11.560		
8/24/20 10:17	69.0	0.222	1.053	11.558		
8/24/20 10:18	70.0	0.222	1.053	11.555		
8/24/20 10:19	71.0	0.222	1.052	11.539		
8/24/20 10:20	72.0	0.222	1.041	11.411		
8/24/20 10:21	73.0	0.222	1.041	11.406		
8/24/20 10:22	74.0	0.222	1.039	11.388		

PIT Test Characteristics	
Date of Test	8/24/2020
Depth of Test PIT (ft)	4.5
Test Pit Width (ft)	3.0
Test Pit Length (ft)	4.5
Test Pit Area (sf)	13.5
Totalizer Flow (gal)=	136
End of Constant Head Test (420 min >12 in.) (min.)	520
Constant Head Infiltration Rate (at 520 min.)	**0.51**
Falling Head Infiltration Rate (at 580 min.)	**0.46**



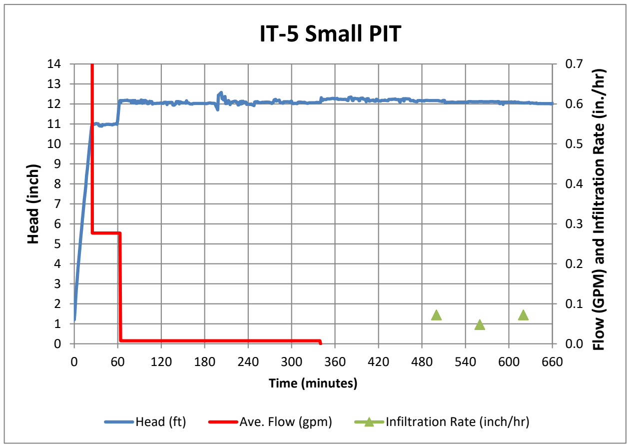
Location:	Carrik Ct.	IT-4	Corr:	-0.050		
Date and Time	Time (min.)	Ave. Flow (gpm)	Head (ft)	Corr. Head (inch)	Cumulative Volume (gal)	Infiltration Rate (inch/hr)
8/24/20 9:42	0.0	4.313	0.106	1.872	0.00	
8/24/20 9:43	1.0	4.313	0.126	2.112		
8/24/20 9:44	2.0	4.313	0.175	2.700		
8/24/20 9:45	3.0	4.313	0.192	2.904		
8/24/20 9:46	4.0	4.313	0.232	3.384		
8/24/20 9:47	5.0	4.313	0.271	3.852		
8/24/20 9:48	6.0	4.313	0.311	4.332		
8/24/20 9:49	7.0	4.313	0.34	4.680		
8/24/20 9:50	8.0	4.313	0.38	5.160		
8/24/20 9:51	9.0	4.313	0.4	5.400		
8/24/20 9:52	10.0	4.313	0.42	5.640		
8/24/20 9:53	11.0	4.313	0.449	5.988		
8/24/20 9:54	12.0	4.313	0.489	6.468		
8/24/20 9:55	13.0	4.313	0.518	6.816		
8/24/20 9:56	14.0	4.313	0.547	7.164		
8/24/20 9:57	15.0	4.313	0.575	7.500		
8/24/20 9:58	16.0	4.313	0.614	7.968	69.00	
8/24/20 9:59	17.0	2.273	0.632	8.184		
8/24/20 10:00	18.0	2.273	0.672	8.664		
8/24/20 10:01	19.0	2.273	0.702	9.024		
8/24/20 10:02	20.0	2.273	0.724	9.288		
8/24/20 10:03	21.0	2.273	0.755	9.660		
8/24/20 10:04	22.0	2.273	0.786	10.032		
8/24/20 10:05	23.0	2.273	0.803	10.236		
8/24/20 10:06	24.0	2.273	0.831	10.572		
8/24/20 10:07	25.0	2.273	0.86	10.920		
8/24/20 10:08	26.0	2.273	0.879	11.148		
8/24/20 10:09	27.0	2.273	0.908	11.496	94.00	
8/24/20 10:10	28.0	0.283	0.904	11.448		
8/24/20 10:11	29.0	0.283	0.904	11.448		
8/24/20 10:12	30.0	0.283	0.904	11.448		
8/24/20 10:13	31.0	0.283	0.904	11.448		
8/24/20 10:14	32.0	0.283	0.904	11.448		
8/24/20 10:15	33.0	0.283	0.904	11.448		
8/24/20 10:16	34.0	0.283	0.905	11.460		
8/24/20 10:17	35.0	0.283	0.906	11.472		
8/24/20 10:18	36.0	0.283	0.907	11.484		
8/24/20 10:19	37.0	0.283	0.908	11.496		
8/24/20 10:20	38.0	0.283	0.888	11.256		
8/24/20 10:21	39.0	0.283	0.889	11.268		
8/24/20 10:22	40.0	0.283	0.89	11.280		
8/24/20 10:23	41.0	0.283	0.89	11.280		
8/24/20 10:24	42.0	0.283	0.891	11.292		
8/24/20 10:25	43.0	0.283	0.885	11.220		
8/24/20 10:26	44.0	0.283	0.885	11.220		
8/24/20 10:27	45.0	0.283	0.885	11.220		
8/24/20 10:28	46.0	0.283	0.885	11.220		
8/24/20 10:29	47.0	0.283	0.885	11.220		
8/24/20 10:30	48.0	0.283	0.877	11.124		
8/24/20 10:31	49.0	0.283	0.887	11.244		
8/24/20 10:32	50.0	0.283	0.886	11.232		
8/24/20 10:33	51.0	0.283	0.876	11.112		
8/24/20 10:34	52.0	0.283	0.876	11.112		
8/24/20 10:35	53.0	0.283	0.877	11.124		
8/24/20 10:36	54.0	0.283	0.887	11.244		
8/24/20 10:37	55.0	0.283	0.887	11.244		
8/24/20 10:38	56.0	0.283	0.888	11.256		
8/24/20 10:39	57.0	0.283	0.878	11.136		
8/24/20 10:40	58.0	0.283	0.875	11.100		
8/24/20 10:41	59.0	0.283	0.885	11.220		
8/24/20 10:42	60.0	0.283	0.875	11.100		
8/24/20 10:43	61.0	0.283	0.874	11.088		
8/24/20 10:44	62.0	0.283	0.874	11.088		
8/24/20 10:45	63.0	0.283	0.887	11.244		
8/24/20 10:46	64.0	0.283	0.887	11.244		
8/24/20 10:47	65.0	0.283	0.887	11.244		
8/24/20 10:48	66.0	0.283	0.876	11.112		
8/24/20 10:49	67.0	0.283	0.876	11.112		
8/24/20 10:50	68.0	0.283	0.879	11.148		
8/24/20 10:51	69.0	0.283	0.878	11.136		
8/24/20 10:52	70.0	0.283	0.907	11.484		
8/24/20 10:53	71.0	0.283	0.927	11.724		
8/24/20 10:54	72.0	0.283	0.955	12.060		

PIT Test Characteristics	
Date of Test	8/24/2020
Depth of Test PIT (ft)	4.5
Test Pit Width (ft)	3.0
Test Pit Length (ft)	4.5
Test Pit Area (sf)	13.5
Totalizer Flow (gal)=	120
End of Constant Head Test (420 min >12 in.) (min.)	490
Constant Head Infiltration Rate (at 490 min.)	**0.16**
Falling Head Infiltration Rate (at 650 min.)	**0.10**



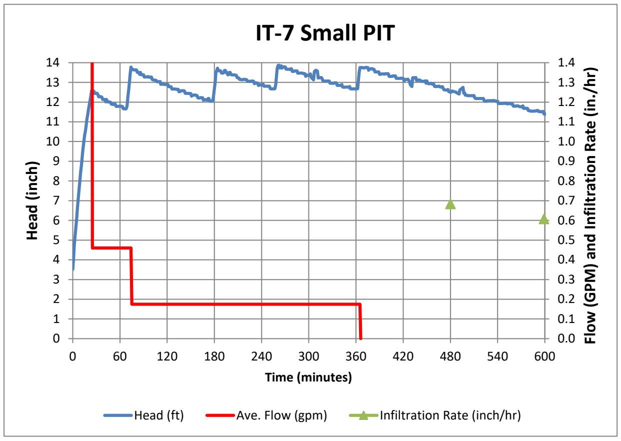
Location:	Carrik Ct.	IT-5	Corr:	-0.100		
Date and Time	Time (min.)	Ave. Flow (gpm)	Head (ft)	Corr. Head (inch)	Cumulative Volume (gal)	Infiltration Rate (inch/hr)
8/24/20 10:16	0.0	3.550	0.000	1.200	0.00	
8/24/20 10:17	1.0	3.550	0.040	1.680		
8/24/20 10:18	2.0	3.550	0.090	2.280		
8/24/20 10:19	3.0	3.550	0.131	2.772		
8/24/20 10:20	4.0	3.550	0.170	3.240		
8/24/20 10:21	5.0	3.550	0.210	3.720		
8/24/20 10:22	6.0	3.550	0.241	4.092		
8/24/20 10:23	7.0	3.550	0.280	4.560		
8/24/20 10:24	8.0	3.550	0.311	4.932		
8/24/20 10:25	9.0	3.550	0.344	5.328		
8/24/20 10:26	10.0	3.550	0.373	5.676		
8/24/20 10:27	11.0	3.550	0.413	6.156		
8/24/20 10:28	12.0	3.550	0.442	6.504		
8/24/20 10:29	13.0	3.550	0.472	6.864		
8/24/20 10:30	14.0	3.550	0.503	7.236	59.00	
8/24/20 10:31	15.0	3.550	0.533	7.596		
8/24/20 10:32	16.0	3.550	0.562	7.944		
8/24/20 10:33	17.0	3.550	0.601	8.412		
8/24/20 10:34	18.0	3.550	0.630	8.760		
8/24/20 10:35	19.0	3.550	0.661	9.132		
8/24/20 10:36	20.0	3.550	0.690	9.480		
8/24/20 10:37	21.0	3.550	0.720	9.840		
8/24/20 10:38	22.0	3.550	0.750	10.200		
8/24/20 10:39	23.0	3.550	0.780	10.560		
8/24/20 10:40	24.0	3.550	0.806	10.872	85.20	
8/24/20 10:41	25.0	0.277	0.816	10.992		
8/24/20 10:42	26.0	0.277	0.816	10.992		
8/24/20 10:43	27.0	0.277	0.815	10.980		
8/24/20 10:44	28.0	0.277	0.815	10.980		
8/24/20 10:45	29.0	0.277	0.818	11.016		
8/24/20 10:46	30.0	0.277	0.818	11.016		
8/24/20 10:47	31.0	0.277	0.818	11.016		
8/24/20 10:48	32.0	0.277	0.817	11.004		
8/24/20 10:49	33.0	0.277	0.817	11.004		
8/24/20 10:50	34.0	0.277	0.810	10.920		
8/24/20 10:51	35.0	0.277	0.809	10.908		
8/24/20 10:52	36.0	0.277	0.808	10.896		
8/24/20 10:53	37.0	0.277	0.808	10.896		
8/24/20 10:54	38.0	0.277	0.807	10.884		
8/24/20 10:55	39.0	0.277	0.814	10.968		
8/24/20 10:56	40.0	0.277	0.813	10.956		
8/24/20 10:57	41.0	0.277	0.813	10.956		
8/24/20 10:58	42.0	0.277	0.813	10.956		
8/24/20 10:59	43.0	0.277	0.813	10.956		
8/24/20 11:00	44.0	0.277	0.815	10.980		
8/24/20 11:01	45.0	0.277	0.815	10.980		
8/24/20 11:02	46.0	0.277	0.815	10.980		
8/24/20 11:03	47.0	0.277	0.815	10.980		
8/24/20 11:04	48.0	0.277	0.815	10.980		
8/24/20 11:05	49.0	0.277	0.814	10.968		
8/24/20 11:06	50.0	0.277	0.814	10.968		
8/24/20 11:07	51.0	0.277	0.814	10.968		
8/24/20 11:08	52.0	0.277	0.813	10.956		
8/24/20 11:09	53.0	0.277	0.813	10.956		
8/24/20 11:10	54.0	0.277	0.816	10.992		
8/24/20 11:11	55.0	0.277	0.816	10.992		
8/24/20 11:12	56.0	0.277	0.816	10.992		
8/24/20 11:13	57.0	0.277	0.817	11.004		
8/24/20 11:14	58.0	0.277	0.817	11.004		
8/24/20 11:15	59.0	0.277	0.815	10.980		
8/24/20 11:16	60.0	0.277	0.835	11.220		
8/24/20 11:17	61.0	0.277	0.865	11.580		
8/24/20 11:18	62.0	0.277	0.904	12.048		
8/24/20 11:19	63.0	0.277	0.914	12.168	96.01	
8/24/20 11:20	64.0	0.008	0.904	12.048		
8/24/20 11:21	65.0	0.008	0.914	12.168		
8/24/20 11:22	66.0	0.008	0.914	12.168		
8/24/20 11:23	67.0	0.008	0.914	12.168		
8/24/20 11:24	68.0	0.008	0.913	12.156		
8/24/20 11:25	69.0	0.008	0.915	12.180		
8/24/20 11:26	70.0	0.008	0.915	12.180		
8/24/20 11:27	71.0	0.008	0.915	12.180		
8/24/20 11:28	72.0	0.008	0.915	12.180		
8/24/20 11:29	73.0	0.008	0.916	12.192		
8/24/20 11:30	74.0	0.008	0.914	12.168		

PIT Test Characteristics	
Date of Test	8/24/2020
Depth of Test PIT (ft)	4.5
Test Pit Width (ft)	3.0
Test Pit Length (ft)	4.5
Test Pit Area (sf)	13.5
Totalizer Flow (gal)=	98
End of Constant Head Test (420 min >12 in.) (min.)	482
Constant Head Infiltration Rate (at 500 min.)	**0.07**
Falling Head Infiltration Rate (at 620 min.)	**0.07**



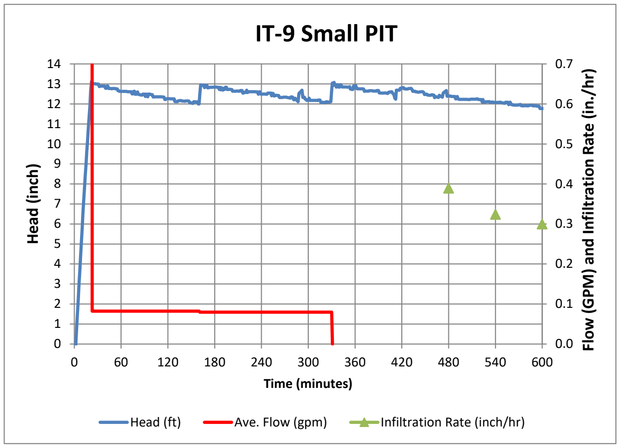
Location:	Carrik Ct.	IT-7	Corr:	-0.250		
Date and Time	Time (min.)	Ave. Flow (gpm)	Head (ft)	Corr. Head (inch)	Cumulative Volume (gal)	Infiltration Rate (inch/hr)
8/25/20 8:58	0.0	4.208	0.043	3.516	0.00	
8/25/20 8:59	1.0	4.208	0.091	4.092		
8/25/20 9:00	2.0	4.208	0.145	4.740		
8/25/20 9:01	3.0	4.208	0.185	5.220		
8/25/20 9:02	4.0	4.208	0.223	5.676		
8/25/20 9:03	5.0	4.208	0.262	6.144		
8/25/20 9:04	6.0	4.208	0.302	6.624		
8/25/20 9:05	7.0	4.208	0.343	7.116		
8/25/20 9:06	8.0	4.208	0.382	7.584		
8/25/20 9:07	9.0	4.208	0.412	7.944		
8/25/20 9:08	10.0	4.208	0.452	8.424		
8/25/20 9:09	11.0	4.208	0.482	8.784		
8/25/20 9:10	12.0	4.208	0.52	9.240		
8/25/20 9:11	13.0	4.208	0.55	9.600		
8/25/20 9:12	14.0	4.208	0.579	9.948		
8/25/20 9:13	15.0	4.208	0.609	10.308		
8/25/20 9:14	16.0	4.208	0.627	10.524		
8/25/20 9:15	17.0	4.208	0.648	10.776		
8/25/20 9:16	18.0	4.208	0.678	11.136		
8/25/20 9:17	19.0	4.208	0.697	11.364		
8/25/20 9:18	20.0	4.208	0.717	11.604		
8/25/20 9:19	21.0	4.208	0.737	11.844		
8/25/20 9:20	22.0	4.208	0.757	12.084		
8/25/20 9:21	23.0	4.208	0.777	12.324		
8/25/20 9:22	24.0	4.208	0.798	12.576	101.00	
8/25/20 9:23	25.0	0.460	0.798	12.576		
8/25/20 9:24	26.0	0.460	0.798	12.576		
8/25/20 9:25	27.0	0.460	0.795	12.540		
8/25/20 9:26	28.0	0.460	0.786	12.432		
8/25/20 9:27	29.0	0.460	0.787	12.444		
8/25/20 9:28	30.0	0.460	0.787	12.444		
8/25/20 9:29	31.0	0.460	0.788	12.456		
8/25/20 9:30	32.0	0.460	0.782	12.384		
8/25/20 9:31	33.0	0.460	0.772	12.264		
8/25/20 9:32	34.0	0.460	0.773	12.276		
8/25/20 9:33	35.0	0.460	0.773	12.276		
8/25/20 9:34	36.0	0.460	0.773	12.276		
8/25/20 9:35	37.0	0.460	0.771	12.252		
8/25/20 9:36	38.0	0.460	0.761	12.132		
8/25/20 9:37	39.0	0.460	0.761	12.132		
8/25/20 9:38	40.0	0.460	0.761	12.132		
8/25/20 9:39	41.0	0.460	0.761	12.132		
8/25/20 9:40	42.0	0.460	0.751	12.012		
8/25/20 9:41	43.0	0.460	0.761	12.132		
8/25/20 9:42	44.0	0.460	0.751	12.012		
8/25/20 9:43	45.0	0.460	0.751	12.012		
8/25/20 9:44	46.0	0.460	0.751	12.012		
8/25/20 9:45	47.0	0.460	0.75	12.000		
8/25/20 9:46	48.0	0.460	0.75	12.000		
8/25/20 9:47	49.0	0.460	0.741	11.892		
8/25/20 9:48	50.0	0.460	0.741	11.892		
8/25/20 9:49	51.0	0.460	0.74	11.880		
8/25/20 9:50	52.0	0.460	0.742	11.904		
8/25/20 9:51	53.0	0.460	0.742	11.904		
8/25/20 9:52	54.0	0.460	0.742	11.904		
8/25/20 9:53	55.0	0.460	0.732	11.784		
8/25/20 9:54	56.0	0.460	0.732	11.784		
8/25/20 9:55	57.0	0.460	0.732	11.784		
8/25/20 9:56	58.0	0.460	0.732	11.784		
8/25/20 9:57	59.0	0.460	0.733	11.796		
8/25/20 9:58	60.0	0.460	0.733	11.796		
8/25/20 9:59	61.0	0.460	0.733	11.796		
8/25/20 10:00	62.0	0.460	0.732	11.784		
8/25/20 10:01	63.0	0.460	0.732	11.784		
8/25/20 10:02	64.0	0.460	0.722	11.664		
8/25/20 10:03	65.0	0.460	0.722	11.664		
8/25/20 10:04	66.0	0.460	0.722	11.664		
8/25/20 10:05	67.0	0.460	0.721	11.652		
8/25/20 10:06	68.0	0.460	0.722	11.664		
8/25/20 10:07	69.0	0.460	0.732	11.784		
8/25/20 10:08	70.0	0.460	0.771	12.252		
8/25/20 10:09	71.0	0.460	0.801	12.612		
8/25/20 10:10	72.0	0.460	0.829	12.948		
8/25/20 10:11	73.0	0.460	0.869	13.428		
8/25/20 10:12	74.0	0.460	0.898	13.776	124.00	

PIT Test Characteristics	
Date of Test	8/25/2020
Depth of Test PIT (ft)	4.0
Test Pit Width (ft)	3.0
Test Pit Length (ft)	5.3
Test Pit Area (sf)	15.9
Totalizer Flow (gal)=	170
End of Constant Head Test (420 min >12 in.) (min.)	480
Constant Head Infiltration Rate (at 480 min.)	**0.68**
Falling Head Infiltration Rate (at 600 min.)	**0.61**



Location:	**Carrik Ct.**	**IT-9**	Corr:	0.130		
Date and Time	**Time (min.)**	**Ave. Flow (gpm)**	**Head (ft)**	**Corr. Head (inch)**	**Cumulative Volume (gal)**	**Infiltration Rate (inch/hr)**
8/25/20 9:17	0.0	6.739	-0.001	-1.572	0.00	
8/25/20 9:18	1.0	6.739	0.067	-0.756		
8/25/20 9:19	2.0	6.739	0.136	0.072		
8/25/20 9:20	3.0	6.739	0.206	0.912		
8/25/20 9:21	4.0	6.739	0.255	1.500		
8/25/20 9:22	5.0	6.739	0.316	2.232		
8/25/20 9:23	6.0	6.739	0.375	2.940		
8/25/20 9:24	7.0	6.739	0.434	3.648		
8/25/20 9:25	8.0	6.739	0.5	4.440		
8/25/20 9:26	9.0	6.739	0.55	5.040		
8/25/20 9:27	10.0	6.739	0.61	5.760	79.00	
8/25/20 9:28	11.0	6.739	0.669	6.468		
8/25/20 9:29	12.0	6.739	0.729	7.188		
8/25/20 9:30	13.0	6.739	0.772	7.704		
8/25/20 9:31	14.0	6.739	0.831	8.412		
8/25/20 9:32	15.0	6.739	0.881	9.012	108.20	
8/25/20 9:33	16.0	6.739	0.931	9.612		
8/25/20 9:34	17.0	6.739	0.98	10.200		
8/25/20 9:35	18.0	6.739	1.027	10.764		
8/25/20 9:36	19.0	6.739	1.076	11.352		
8/25/20 9:37	20.0	6.739	1.125	11.940		
8/25/20 9:38	21.0	6.739	1.185	12.660		
8/25/20 9:39	22.0	6.739	1.224	13.128	148.25	
8/25/20 9:40	23.0	0.082	1.214	13.008		
8/25/20 9:41	24.0	0.082	1.214	13.008		
8/25/20 9:42	25.0	0.082	1.214	13.008		
8/25/20 9:43	26.0	0.082	1.214	13.008		
8/25/20 9:44	27.0	0.082	1.214	13.008		
8/25/20 9:45	28.0	0.082	1.213	12.996		
8/25/20 9:46	29.0	0.082	1.213	12.996		
8/25/20 9:47	30.0	0.082	1.213	12.996		
8/25/20 9:48	31.0	0.082	1.213	12.996		
8/25/20 9:49	32.0	0.082	1.202	12.864		
8/25/20 9:50	33.0	0.082	1.204	12.888		
8/25/20 9:51	34.0	0.082	1.204	12.888		
8/25/20 9:52	35.0	0.082	1.204	12.888		
8/25/20 9:53	36.0	0.082	1.204	12.888		
8/25/20 9:54	37.0	0.082	1.204	12.888		
8/25/20 9:55	38.0	0.082	1.204	12.888		
8/25/20 9:56	39.0	0.082	1.204	12.888		
8/25/20 9:57	40.0	0.082	1.195	12.780		
8/25/20 9:58	41.0	0.082	1.195	12.780		
8/25/20 9:59	42.0	0.082	1.205	12.900		
8/25/20 10:00	43.0	0.082	1.204	12.888		
8/25/20 10:01	44.0	0.082	1.194	12.768		
8/25/20 10:02	45.0	0.082	1.194	12.768		
8/25/20 10:03	46.0	0.082	1.194	12.768		
8/25/20 10:04	47.0	0.082	1.194	12.768		
8/25/20 10:05	48.0	0.082	1.193	12.756		
8/25/20 10:06	49.0	0.082	1.194	12.768		
8/25/20 10:07	50.0	0.082	1.194	12.768		
8/25/20 10:08	51.0	0.082	1.194	12.768		
8/25/20 10:09	52.0	0.082	1.194	12.768		
8/25/20 10:10	53.0	0.082	1.193	12.756		
8/25/20 10:11	54.0	0.082	1.193	12.756		
8/25/20 10:12	55.0	0.082	1.193	12.756		
8/25/20 10:13	56.0	0.082	1.185	12.660		
8/25/20 10:14	57.0	0.082	1.185	12.660		
8/25/20 10:15	58.0	0.082	1.182	12.624		
8/25/20 10:16	59.0	0.082	1.182	12.624		
8/25/20 10:17	60.0	0.082	1.182	12.624		
8/25/20 10:18	61.0	0.082	1.182	12.624		
8/25/20 10:19	62.0	0.082	1.182	12.624		
8/25/20 10:20	63.0	0.082	1.182	12.624		
8/25/20 10:21	64.0	0.082	1.182	12.624		
8/25/20 10:22	65.0	0.082	1.182	12.624		
8/25/20 10:23	66.0	0.082	1.182	12.624		
8/25/20 10:24	67.0	0.082	1.182	12.624		
8/25/20 10:25	68.0	0.082	1.181	12.612		
8/25/20 10:26	69.0	0.082	1.181	12.612		
8/25/20 10:27	70.0	0.082	1.181	12.612		
8/25/20 10:28	71.0	0.082	1.181	12.612		
8/25/20 10:29	72.0	0.082	1.181	12.612		
8/25/20 10:30	73.0	0.082	1.181	12.612		
8/25/20 10:31	74.0	0.082	1.172	12.504		

PIT Test Characteristics	
Date of Test	8/25/2020
Depth of Test PIT (ft)	4.0
Test Pit Width (ft)	3.0
Test Pit Length (ft)	5.0
Test Pit Area (sf)	15.0
Totalizer Flow (gal)=	173
End of Constant Head Test (420 min >12 in.) (min.)	440
Constant Head Infiltration Rate (at 480 min.)	**0.39**
Falling Head Infiltration Rate (at 600 min.)	**0.30**



Earth Solutions NW LLC

Geotechnical Engineering
Construction Observation/Testing
Environmental Services

GEOTECHNICAL ENGINEERING STUDY
PROPOSED MUKILTEO STRICKLAND
MULTI-FAMILY DEVELOPMENT
MUKILTEO, WASHINGTON

ES-7422

15365 N.E. 90th Street, Suite 100 | Redmond, WA 98052
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PREPARED FOR

WESTCOTT HOLDINGS, INC.

September 15, 2020
Updated October 12, 2020

State of Washington
Engineering Geologist
2561
Licensed Geologist
Scott S. Riegel
10/12/2020

Scott S. Riegel, L.G., L.E.G.
Senior Project Manager

KYLE R. CAMPBELL
STATE OF WASHINGTON
27674
REGISTERED
PROFESSIONAL ENGINEER
10/12/2020

Kyle R. Campbell, P.E.
Principal Engineer

GEOTECHNICAL ENGINEERING STUDY PROPOSED MUKILTEO STRICKLAND MULTI-FAMILY DEVELOPMENT MUKILTEO, WASHINGTON

ES-7422

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Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of 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.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will <u>not</u> likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will <u>not</u> be adequate to develop geotechnical design recommendations for the project.

Do <u>not</u> rely on this report if your geotechnical engineer prepared it:
- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do <u>not</u> rely on an executive summary. Do <u>not</u> read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:
- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are <u>not</u> final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are <u>Not</u> Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will <u>not</u> of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are <u>not</u> building-envelope or mold specialists.***

GBA
GEOPROFESSIONAL
BUSINESS
ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

Earth Solutions NW LLC

Earth Solutions NW LLC
Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

September 15, 2020
Updated October 12, 2020
ES-7422

Westcott Holdings, Inc.
1010 Market Street
Kirkland, Washington 98033

Attention: Mr. Ryan Appleby

Dear Mr. Appleby:

Earth Solutions NW, LLC (ESNW) is pleased to present this report supporting the planned multi-family development for Mukilteo, Washington. Based on the results of our study, in our opinion, the proposed residential development is feasible from a geotechnical standpoint. In general, the subject property is underlain by medium dense to dense glacial till deposits and isolated areas of fill. Fill encountered on this site is not suitable for direct foundation support due to high organic and debris levels. The proposed structures may be supported on competent native soil or new structural fill placed directly on competent native soil. We anticipate competent native soil, capable of providing adequate foundation support, to be encountered at depths of about two to three feet bgs across a majority of the site where fill is not present. The condition of the existing fill should be evaluated by ESNW during grading operations but in most areas encountered, in its current condition is not suitable for direct support of foundations and must be removed beneath foundations.

Geotechnical recommendations related to the proposed site development are provided in this geotechnical engineering study. If you have any questions regarding the content of this study, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

Scott S. Riegel, L.G., L.E.G.
Senior Project Manager

Table of Contents

ES-7422

Table of Contents

Cont'd

ES-7422

GEOTECHNICAL ENGINEERING STUDY
PROPOSED MUKILTEO STRICKLAND
MULTI-FAMILY DEVELOPMENT
MUKILTEO, WASHINGTON

ES-7422

INTRODUCTION

General

This geotechnical engineering study (study) was prepared for the proposed multi-family residential development to be completed along the west side of Mukilteo Speedway, just north of the intersection with 88th Street Southwest in Mukilteo, Washington. The purpose of this study was to provide geotechnical recommendations for currently proposed development plans. Our scope of services for completing this study included the following:

- Completing borings and test pits for purposes of characterizing site soils;
- Completing laboratory testing of soil samples collected at the test pit locations;
- Conducting engineering analyses, and;
- Preparation of this report.

The following documents and maps were reviewed as part of our study preparation:

- Strickland Site Plan Study, prepared by CP|H Consultants, dated June 20, 2020;
- Snohomish County Liquefaction Susceptibility, endorsed by the Washington State Department of Natural Resources, dated October 2009;
- Chapter 17.52A Geologic Sensitive Areas Regulations of the Mukilteo Municipal Code (MMC);
- Title 30.63A of the Snohomish County Drainage Manual (SCDM);
- Geologic Map of the Mukilteo Quadrangle 1:24,000-scale, Washington, by James P. Minard, 1985, and;
- Online Web Soil Survey (WSS) resource, provided by the United States Department of Agriculture (USDA), Natural Resources Conservation Service.

Project Description

The preliminary site layout indicates a multi-family residential development comprised of about 114 townhome residences, general infrastructure improvements and stormwater facilities. At the time of report submission, specific building load and grading plans were not available for review; however, based on our experience with similar developments, the proposed structures will likely be three to four stories in height and constructed utilizing relatively lightly-loaded wood framing supported on conventional foundations. Perimeter footing loads will likely be 2 to 3 kips per lineal foot (klf). Slab-on-grade loading is anticipated to be approximately 150 pounds per square foot (psf). Retaining walls and/or rockeries may be utilized in some areas to accommodate grade transitions, where necessary. Stormwater will likely be managed using conventional detention, with limited to low impact development (LID) infiltration elements incorporated to the extent feasible.

If the above design assumptions are incorrect or change, ESNW should be contacted to review the recommendations provided in this report. ESNW should review final designs to confirm that our geotechnical recommendations been incorporated into the plans.

SITE CONDITIONS

Surface

The subject site is located in the northwestern corner of the intersection between Mukilteo Speedway and 88th Street Southwest in Mukilteo, Washington. The approximate location of the property is illustrated on Plate 1 (Vicinity Map). The property is comprised of three adjoined tax parcels (Snohomish County Parcel Nos. 00611600013-402, -500 & -600) totaling about 9.6 acres.

The site is bordered to the north and west by developed parcels, to the south by 88th Street Southwest and to the east by Mukilteo Speedway. Two residential buildings and associated outbuildings occupy the site but will be removed as part of the redevelopment plans. In general, site topography descends toward the west with total topographic change of about 40 feet at a gradient of about 10 percent or less.

Subsurface

A representative of ESNW observed, logged, and sampled three borings and 10 test pits, advanced at accessible locations within the property boundaries. Borings were completed on August 4 through 8, 2020 using a sonic drill rig and the test pits were excavated on August 21, 2020 using a trackhoe and operator retained by our firm. The borings were focused on deep infiltration feasibility while the test pits were completed for purposes of assessment and classification of site soils as well as characterization of groundwater conditions within areas proposed for new development. The approximate locations of the borings and test pits are depicted on Plate 2 (Subsurface Exploration Plan). Please refer to the test pit logs provided in Appendix A for a more detailed description of subsurface conditions. Representative soil samples collected at the test pit locations were evaluated in accordance with both Unified Soil Classification System (USCS) and United States Department of Agriculture (USDA) methods and procedures. We did not collect samples of the soil borings; however, completed visual classifications of the soils extracted by the drill rig.

A hydrogeologic consultant (Kindred Hydro) was contracted by the client to log, sample and evaluate the boring locations as part of a separate deep infiltration feasibility study.

Topsoil and Fill

Topsoil was encountered generally within the upper 8 to 12 inches of existing grades at the test pit locations. The topsoil was characterized by light brown color, the presence of fine organic material, and small root intrusions. In general, forested areas will likely require a deeper stripping depth than areas where grass yards are currently located.

Fill was encountered at test pit locations TP-1, TP-8, and TP-10 extending to depths of approximately 11, 16 and 3 feet bgs, respectively. The fill was variable and was characterized as silty sand with gravel, and silty gravel (USCS: SM), and was encountered in a loose to medium dense and moist condition. Scattered roots and wood fragments, bricks, and asphalt were observed within the fill. The condition of the existing fill must be evaluated by ESNW during grading operations. The existing fill in its current condition is not suitable for direct support of foundations and must be removed beneath foundations.

Native Soil

Underlying topsoil and fill, native soils consisted primarily of medium dense to very dense, silty sand with gravel (USCS: SM). The maximum exploration depth was approximately 137.5 feet bgs.

Geologic Setting

The referenced geologic map resource identifies Vashon glacial till (Qvt) across the site. Vashon advance outwash is mapped just east of the subject property. As reported on the geologic map resource, Vashon subglacial till consists primarily of a nonsorted mixture of silt, sand, and sub-rounded to well-rounded gravels, commonly referred to as “hardpan.” The till was deposited directly from the glacier as it advanced over bedrock and older Quaternary sediment. Vashon advance outwash consists primarily of well stratified, unconsolidated sand with pebbles and some cobbles. The composition of the deposit in this area is noted to be similar to that of recessional outwash and was deposited as bar and channel sediment in and along meltwater streams flowing from the advancing Vashon glacier.

The referenced WSS resource identifies Alderwood-Urban land complex (Map Unit Symbol: 5) and Alderwood gravelly sandy loam (Map Unit Symbol: 3) as the primary soil units underlying the subject site. The Alderwood series soils were formed in glacial till plains and are typically deposited as hills and ridges. The Alderwood-Urban land complex series soils are associated with large-scale urban grading.

Based on our field observations, the on site native soils generally correlate with glacial till deposits.

Groundwater

During our subsurface exploration completed in August 2020, groundwater seepage was encountered within isolated zones within boring location B-1. Oxide staining was noted in some of the native glacial till zones in the test pits. As such, it is our opinion the contractor should anticipate, and be prepared to respond to, zones of perched groundwater seepage during construction, especially within excavations required for utility installations and stormwater facilities (where necessary). Temporary measures to control surface water runoff and groundwater during construction would likely involve passive elements such as interceptor trenches, sumps, and dewatering pumps. Seepage rates and elevations fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, groundwater flow rates are higher during the wetter, winter months.

Geologic Hazard Areas Assessment

Based on our review of Title 17.52A, the site does not include geologically hazardous areas. Standard development practices are applicable to the proposed development.

DISCUSSION AND RECOMMENDATIONS

General

Based on the results of our investigation, construction of the proposed residential development is feasible from a geotechnical standpoint. The primary geotechnical considerations associated with the proposed development include foundation support, slab-on-grade subgrade support, the suitability of using native soils as structural fill, installation of site utilities, and construction of stormwater management facilities.

In our opinion, the proposed structures may be constructed on conventional continuous and spread footing foundations bearing upon competent native soil, recompacted native soil, or new structural fill placed directly on competent native soil. In general, competent native soil, suitable for support of new foundations, will likely be encountered at depths of about two to three feet bgs across a majority of the site except where existing fill is present. The condition of the existing fill must be evaluated by ESNW during grading operations. The existing fill in its current condition is not suitable for direct support of foundations and must be removed beneath foundations.

This study has been prepared for the exclusive use of the Westcott Holdings, Inc. and their representatives. No warranty, expressed or implied, is made. This study has been prepared in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area.

Site Preparation and Earthwork

Initial site preparation activities will consist of installing temporary erosion control measures, establishing grading limits, and performing site clearing and site stripping (as necessary). Subsequent earthwork will involve mass grading and related infrastructure improvements.

Temporary Erosion Control

Temporary construction entrances and drive lanes, consisting of at least six inches of quarry spalls, should be considered in order to both minimize off-site soil tracking and provide a stable access surface for construction vehicles. Geotextile fabric may be placed below the quarry spalls for greater stability of the temporary construction entrance. Erosion control measures should consist of silt fencing placed around appropriate portions of the site perimeter. Soil stockpiles should be covered or otherwise protected to reduce the potential for soil erosion during periods of wet weather. Temporary approaches for controlling surface water runoff should be established prior to beginning earthwork activities. Additional Best Management Practices (BMPs), as specified by the project civil engineer and indicated on the plans, should be incorporated into construction activities, as necessary.

Stripping

Topsoil and transitional mineral-like deposits was encountered generally within the upper 8 to 12 inches of existing grades at test pit locations. For preliminary planning purposes, topsoil-stripping depths of about four to six inches bgs should be considered but may be deeper in forested areas. The material remaining immediately below the topsoil may have some root zones and will likely be variable in composition, density, and/or moisture content. The material exposed after initial topsoil stripping will likely not be suitable for direct structural support as is and will likely need to be compacted in place or stripped and stockpiled for reuse as fill; depending on the time of year stripping occurs, the soil exposed below the topsoil may be too wet to compact and may need to be aerated or treated. ESNW should observe initial stripping activities to provide recommendations regarding stripping depths and material suitability.

ESNW will coordinate with the owner and contractor(s), as necessary, to utilize on site soils to the extent feasible. Over-stripping should be avoided, as it is unnecessary and may result in increased project development costs.

In-situ and Imported Soils

On-site soils are highly moisture sensitive, and successful use as structural fill will largely be dictated by the moisture content at the time of placement and compaction. Remedial measures, such as soil aeration and/or cement treatment (where allowed by the local jurisdiction or utility district), may be necessary as part of site grading and earthwork activities. If the on-site soils cannot be successfully compacted, the use of an imported soil may be necessary. In our opinion, a contingency should be provided in the project budget for export of soil that cannot be successfully compacted as structural fill (due to over-optimum moisture content) if grading activities take place during periods of extended rainfall activity. Soils with fines contents greater than 5 percent typically degrade rapidly when exposed to periods of rainfall.

Imported soil intended for use as structural fill should consist of a well-graded, granular soil with a moisture content that is at (or slightly above) the optimum level. During wet weather conditions, imported soil intended for use as structural fill should consist of a well-graded, granular soil with a fines content of 5 percent or less (where the fines content is defined as the percent passing the Number 200 sieve, based on the minus three-quarter-inch fraction).

Subgrade Preparation

Soil conditions anticipated at proposed foundation subgrade elevations will likely expose very loose to medium dense, fill and dense native soils. The larger area of fill is located in the east-central portion of the property which contained abundant debris and organics and extended to depths of up to about 16 feet below existing grades. Because of the variability in soil type and relative density between the existing fill soils, potential differential settlement should be mitigated by removal of the existing fill. The existing fill in its current condition is not suitable for support of foundations and must be removed beneath foundations.

Foundation and slab subgrade surfaces should be compacted in-situ to a minimum depth of one foot below the design subgrade elevation. Uniform compaction of the foundation and slab subgrade areas will establish a relatively consistent subgrade condition below the foundation and slab elements. ESNW should observe the compacted subgrade areas prior to placing formwork. Supplementary recommendations for subgrade improvement may be provided at the time of construction; such recommendations would likely include further mechanical compaction effort and/or overexcavation and replacement with suitable structural fill.

Structural Fill

Structural fill is defined as compacted soil placed in foundation, slab-on-grade, and roadway areas. Fill placed to construct permanent slopes and throughout retaining wall and utility trench backfill areas is considered structural fill as well. Soils placed in structural areas should be placed in loose lifts of 12 inches or less and compacted to a relative compaction of 95 percent, based on the laboratory maximum dry density as determined by the Modified Proctor Method (ASTM D1557). For soil placed in utility trenches underlying structural areas, compaction requirements are dictated by the local city, county, or utility district, and are typically specified to a relative compaction of at least 95 percent.

Foundations

In our opinion, the proposed structures may be constructed on conventional continuous and spread footing foundations bearing upon competent native soil, recompacted native soil, or new structural fill placed directly on a competent native soil subgrade. In general, competent native soil, suitable for support of new foundations, should be encountered at depths of about two to three feet below existing grades, except areas where existing fill is located. Loose or unsuitable soil conditions exposed at foundation subgrade elevations should be compacted to the specifications of structural fill or overexcavation and replaced with a suitable structural fill. Organic-rich material encountered at structural subgrade elevations should be removed, and grades should be restored with structural fill.

Provided the foundations will be supported as described above, the following parameters may be used for design:

• Allowable soil bearing capacity	2,500 psf
• Passive earth pressure	300 pcf (equivalent fluid)
• Coefficient of friction	0.40

A one-third increase in the allowable soil bearing capacity may be assumed for short-term wind and seismic loading conditions. The above passive pressure and friction values include a factor-of-safety of 1.5. With structural loading as expected, total settlement in the range of one inch and differential settlement of about one-half inch is anticipated. The majority of the settlements should occur during construction, as dead loads are applied.

Seismic Design

The 2015 International Building Code recognizes the American Society of Civil Engineers (ASCE) for seismic site class definitions. In accordance with Table 20.3-1 of the ASCE Minimum Design Loads for Buildings and Other Structures manual, Site Class C should be used for design.

Liquefaction is a phenomenon where saturated or loose soils suddenly lose internal strength and behave as a fluid. This behavior is in response to soil grain contraction and increased pore water pressures resulting from an earthquake or other intense ground shaking. In our opinion, the site soils are not susceptible to liquefaction. The relative density of native soils and lack of a shallow groundwater table is the primary basis for this opinion.

Slab-on-Grade Floors

Slab-on-grade floors for the proposed structures should be supported on a well-compacted, firm and unyielding subgrade. Where feasible, native soils exposed at the slab-on-grade subgrade level can likely be compacted in-situ to the specifications of structural fill. Unstable or yielding areas of the subgrade should be recompacted, or overexcavated and replaced with suitable structural fill, prior to construction of the slab.

A capillary break consisting of a minimum of four inches of free-draining crushed rock or gravel should be placed below the slab. The free-draining crushed rock or gravel should have a fines content of 5 percent or less (where the fines content is defined as the percent passing the Number 200 sieve, based on the minus three-quarter-inch fraction). In areas where slab moisture is undesirable, installation of a vapor barrier below the slab should be considered. If a vapor barrier is to be utilized, it should be a material specifically designed for use as a vapor barrier and should be installed in accordance with the specifications of the manufacturer.

Retaining Walls

Retaining walls must be designed to resist earth pressures and applicable surcharge loads. The following parameters may be used for design:

• Active earth pressure (yielding condition)	35 pcf (equivalent fluid)
• At-rest earth pressure (restrained condition)	55 pcf
• Traffic surcharge (passenger vehicles)	70 psf (rectangular distribution)*
• Passive earth pressure	300 pcf (equivalent fluid)
• Coefficient of friction	0.40
• Seismic surcharge	6H psf**

* *Where applicable*

** *Where H equals the retained height (in feet)*

The above design parameters are based on a level backfill condition and level grade at the wall toe. Revised design values will be necessary if sloping grades are to be used above or below retaining walls. Additional surcharge loading from adjacent foundations, sloped backfill, or other loads should be included in the retaining wall design, where applicable.

Retaining walls should be backfilled with free-draining material that extends along the height of the wall and a distance of at least 18 inches behind the wall. The upper 12 inches of the wall backfill can consist of a less permeable soil, if desired. A perforated drainpipe should be placed along the base of the wall and connected to an approved discharge location. A typical retaining wall drainage detail is provided on Plate 3. If drainage is not provided, hydrostatic pressures should be included in the wall design.

Drainage

During our subsurface exploration light perched groundwater seepage was encountered within B-1 within a fill layer that extended to about 10 feet bgs. As such, groundwater may be encountered within site excavations, such as excavations for new utilities and stormwater facilities. In addition, groundwater will likely be encountered during excavation and removal of the existing fill. Temporary measures to control surface water runoff and groundwater during construction would likely involve interceptor trenches, sumps, and/or dewatering pumps. ESNW should be consulted during preliminary grading to identify areas of seepage and to provide recommendations to reduce the potential for instability related to seepage effects.

Finish grades must be designed to direct surface drain water away from structures and slopes. Water must not be allowed to pond adjacent to structures or slopes. In our opinion, foundation drains should be installed along building perimeter footings. A typical foundation drain detail is provided on Plate 4.

Infiltration Feasibility

Based on the results of USDA textural analyses, native soils are classified as slightly gravelly sandy loam with corresponding fines content of 19 to 39 percent.

Small-scale infiltration BMPs (such as rain gardens or infiltration trenches) may be feasible depending largely on the proposed grading scheme. If significant grading will occur, the weathered soil zone may be completely removed to reveal very dense glacial till, which is not suitable for infiltration. ESNW can provide supplementary stormwater management recommendations, as project plans develop.

On-site Stormwater Management

The intent of BMP implementation is to infiltrate, disperse, and retain stormwater runoff on site to the extent feasible. The table below summarizes our evaluation of the BMPs from a geotechnical standpoint.

BMP	**Viable?**	**Limitations or Infeasibility Criteria**
Lawns and Landscaped Areas		
T5.13: Post-construction soil quality and depth (Volume V, Chapter 5)	Yes	
Roofs		
T5.30: Full dispersion (Volume V, Chapter 5) **T5.10A**: Downspout full infiltration systems (Volume III, Chapter 3)	Yes No	**T5.30**: No flooding or erosion impacts are anticipated. However, adequate vegetative flow paths may not be available. **T5.10A**: The soils conditions including glacial till generally exhibit poor soil infiltration characteristics.
Bioretention (Volume V, Chapter 7)	No	The soils conditions including glacial till generally exhibit poor soil infiltration characteristics.
T5.10B: Downspout dispersion systems (Volume III, Chapter 3)	Yes	No flooding or erosion impacts are anticipated. However, adequate vegetative flow paths may not available.
T5.10C: Perforated stub-out connections (Volume III, Chapter 3)	Yes	Except where unweathered glacial till soil is exposed that will likely interfere with the trench bottom.
Other Hard Surfaces		
T5.30: Full dispersion (Volume V, Chapter 5)	Yes	No critical areas. No flooding or erosion impacts are anticipated. However, adequate vegetative flow paths are likely not available.
T5.15: Permeable pavement (Volume V, Chapter 5)	No	Glacial till will not allow for infiltration below driveways, could cause inundation unless tied into the storm system.
Bioretention (Volume V, Chapter 7)	Yes	Except where unweathered glacial till soil deposits are exposed at relatively shallow depths due to generally poor soil infiltration characteristics.
T5.12: Sheet flow dispersion T5.11: Concentrated flow dispersion (Volume V, Chapter 5)	Yes	No flooding or erosion impacts are anticipated. However, adequate vegetative flow paths are likely not available.

ESNW should review the final design to confirm our recommendations are included and to provide additional recommendations.

Excavations and Slopes

Excavation activities are likely to expose both loose to medium dense and dense to very dense glacial deposits. Provided appropriate methods of sloping and shoring (as necessary) for the excavations are incorporated into the design and construction, overall stability of site excavations is anticipated to be good. Based on the soil conditions observed at the test pit locations, the following allowable temporary slope inclinations, as a function of horizontal to vertical (H:V) inclination, may be used. The applicable Federal Occupation Safety and Health Administration (OSHA) and Washington Industrial Safety and Health Act (WISHA) soil classifications are also provided:

• Loose and medium dense soils	1.5H:1V (Type C)
• Areas containing groundwater seepage	1.5H:1V (Type C)
• Dense soils	1H:1V (Type B)
• Dense glacial till where no groundwater is exposed	0.75H:1V (Type A)

Steeper temporary slope inclinations within undisturbed, dense to very dense native deposits may be feasible based on the soil and groundwater conditions exposed within the excavations, however, must be evaluated by ESNW at the time of construction.

Permanent slopes should be planted with vegetation to enhance stability and to minimize erosion, and should maintain a gradient of 2H:1V or flatter. The presence of perched groundwater may cause localized sloughing of temporary slopes due to excess seepage forces. An ESNW representative should observe temporary and permanent slopes to confirm the slope inclinations are suitable for the exposed soil conditions and to provide additional excavation and slope recommendations as necessary. If the recommended temporary slope inclinations cannot be achieved, temporary shoring may be necessary to support excavations.

Preliminary Pavement Sections

The performance of site pavements is largely related to the condition of the underlying subgrade. To ensure adequate pavement performance, the subgrade should be in a firm and unyielding condition when subjected to proofrolling with a loaded dump truck. Structural fill in pavement areas should be compacted to the specifications previously detailed in this report. Soft, wet, or otherwise unsuitable subgrade areas may still exist after base grading activities. Areas containing unsuitable or yielding subgrade conditions will require remedial measures, such as overexcavation and/or placement of thicker crushed rock or structural fill sections, prior to pavement.

We anticipate new pavement sections will be subjected primarily to passenger vehicle traffic. For lightly loaded pavement areas subjected primarily to passenger vehicles, the following preliminary pavement sections may be considered for site alignments:

- A minimum of two inches of hot mix asphalt (HMA) placed over four inches of crushed rock base (CRB), or;

- A minimum of two inches of HMA placed over three inches of asphalt-treated base (ATB).

The HMA, ATB and CRB materials should conform to WSDOT specifications. All soil base material should be compacted to a relative compaction of 95 percent, based on the laboratory maximum dry density as determined by ASTM D1557. Heavier truck-traffic areas generally require thicker pavement sections depending on site usage, pavement life expectancy, and site traffic. ESNW can provide appropriate pavement section design recommendations for truck traffic areas and right-of-way improvements, upon request. Road standards utilized by Mukilteo may supersede the recommendations provided in this report.

If an inverted crown configuration will be used for on site pavement, we recommend including drainage within the aggregate section that will prevent water from building up within the pavement section and to protect the subgrade from excessive moisture.

Utility Support and Trench Backfill

In our opinion, native soils will generally be suitable for support of utilities. Organic-rich soils are not considered suitable for direct support of utilities and may require removal at utility grades if encountered. Remedial measures, such as overexcavation and replacement with structural fill and/or installation of geotextile fabric, may be necessary in some areas in order to provide support for utilities. Groundwater will likely be encountered within utility excavations, and caving of trench walls may occur where groundwater is encountered. Temporary construction dewatering, as well as temporary trench shoring, may be necessary during utility excavation and installation as conditions warrant.

In general, native soils may not be suitable for use as structural backfill throughout utility trench excavations, unless the soils are at (or slightly above) the optimum moisture content at the time of placement and compaction. Structural trench backfill should not be placed dry of the optimum moisture content. Each section of the site utility lines must be adequately supported in appropriate bedding material. Utility trench backfill should be placed and compacted to the specifications of structural fill as previously detailed in this report, or to the applicable specifications of Mukilteo or other responsible jurisdiction or agency.

LIMITATIONS

The recommendations and conclusions provided in this study are professional opinions consistent with the level of care and skill that is typical of other members in the profession currently practicing under similar conditions in this area. A warranty is neither expressed nor implied. Variations in the soil and groundwater conditions observed at the test pit locations may exist and may not become evident until construction. ESNW should reevaluate the conclusions provided in this study if variations are encountered.

Additional Services

ESNW should have an opportunity to review final project plans with respect to the geotechnical recommendations provided in this study. ESNW should also be retained to provide testing and consultation services during construction.

Reference:
Snohomish County, Washington
OpenStreetMap.org

NORTH

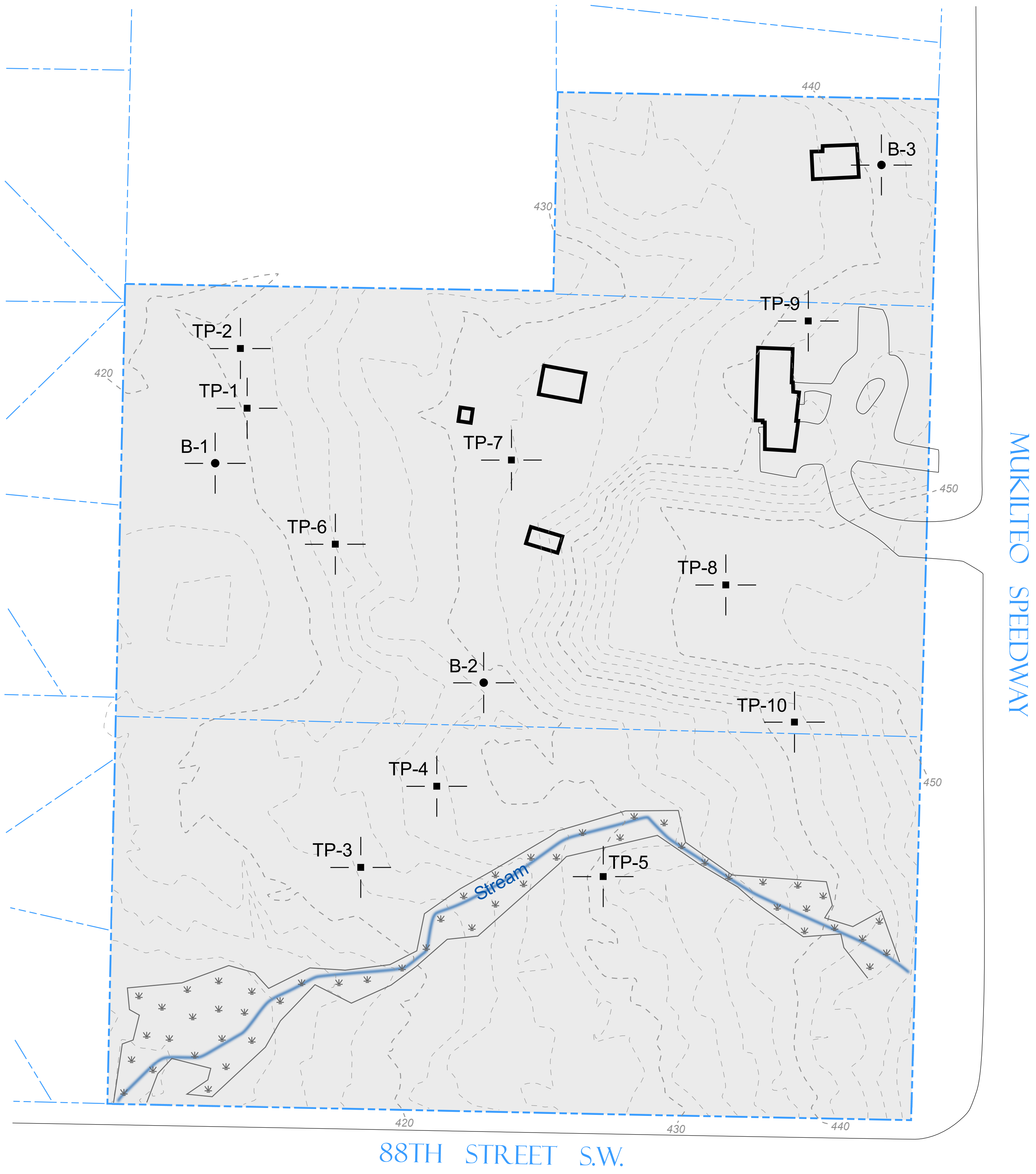
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NWLLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

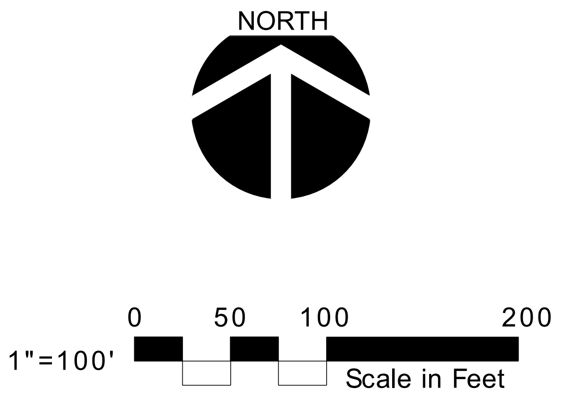
Vicinity Map
Mukilteo Strickland Property
Mukilteo, Washington

Drwn. CAM	Date 09/14/2020	Proj. No. 7422
Checked SSR	Date Sept. 2020	Plate 1



LEGEND

B-1 ●	Approximate Location of ESNW Boring, Proj. No. ES-7422, Aug. 2020
TP-1 ■	Approximate Location of ESNW Test Pit, Proj. No. ES-7422, Aug. 2020
▨	Subject Site
☐	Existing Building
⁎	Wetland (Delineated by Others)



NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided by the client at the time of our study. ESNW cannot be responsible for subsequent design changes or interpretation of the data by others.

NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Subsurface Exploration Plan
Mukilteo Strickland Property
Mukilteo, Washington

Earth Solutions NWLLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

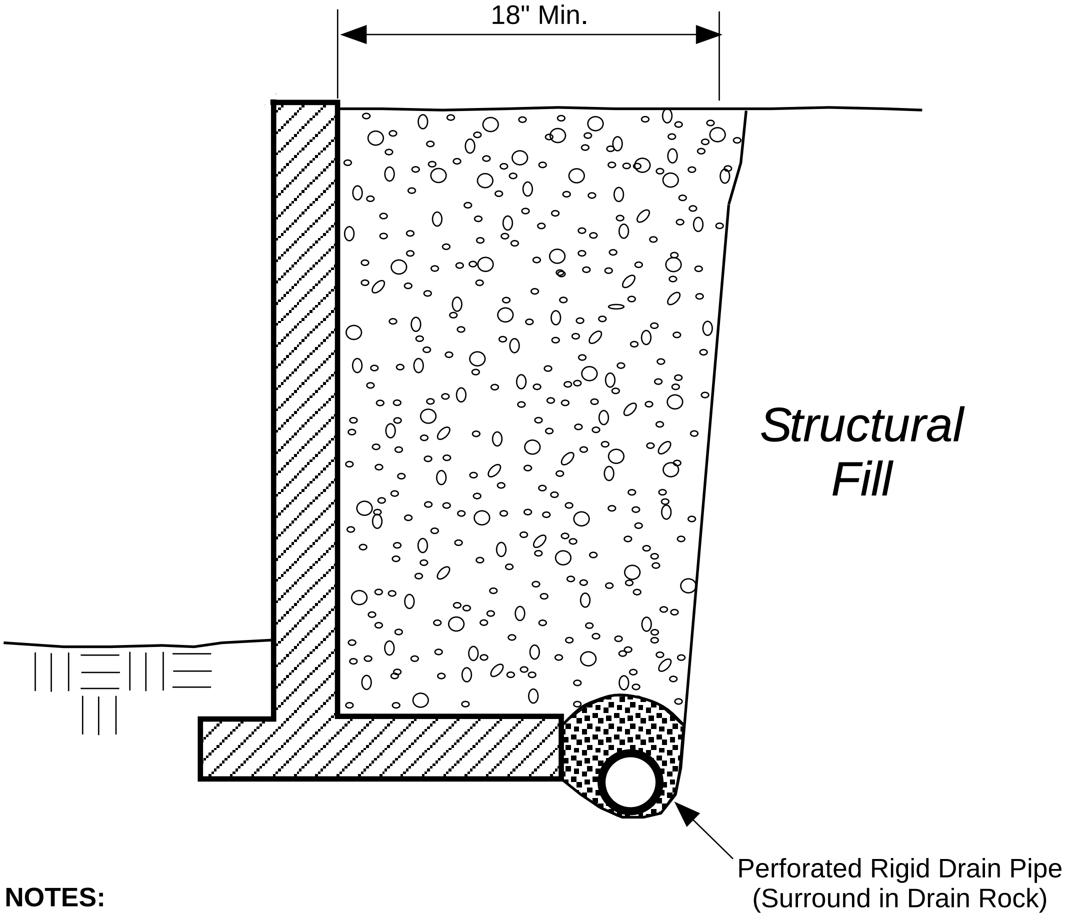
Drwn. By
CAM

Checked By
SSR

Date
10/09/2020

Proj. No.
7422

Plate
2



NOTES:

- Free-draining Backfill should consist of soil having less than 5 percent fines. Percent passing No. 4 sieve should be 25 to 75 percent.
- Sheet Drain may be feasible in lieu of Free-draining Backfill, per ESNW recommendations.
- Drain Pipe should consist of perforated, rigid PVC Pipe surrounded with 1-inch Drain Rock.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

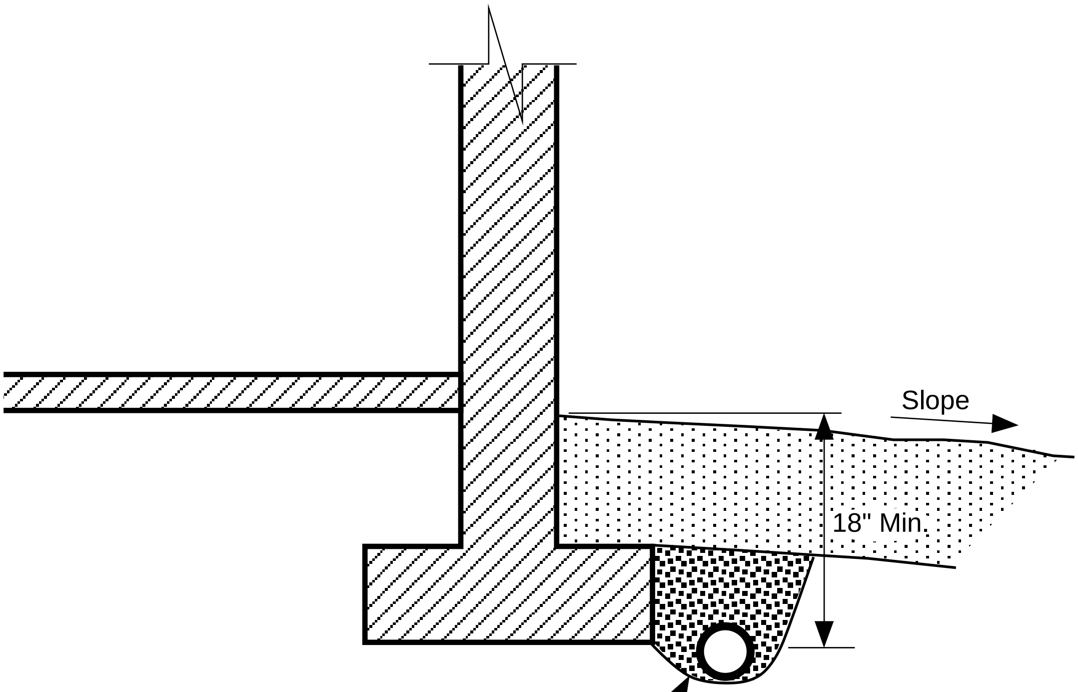
○	Free-draining Structural Backfill
▩	1-inch Drain Rock

Earth Solutions NW LLC

Earth Solutions NWLLC
Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

Retaining Wall Drainage Detail
Mukilteo Strickland Property
Mukilteo, Washington

Drwn. CAM	Date 09/15/2020	Proj. No. 7422
Checked SSR	Date Sept. 2020	Plate 3



Perforated Rigid Drain Pipe
(Surround in Drain Rock)

NOTES:

- Do NOT tie roof downspouts to Footing Drain.
- Surface Seal to consist of 12" of less permeable, suitable soil. Slope away from building.

LEGEND:

░	Surface Seal: native soil or other low-permeability material.
▓	1-inch Drain Rock

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

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Footing Drain Detail
Mukilteo Strickland Property
Mukilteo, Washington

Drwn. CAM	Date 09/15/2020	Proj. No. 7422
Checked SSR	Date Sept. 2020	Plate 4

Appendix A

Subsurface Exploration
Boring and Test Pit Logs

ES-7422

A representative of ESNW observed, logged, and sampled three borings and 10 test pits, advanced at accessible locations within the property boundaries. Borings were completed on August 4 through 8, 2020 using a sonic drill rig and the test pits were excavated on August 21, 2020 using a trackhoe and operator retained by our firm. The maximum exploration depth was 137.5 feet below existing grades.

The final logs represent the interpretations of the field logs and the results of laboratory analyses. The stratification lines on the logs represent the approximate boundaries between soil types. In actuality, the transitions may be more gradual.

Earth Solutions NW LLC

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	●	GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
			○	GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	○	GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
			▨	GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	⁘	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			⁖	SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	⁖	SM	SILTY SANDS, SAND - SILT MIXTURES
			▨	SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	▥	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			▨	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			☰	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	▥	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			▨	CH	INORGANIC CLAYS OF HIGH PLASTICITY
			≈	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			⁂	PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

DUAL SYMBOLS are used to indicate borderline soil classifications.

The discussion in the text of this report is necessary for a proper understanding of the nature of the material presented in the attached logs.

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BORING NUMBER B-1

PAGE 1 OF 7

PROJECT NUMBER ES-7422
PROJECT NAME Mukilteo Strickland Property
DATE STARTED 8/4/20 **COMPLETED** 8/5/20
GROUND ELEVATION 420 ft **HOLE SIZE**
DRILLING CONTRACTOR Holocene Drilling
GROUND WATER LEVELS:
DRILLING METHOD Sonic
AT TIME OF DRILLING ---
LOGGED BY BCS **CHECKED BY** SSR
AT END OF DRILLING ---
NOTES Surface Conditions: tall grass
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0		SM		Light brown silty SAND, loose, moist (Fill)	
5				5.0	415.0
		TPSL		Dark brown organic TOPSOIL, wet, very rich in organics	
				9.5	410.5
10		ML		Gray sandy SILT with scattered gravel, soft to medium stiff, wet	
15				-becomes stiff to hard, moist	
20				20.0	400.0

(Continued Next Page)

PROJECT NUMBER ES-7422 **PROJECT NAME** Mukilteo Strickland Property

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20		ML		Gray sandy SILT with gravel, hard, moist
				24.0 396.0
		SM		Gray silty SAND with gravel, dense to very dense, moist
25				
				-fragments of weakly cemented till
				-moderate groundwater seepage
				-very wet cuttings (slurry) -water upwelling from auger stem during sample retrieval
30				
				-weak iron oxide staining
35				-light brown color
40				40.0 380.0
		SM		Gray silty SAND with gravel, loose to medium dense, wet
				-weakly cemented

(Continued Next Page)

BORING NUMBER B-1

PROJECT NUMBER ES-7422 **PROJECT NAME** Mukilteo Strickland Property

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
43.0		SP-SM		Dark gray/tan poorly graded SAND with silt and gravel, loose to medium dense, wet	377.0
45				-moderate groundwater seepage, driller notes loose conditions -increased density from 45' to 50'	
				-very dense, slow drilling	
49.0		ML		Gray sandy SILT, hard, moist	371.0
50 / 50.0		SM		Gray silty SAND with gravel, dense, moist to wet -weak iron oxide staining -weakly cemented	370.0
55					
				-increasing sand and gravel content -very dense conditions, difficult drilling	
60 / 60.0		SM		Gray silty SAND with gravel, very dense, wet -very weakly cemented	360.0
65					

(Continued Next Page)

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
		SM		Gray silty SAND with gravel, very dense, wet *(continued)* -decreased sand and gravel content	
70				-decrease in sand grain size -slight increase in silt content -variable sand/silt content	
75					
			77.0		343.0
		ML		Gray sandy SILT, hard, moist	
80					
			84.0		336.0
		SM		Gray silty SAND with gravel, dense to very dense, moist to wet	
85				-weak to moderately cemented	

(Continued Next Page)

PROJECT NUMBER ES-7422 **PROJECT NAME** Mukilteo Strickland Property

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
		SM		Gray silty SAND with gravel, dense to very dense, moist to wet *(continued)*
90				
95				-unremarkable fine silty sand with gravel -typical glacial till
100			100.0	320.0
		SM		Gray silty SAND with gravel, very dense, moist -weak to moderately cemented
105				-cemented glacial till with variable sand/silt content
110				

(Continued Next Page)

PROJECT NUMBER ES-7422 **PROJECT NAME** Mukilteo Strickland Property

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
				Gray silty SAND with gravel, very dense, moist *(continued)*
115		SM		
120			120.0	-boring paused at 120' at end of day 300.0
				Gray silty SAND with gravel, very dense, moist
				-driller adds approximately 10 gallons of water to assist drilling
				-decreasing fines, not cemented
				-machine chatter
125		SM		
				-very dense drilling conditions
130				

(Continued Next Page)

PROJECT NUMBER ES-7422 **PROJECT NAME** Mukilteo Strickland Property

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
135		SM	░	Gray silty SAND with gravel, very dense, moist *(continued)* -driller adds approximately 10 gallons of water to assist drilling
			137.5	282.5

Boring terminated at 137.5 feet below existing grade. Groundwater seepage encountered at 27.0 and 45.0 feet during drilling. Boring backfilled with grout/bentonite.

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BORING NUMBER B-2

PAGE 1 OF 5

PROJECT NUMBER ES-7422

PROJECT NAME Mukilteo Strickland Property

DATE STARTED 8/5/20 **COMPLETED** 8/6/20

GROUND ELEVATION 430 ft **HOLE SIZE**

DRILLING CONTRACTOR Holocene Drilling

GROUND WATER LEVELS:

DRILLING METHOD Sonic

AT TIME OF DRILLING ---

LOGGED BY BCS **CHECKED BY** SSR

AT END OF DRILLING ---

NOTES Surface Conditions: tall grass

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0		TPSL		Dark brown TOPSOIL	
				1.0	429.0
		ML		Brown sandy SILT with scattered gravel, very soft, wet	
5				-moderate iron oxide staining	
				-dark brown organics intermixed	
				-becomes gray, medium to stiff	
				9.0	421.0
		SM		Gray silty fine SAND with scattered gravel, dense, moist	
10				-weakly cemented	
15				-very dense drilling	
20				20.0	410.0

(Continued Next Page)

PROJECT NUMBER ES-7422 **PROJECT NAME** Mukilteo Strickland Property

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
20				Gray silty fine SAND with scattered gravel, very dense, moist	
				-light groundwater seepage at 20'	
25					
				-light brown color	
				-weak iron oxide staining	
30		SM		-difficult drilling	
				-becomes wet, very weakly cemented	
35				-becomes moist, weakly cemented	
				-thin lenses of coarse sand/gravel	
40			40.0	-typical cemented glacial till	390.0
				Gray silty fine SAND with gravel, very dense, moist	
		SM		-weakly cemented	

(Continued Next Page)

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
		SM		Gray silty fine SAND with gravel, very dense, moist *(continued)*	
				-lens of poorly graded sand with silt, increasing sand content, becomes wet	
45					
				-weak iron oxide staining	
50				-increased fines content	
				-coarse sand and gravel lenses	
55					
				-becomes brownish in color	
				-becomes gray	
				-moderate groundwater seepage	
				-becomes wet	
60			60.0	-water upwelling from drill stem upon sample retrieval	370.0
		SM	61.0	Gray silty fine SAND with gravel, very dense, moist to wet	369.0
		GW-GM		Gray well-graded GRAVEL with silt and sand, loose to medium dense, wet	
				-lenses of silty fine sand/sandy silt	
65					

(Continued Next Page)

PROJECT NUMBER ES-7422 **PROJECT NAME** Mukilteo Strickland Property

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
		GW-GM		Gray well-graded GRAVEL with silt and sand, loose to medium dense, wet *(continued)* 67.5 362.5
		SM		Gray silty fine SAND with scattered gravel, dense, wet 69.0 361.0
70		SP-SM		Gray poorly graded SAND with silt and gravel, loose, wet 71.0 359.0
75		SM		Gray silty fine SAND, dense,wet -not cemented -drilling paused at 75' at end of day, driller adding water while casing boring 75.0 355.0
80		ML		Gray SILT with sand, stiff to hard, moist -drilling difficulty indicates till -casing filled with water 80.0 350.0
		SM		Gray silty SAND with gravel, very dense, moist 82.5 347.5
85		ML		Gray sandy SILT, hard, moist 85.0 345.0
		SM		Gray silty SAND with gravel, very dense, moist

(Continued Next Page)

PROJECT NUMBER ES-7422 **PROJECT NAME** Mukilteo Strickland Property

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
				Gray silty SAND with gravel, very dense, moist *(continued)*
90				-weakly cemented
95		SM		-driller adds water to assist drilling
100				100.0 330.0

Boring terminated at 100.0 feet below existing grade. Groundwater seepage encountered at 20.0 and 58.0 feet during drilling. Boring backfilled with grout/bentonite.

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BORING NUMBER B-3

PROJECT NUMBER ES-7422
PROJECT NAME Mukilteo Strickland Property
DATE STARTED 8/6/20 **COMPLETED** 8/7/20
GROUND ELEVATION 445 ft **HOLE SIZE**
DRILLING CONTRACTOR Holocene Drilling
GROUND WATER LEVELS:
DRILLING METHOD Sonic
AT TIME OF DRILLING ---
LOGGED BY BCS **CHECKED BY** SSR
AT END OF DRILLING ---
NOTES Surface Conditions: grass/blackberries
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0		TPSL	▨	Dark brown TOPSOIL intermixed with gravel (Fill)	
				1.5	443.5
		SM	░	Brown silty SAND with gravel, loose, moist	
				2.5	442.5
		ML	‖	Gray/light tan sandy SILT, soft, moist to wet -moderate to heavy iron oxide staining	
				3.5	441.5
		SM	░	Gray silty fine SAND with gravel, dense, moist	
5					
				-becomes very dense, decreased gravel content	
10				-weak to moderately cemented	
15				-decreased fines, decreased degree of cementation	
				-difficult drilling	
20				20.0	425.0

(Continued Next Page)

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20				Gray silty fine SAND with scattered gravel, dense, moist
				-lenses of sandy silt and poorly graded silty sand
25				-very weakly cemented
				-varying sand/silt content
30		SM		-driller added 5-10 gallons of water to assist drilling
				-becomes wet
35				
				-large gravels/cobbles
				39.0 406.0
		SP-SM		Gray poorly graded SAND with silt, medium dense, moist
40				40.0 405.0
		SP-SM		Gray poorly graded SAND with silt and gravel, medium dense, moist -light groundwater seepage
				41.5 403.5
		SM		Gray silty fine SAND with scattered gravel, dense, moist

(Continued Next Page)

PROJECT NUMBER ES-7422 **PROJECT NAME** Mukilteo Strickland Property

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
		SM		Gray silty fine SAND with scattered gravel, dense, moist *(continued)*	
45				-weakly cemented	
				-lens of poorly graded sand with silt	
50					
				-becomes wet	
55				-light groundwater seepage	
			55.5		389.5
		ML		Gray sandy SILT, hard, moist to wet	
60				-drilling paused at 60' at end of day	
			60.0		385.0
		SM		Gray silty fine SAND, hard, wet	
			64.0		381.0
65		ML		Gray sandy SILT, hard, moist	

(Continued Next Page)

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION		
70		ML		Gray sandy SILT, hard, moist *(continued)*	72.0	373.0
		GP-GM		Brown poorly graded GRAVEL with silt and sand, loose, wet -light groundwater seepage, moderate iron oxide staining	73.5	371.5
75		ML		Gray sandy SILT, hard, moist	75.0	370.0
80 85		SM		Gray silty SAND with gravel, very dense, moist -weak to moderately cemented -weak to moderate cementation -difficult drilling		

(Continued Next Page)

BORING NUMBER B-3

PROJECT NUMBER ES-7422 **PROJECT NAME** Mukilteo Strickland Property

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION	
		SM			Gray silty SAND with gravel, very dense, moist *(continued)*	
90				90.0	-very difficult drilling	355.0

Boring terminated at 90.0 feet below existing grade. Groundwater seepage encountered at 41.0, 55.0 and 73.0 feet during drilling. Boring backfilled with bentonite.

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TEST PIT NUMBER TP-1

PAGE 1 OF 1

PROJECT NUMBER ES-7422

PROJECT NAME Mukilteo Strickland Property

DATE STARTED 8/21/20 **COMPLETED** 8/21/20

GROUND ELEVATION 420 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating

GROUND WATER LEVELS:

EXCAVATION METHOD

AT TIME OF EXCAVATION ---

LOGGED BY BCS **CHECKED BY** SSR

AT END OF EXCAVATION ---

NOTES Surface Conditions: tall grass

AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			SM	▨	Brown silty SAND, medium dense, moist (Fill)	
				▨	-asphalt chunk	
		MC = 9.5%		▨		
5				▨		
		MC = 15.7%		▨	-becomes blue gray, scrap metal	
7.0						413.0
		MC = 100.0%	TPSL	▨	Dark brown TOPSOIL with sand (Fill) -grades into silty sand with gravel	
9.0						411.0
10			SM	▨	Brown silty SAND with gravel, dense, moist to wet (Fill)	
11.0		MC = 20.7%				409.0

Test pit terminated at 11.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

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TEST PIT NUMBER TP-2

PAGE 1 OF 1

PROJECT NUMBER ES-7422

PROJECT NAME Mukilteo Strickland Property

DATE STARTED 8/21/20 **COMPLETED** 8/21/20

GROUND ELEVATION 420 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating

GROUND WATER LEVELS:

EXCAVATION METHOD

AT TIME OF EXCAVATION ---

LOGGED BY BCS **CHECKED BY** SSR

AT END OF EXCAVATION ---

NOTES Depth of Topsoil & Sod 10": blackberries

AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL	0.9	Dark brown TOPSOIL	419.1
			SM		Light brown silty SAND, medium dense, moist	
					-large tree stump/trunk/root	
		MC = 10.3%			-becomes gray, very dense, moderately cemented	
5						
		MC = 13.0% Fines = 36.7%		7.0	[USDA Classification: slightly gravelly fine sandy LOAM]	413.0

Test pit terminated at 7.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

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TEST PIT NUMBER TP-3

PAGE 1 OF 1

PROJECT NUMBER ES-7422

PROJECT NAME Mukilteo Strickland Property

DATE STARTED 8/21/20 **COMPLETED** 8/21/20

GROUND ELEVATION 420 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating

GROUND WATER LEVELS:

EXCAVATION METHOD

AT TIME OF EXCAVATION ---

LOGGED BY BCS **CHECKED BY** SSR

AT END OF EXCAVATION ---

NOTES Depth of Topsoil & Sod 10": forest shrubs

AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL	
				0.9		419.1
			SM		Light brown silty SAND, dense, damp	
		MC = 5.8% Fines = 18.5%			-weakly cemented [USDA Classification: gravelly loamy SAND]	
		MC = 9.4%			-becomes gray, very dense, moist	
5		MC = 9.4%		5.0		415.0

Test pit terminated at 5.0 feet below existing grade due to refusal in very dense till. No groundwater encountered during excavation. No caving observed.

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TEST PIT NUMBER TP-4

PAGE 1 OF 1

PROJECT NUMBER ES-7422

PROJECT NAME Mukilteo Strickland Property

DATE STARTED 8/21/20 **COMPLETED** 8/21/20

GROUND ELEVATION 430 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating

GROUND WATER LEVELS:

EXCAVATION METHOD

AT TIME OF EXCAVATION ---

LOGGED BY BCS **CHECKED BY** SSR

AT END OF EXCAVATION ---

NOTES Depth of Topsoil & Sod 12": forest detritus

AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION	
0			TPSL		1.0	Dark brown TOPSOIL -root intrusions to 2'	429.0
5		MC = 9.9% MC = 11.7% MC = 9.6% Fines = 39.1%	SM		6.0	Brown silty SAND, medium dense, moist -moderate iron oxide staining to 4' -weak to moderately cemented -becomes gray, very dense [USDA Classification: gravelly fine sandy LOAM]	424.0

Test pit terminated at 6.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

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TEST PIT NUMBER TP-5

PAGE 1 OF 1

PROJECT NUMBER ES-7422
PROJECT NAME Mukilteo Strickland Property
DATE STARTED 8/21/20 **COMPLETED** 8/21/20
GROUND ELEVATION 437 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY BCS **CHECKED BY** SSR
AT END OF EXCAVATION ---
NOTES Depth of Topsoil & Sod 8": forest shrubs
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL	0.7	Dark brown TOPSOIL	436.3
		MC = 9.6% MC = 10.0%	SM	4.0	Light brown silty SAND, medium dense, moist -weak iron oxide staining, weakly cemented -becomes gray/dark gray	433.0

Test pit terminated at 4.0 feet below existing grade due to refusal in very dense till. No groundwater encountered during excavation. No caving observed.

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TEST PIT NUMBER TP-6

PAGE 1 OF 1

PROJECT NUMBER ES-7422

PROJECT NAME Mukilteo Strickland Property

DATE STARTED 8/21/20 **COMPLETED** 8/21/20

GROUND ELEVATION 422 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating

GROUND WATER LEVELS:

EXCAVATION METHOD

AT TIME OF EXCAVATION ---

LOGGED BY BCS **CHECKED BY** SSR

AT END OF EXCAVATION ---

NOTES Depth of Topsoil & Sod 12": tall grass

AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL	1.0	Dark brown TOPSOIL -root intrusions to 2.5'	421.0
		MC = 11.4% MC = 15.1%	SM		Brown silty SAND, dense, moist -becomes gray, weak iron oxide staining -weakly cemented	
5		MC = 12.8%		6.0		416.0

Test pit terminated at 6.0 feet below existing grade due to refusal in very dense till. No groundwater encountered during excavation. No caving observed.

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TEST PIT NUMBER TP-7

PAGE 1 OF 1

PROJECT NUMBER ES-7422

PROJECT NAME Mukilteo Strickland Property

DATE STARTED 8/21/20 **COMPLETED** 8/21/20

GROUND ELEVATION 431 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating

GROUND WATER LEVELS:

EXCAVATION METHOD

AT TIME OF EXCAVATION ---

LOGGED BY BCS **CHECKED BY** SSR

AT END OF EXCAVATION ---

NOTES Depth of Topsoil & Sod 12": tall grass

AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Gray/brown TOPSOIL	
				1.0		430.0
			SM		Light brown silty SAND, medium dense, moist	
		MC = 17.6%				
					-becomes gray, dense, weakly cemented -moderate iron oxide staining to BOH -grades into silty sand with gravel	
		MC = 13.5%				
5						
		MC = 12.7%		6.0		425.0

Test pit terminated at 6.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

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TEST PIT NUMBER TP-8

PAGE 1 OF 1

PROJECT NUMBER ES-7422
PROJECT NAME Mukilteo Strickland Property
DATE STARTED 8/21/20 **COMPLETED** 8/21/20
GROUND ELEVATION 450 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY BCS **CHECKED BY** SSR
AT END OF EXCAVATION ---
NOTES Surface Conditions: tall grass
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				▨	Gray silty SAND with gravel, loose to medium dense, moist (Fill)
		MC = 7.9%		▨	
				▨	-asphalt layer -becomes dark gray
5		MC = 11.1%		▨	-wood scraps
			SM	▨	-bricks, asphalt, strong petrol odor
10				▨	
				▨	-wood fragments, bricks
15				▨	
				16.0	434.0
		MC = 26.5% Fines = 44.9%	SM	░	Dark brown silty SAND with organics, medium dense, wet -mottled color, resembles wetland deposits [USDA Classification: slightly gravelly LOAM]
		MC = 13.2% Fines = 46.4%		░	-becomes gray, dense, moist, weakly cemented [USDA Classification: slightly gravelly fine sandy LOAM]
				19.0	431.0

Test pit terminated at 19.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

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TEST PIT NUMBER TP-9

PAGE 1 OF 1

PROJECT NUMBER ES-7422
PROJECT NAME Mukilteo Strickland Property
DATE STARTED 8/21/20 **COMPLETED** 8/21/20
GROUND ELEVATION 447 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY BCS **CHECKED BY** SSR
AT END OF EXCAVATION ---
NOTES Depth of Topsoil & Sod 8": lawn grass
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		Brown/gray TOPSOIL
				0.7	446.3
			SM		Tan silty SAND with scattered gravel, medium dense, moist
		MC = 8.2%			-becomes gray, dense, weakly cemented
				4.0	443.0
		MC = 9.3%			

Test pit terminated at 4.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

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TEST PIT NUMBER TP-10

PAGE 1 OF 1

PROJECT NUMBER ES-7422
PROJECT NAME Mukilteo Strickland Property
DATE STARTED 8/21/20 **COMPLETED** 8/21/20
GROUND ELEVATION 440 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY BCS **CHECKED BY** SSR
AT END OF EXCAVATION ---
NOTES Surface Conditions: blackberries
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			SM	▨ 3.0	Dark gray silty SAND, medium dense, moist (Fill) -large woody debris 437.0
		MC = 18.4% Fines = 32.7%			
5		MC = 16.0%	SM	░ 6.0	Light brown silty SAND, dense, moist to wet -weak iron oxide staining [USDA Classification: gravelly sandy LOAM] -becomes gray -moderate iron oxide staining 434.0

Test pit terminated at 6.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

Appendix B

Laboratory Test Results

ES-7422

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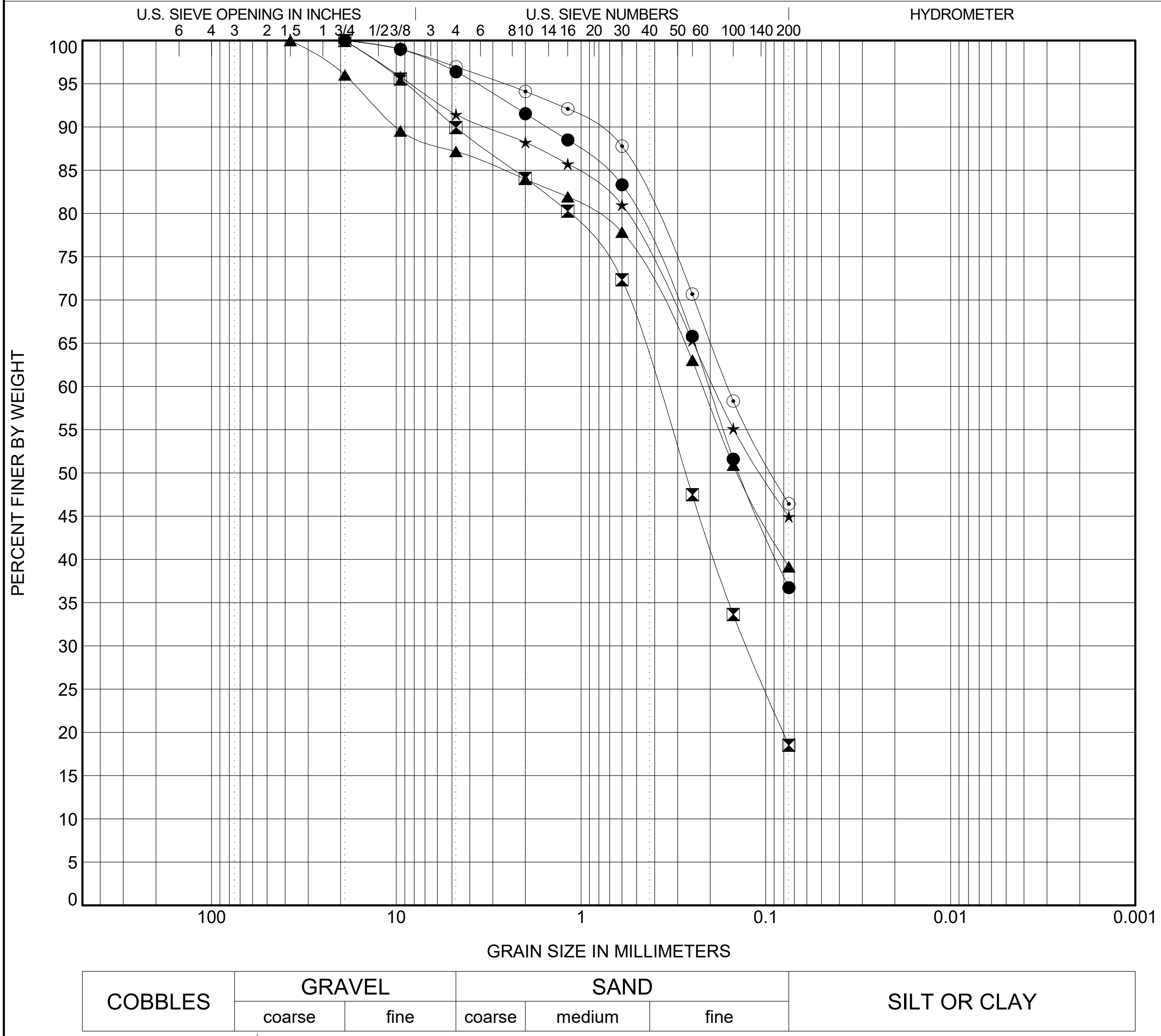
GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-7422

PROJECT NAME Mukilteo Strickland Property



Specimen Identification			Classification	Cc	Cu
●	**TP-02**	**7.00ft.**	**USDA: Gray Slightly Gravelly Fine Sandy Loam. USCS: SM.**		
⧗	**TP-03**	**2.00ft.**	**USDA: Lt Brown Gravelly Loamy Sand. USCS: SM.**		
▲	**TP-04**	**6.00ft.**	**USDA: Gray Gravelly Fine Sandy Loam. USCS: SM.**		
★	**TP-08**	**17.00ft.**	**USDA: Dk Brown Slightly Gravelly Loam. USCS: SM.**		
⊙	**TP-08**	**19.00ft.**	**USDA: Gray Slightly Gravelly Fine Sandy Loam. USCS: SM.**		

Specimen Identification			D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
●	**TP-02**	**7.0ft.**	**19**	**0.203**						**36.7**	
⧗	**TP-03**	**2.0ft.**	**19**	**0.388**	**0.127**					**18.5**	
▲	**TP-04**	**6.0ft.**	**37.5**	**0.22**						**39.1**	
★	**TP-08**	**17.0ft.**	**19**	**0.192**						**44.9**	
⊙	**TP-08**	**19.0ft.**	**19**	**0.161**						**46.4**	

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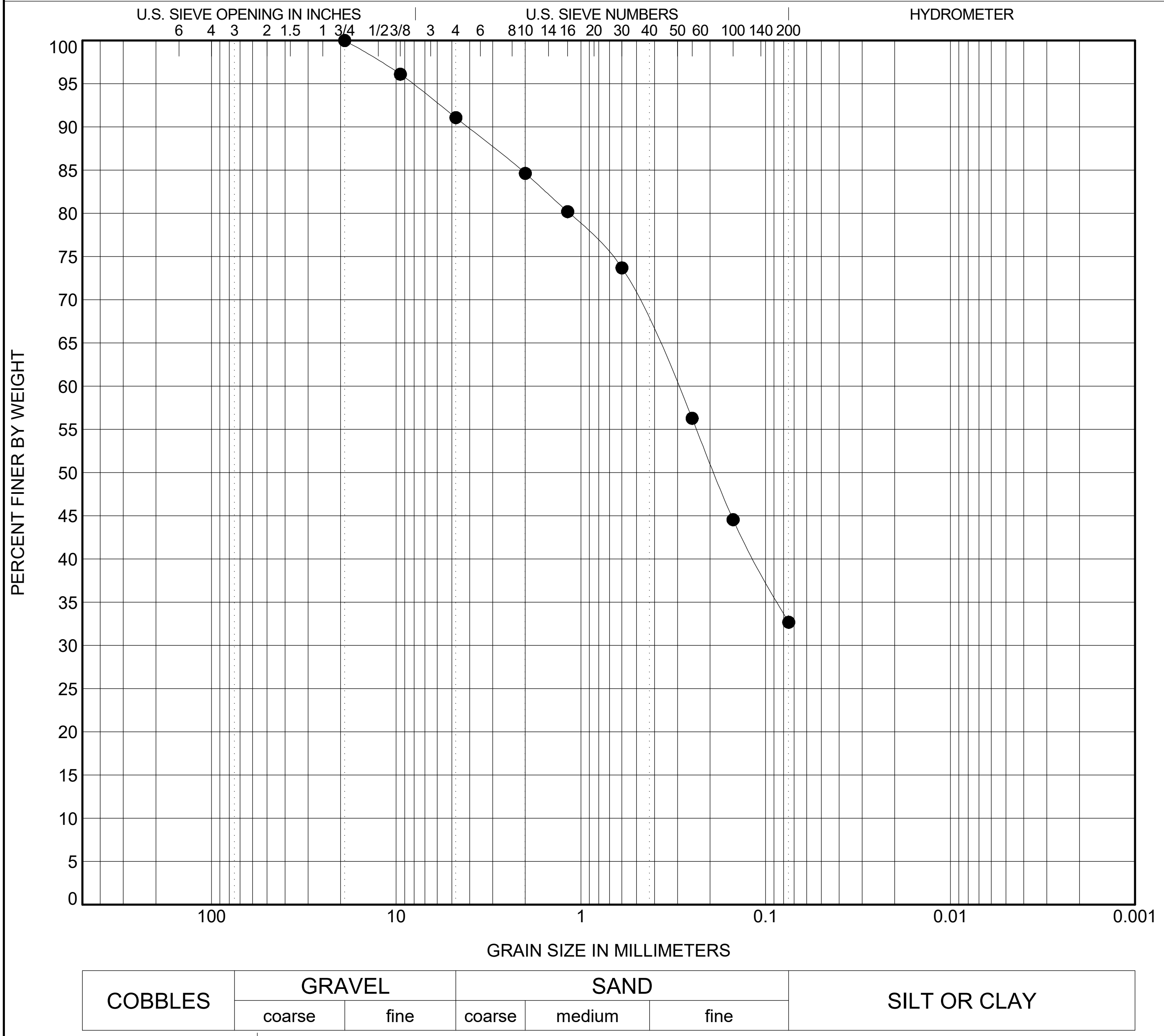
GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-7422 **PROJECT NAME** Mukilteo Strickland Property



Specimen Identification		Classification	Cc	Cu
● **TP-10**	**3.00ft.**	**USDA: Lt Brown Gravelly Sandy Loam. USCS: SM.**		

Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
● **TP-10**	**3.0ft.**	**19**	**0.301**						**32.7**	

Report Distribution

ES-7422

<u>EMAIL ONLY</u>

Westcott Holdings, Inc.
1010 Market Street
Kirkland, Washington 98033

Attention: Mr. Ryan Appleby

C|P|H
CONSULTANTS

APPENDIX B

WWMH INPUT PARAMETERS AND RESULTS

WWHM2012

PROJECT REPORT

Carrik Court

Flow Control and WQ Facility Sizing
CPH Project No. 0054-20-034

General Model Information

Project Name:	211217_Vault Sizing
Site Name:	Carrik Court
Site Address:	
City:	
Report Date:	1/18/2022
Gage:	Everett
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.800
Version Date:	2018/10/10
Version:	4.2.16

POC Thresholds

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

Landuse Basin Data

Predeveloped Land Use

Predev-N

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	3.42
Pervious Total	3.42
Impervious Land Use	acre
Impervious Total	0
Basin Total	3.42

Element Flows To:

Surface	Interflow	Groundwater

Predev-S

Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Mod	4.93
Pervious Total	4.93
Impervious Land Use	acre
Impervious Total	0
Basin Total	4.93

Element Flows To:

Surface	Interflow	Groundwater

Upstream-N

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS MOD	0.277
Impervious Total	0.277
Basin Total	0.277

Element Flows To:

Surface	Interflow	Groundwater

Upstream-S

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS MOD	0.095
Impervious Total	0.095
Basin Total	0.095

Element Flows To:

Surface	Interflow	Groundwater

Predev_Drive G

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	0.58
Pervious Total	0.58
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.58

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Dev-N

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Mod	0.36
Pervious Total	0.36
Impervious Land Use	acre
ROOF TOPS FLAT	0.195
SIDEWALKS MOD	0.015
Impervious Total	0.21
Basin Total	0.57

Element Flows To:

Surface	Interflow	Groundwater

Dev-S

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Mod	2.113
Pervious Total	2.113
Impervious Land Use	acre
ROADS MOD	2.18
ROOF TOPS FLAT	1.849
SIDEWALKS MOD	0.606
Impervious Total	4.635
Basin Total	6.748

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Upstream-N

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS MOD	0.062
Impervious Total	0.062
Basin Total	0.062

Element Flows To:

Surface	Interflow	Groundwater

Bypass-N

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS MOD	0.043
Impervious Total	0.043
Basin Total	0.043

Element Flows To:

Surface	Interflow	Groundwater

Upstream-S

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS MOD	0.309
Impervious Total	0.309
Basin Total	0.309

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Bypass-S

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Mod	0.059
Pervious Total	0.059
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.059

Element Flows To:

Surface	Interflow	Groundwater

Offsite-Dev S

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Mod	0.377
Pervious Total	0.377
Impervious Land Use	acre
ROADS MOD	0.185
Impervious Total	0.185
Basin Total	0.562

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Drive G_Dev

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Mod	0.195
Pervious Total	0.195
Impervious Land Use	acre
ROADS MOD	0.158
ROOF TOPS FLAT	0.227
Impervious Total	0.385
Basin Total	0.58

Element Flows To:

Surface	Interflow	Groundwater
StormTech 2	StormTech 2	

Routing Elements

Predeveloped Routing

Mitigated Routing

Vault 1

Width: 78 ft.
Length: 108 ft.
Depth: 15.5 ft.
Infiltration On
Infiltration rate: 0.04
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 234.178
Total Volume Through Riser (ac-ft.): 441.327
Total Volume Through Facility (ac-ft.): 675.505
Percent Infiltrated: 34.67
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 15 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 0.6125 in Elevation:0 ft.
Orifice 2 Diameter: 1 in. Elevation:13.25 ft.
Element Flows To:
Outlet 1 Outlet 2

Vault Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.193	0.000	0.000	0.000
0.1722	0.193	0.033	0.004	0.007
0.3444	0.193	0.066	0.006	0.007
0.5167	0.193	0.099	0.007	0.007
0.6889	0.193	0.133	0.008	0.007
0.8611	0.193	0.166	0.009	0.007
1.0333	0.193	0.199	0.010	0.007
1.2056	0.193	0.233	0.011	0.007
1.3778	0.193	0.266	0.011	0.007
1.5500	0.193	0.299	0.012	0.007
1.7222	0.193	0.333	0.013	0.007
1.8944	0.193	0.366	0.014	0.007
2.0667	0.193	0.399	0.014	0.007
2.2389	0.193	0.433	0.015	0.007
2.4111	0.193	0.466	0.015	0.007
2.5833	0.193	0.499	0.016	0.007
2.7556	0.193	0.532	0.016	0.007
2.9278	0.193	0.566	0.017	0.007
3.1000	0.193	0.599	0.017	0.007
3.2722	0.193	0.632	0.018	0.007
3.4444	0.193	0.666	0.018	0.007
3.6167	0.193	0.699	0.019	0.007
3.7889	0.193	0.732	0.019	0.007
3.9611	0.193	0.766	0.020	0.007
4.1333	0.193	0.799	0.020	0.007
4.3056	0.193	0.832	0.021	0.007
4.4778	0.193	0.866	0.021	0.007
4.6500	0.193	0.899	0.022	0.007
4.8222	0.193	0.932	0.022	0.007
4.9944	0.193	0.965	0.022	0.007

5.1667	0.193	0.999	0.023	0.007
5.3389	0.193	1.032	0.023	0.007
5.5111	0.193	1.065	0.023	0.007
5.6833	0.193	1.099	0.024	0.007
5.8556	0.193	1.132	0.024	0.007
6.0278	0.193	1.165	0.025	0.007
6.2000	0.193	1.199	0.025	0.007
6.3722	0.193	1.232	0.025	0.007
6.5444	0.193	1.265	0.026	0.007
6.7167	0.193	1.298	0.026	0.007
6.8889	0.193	1.332	0.026	0.007
7.0611	0.193	1.365	0.027	0.007
7.2333	0.193	1.398	0.027	0.007
7.4056	0.193	1.432	0.027	0.007
7.5778	0.193	1.465	0.028	0.007
7.7500	0.193	1.498	0.028	0.007
7.9222	0.193	1.532	0.028	0.007
8.0944	0.193	1.565	0.029	0.007
8.2667	0.193	1.598	0.029	0.007
8.4389	0.193	1.632	0.029	0.007
8.6111	0.193	1.665	0.029	0.007
8.7833	0.193	1.698	0.030	0.007
8.9556	0.193	1.731	0.030	0.007
9.1278	0.193	1.765	0.030	0.007
9.3000	0.193	1.798	0.031	0.007
9.4722	0.193	1.831	0.031	0.007
9.6444	0.193	1.865	0.031	0.007
9.8167	0.193	1.898	0.031	0.007
9.9889	0.193	1.931	0.032	0.007
10.161	0.193	1.965	0.032	0.007
10.333	0.193	1.998	0.032	0.007
10.506	0.193	2.031	0.033	0.007
10.678	0.193	2.065	0.033	0.007
10.850	0.193	2.098	0.033	0.007
11.022	0.193	2.131	0.033	0.007
11.194	0.193	2.164	0.034	0.007
11.367	0.193	2.198	0.034	0.007
11.539	0.193	2.231	0.034	0.007
11.711	0.193	2.264	0.034	0.007
11.883	0.193	2.298	0.035	0.007
12.056	0.193	2.331	0.035	0.007
12.228	0.193	2.364	0.035	0.007
12.400	0.193	2.398	0.035	0.007
12.572	0.193	2.431	0.036	0.007
12.744	0.193	2.464	0.036	0.007
12.917	0.193	2.497	0.036	0.007
13.089	0.193	2.531	0.036	0.007
13.261	0.193	2.564	0.039	0.007
13.433	0.193	2.597	0.048	0.007
13.606	0.193	2.631	0.053	0.007
13.778	0.193	2.664	0.057	0.007
13.950	0.193	2.697	0.060	0.007
14.122	0.193	2.731	0.063	0.007
14.294	0.193	2.764	0.066	0.007
14.467	0.193	2.797	0.068	0.007
14.639	0.193	2.831	0.070	0.007
14.811	0.193	2.864	0.073	0.007
14.983	0.193	2.897	0.075	0.007

15.156	0.193	2.930	1.047	0.007
15.328	0.193	2.964	2.897	0.007
15.500	0.193	2.997	4.719	0.007
15.672	0.178	2.707	5.861	0.000

StormTech 2

Chamber Model:	3500	
Dimensions		
Max Row Length:	240	
Number of Chambers:	32	
Number of Endcaps:	4	
Top Stone Depth:	12	
Bottom Stone Depth:	9	
Discharge Structure		
Riser Height:	4.75 ft.	
Riser Diameter:	12 in.	
Orifice 1 Diameter:	0.5 in.	Elevation:0 ft.
Element Flows To:		
Outlet 1	Outlet 2	

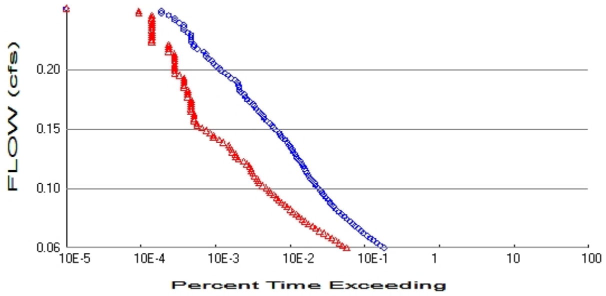
StormTech Hydraulic Table

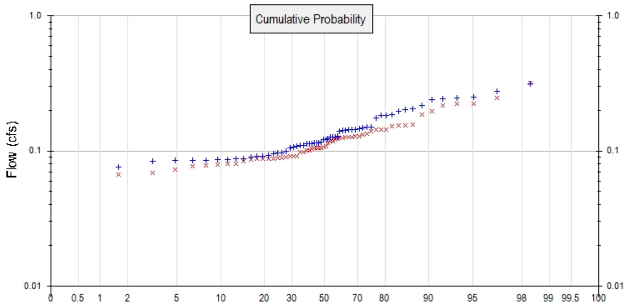
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
3.0000	0.176	0.000	0.000	0.000
3.0444	0.176	0.007	0.001	0.000
3.0889	0.176	0.015	0.002	0.000
3.1333	0.176	0.023	0.002	0.000
3.1778	0.176	0.031	0.002	0.000
3.2222	0.176	0.039	0.003	0.000
3.2667	0.176	0.047	0.003	0.000
3.3111	0.176	0.054	0.003	0.000
3.3556	0.176	0.062	0.004	0.000
3.4000	0.176	0.070	0.004	0.000
3.4444	0.176	0.078	0.004	0.000
3.4889	0.176	0.086	0.004	0.000
3.5333	0.176	0.094	0.005	0.000
3.5778	0.176	0.101	0.005	0.000
3.6222	0.176	0.109	0.005	0.000
3.6667	0.176	0.117	0.005	0.000
3.7111	0.176	0.125	0.005	0.000
3.7556	0.176	0.133	0.005	0.000
3.8000	0.176	0.141	0.006	0.000
3.8444	0.176	0.148	0.006	0.000
3.8889	0.176	0.156	0.006	0.000
3.9333	0.176	0.164	0.006	0.000
3.9778	0.176	0.172	0.006	0.000
4.0222	0.176	0.180	0.006	0.000
4.0667	0.176	0.188	0.007	0.000
4.1111	0.176	0.195	0.007	0.000
4.1556	0.176	0.203	0.007	0.000
4.2000	0.176	0.211	0.007	0.000
4.2444	0.176	0.219	0.007	0.000
4.2889	0.176	0.227	0.007	0.000
4.3333	0.176	0.235	0.007	0.000
4.3778	0.176	0.242	0.008	0.000
4.4222	0.176	0.250	0.008	0.000
4.4667	0.176	0.258	0.008	0.000
4.5111	0.176	0.266	0.008	0.000
4.5556	0.176	0.274	0.008	0.000
4.6000	0.176	0.282	0.008	0.000
4.6444	0.176	0.289	0.008	0.000

4.6889	0.176	0.297	0.008	0.000
4.7333	0.176	0.305	0.008	0.000
4.7778	0.176	0.313	0.009	0.000
4.8222	0.176	0.321	0.009	0.000
4.8667	0.176	0.329	0.009	0.000
4.9111	0.176	0.336	0.009	0.000
4.9556	0.176	0.344	0.009	0.000
5.0000	0.176	0.352	0.009	0.000
5.0444	0.176	0.360	0.009	0.000
5.0889	0.176	0.368	0.009	0.000
5.1333	0.176	0.376	0.009	0.000
5.1778	0.176	0.384	0.010	0.000
5.2222	0.176	0.391	0.010	0.000
5.2667	0.176	0.399	0.010	0.000
5.3111	0.176	0.407	0.010	0.000
5.3556	0.176	0.415	0.010	0.000
5.4000	0.176	0.423	0.010	0.000
5.4444	0.176	0.431	0.010	0.000
5.4889	0.176	0.438	0.010	0.000
5.5333	0.176	0.446	0.010	0.000
5.5778	0.176	0.454	0.010	0.000
5.6222	0.176	0.462	0.011	0.000
5.6667	0.176	0.470	0.011	0.000
5.7111	0.176	0.478	0.011	0.000
5.7556	0.176	0.485	0.011	0.000
5.8000	0.176	0.493	0.011	0.000
5.8444	0.176	0.501	0.011	0.000
5.8889	0.176	0.509	0.011	0.000
5.9333	0.176	0.517	0.011	0.000
5.9778	0.176	0.525	0.011	0.000
6.0222	0.176	0.532	0.011	0.000
6.0667	0.176	0.540	0.011	0.000
6.1111	0.176	0.548	0.012	0.000
6.1556	0.176	0.556	0.012	0.000
6.2000	0.176	0.564	0.012	0.000
6.2444	0.176	0.572	0.012	0.000
6.2889	0.176	0.579	0.012	0.000
6.3333	0.176	0.587	0.012	0.000
6.3778	0.176	0.595	0.012	0.000
6.4222	0.176	0.603	0.012	0.000
6.4667	0.176	0.611	0.012	0.000
6.5111	0.176	0.619	0.012	0.000
6.5556	0.176	0.626	0.012	0.000
6.6000	0.176	0.634	0.012	0.000
6.6444	0.176	0.642	0.013	0.000
6.6889	0.176	0.650	0.013	0.000
6.7333	0.176	0.658	0.013	0.000
6.7778	0.176	0.666	0.013	0.000
6.8222	0.176	0.673	0.013	0.000
6.8667	0.176	0.681	0.013	0.000
6.9111	0.176	0.689	0.013	0.000
6.9556	0.176	0.697	0.013	0.000
7.0000	0.176	0.705	0.013	0.000
7.0444	0.176	0.713	0.013	0.000
7.0889	0.000	0.000	0.013	0.000

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1

Total Pervious Area:	3.42
Total Impervious Area:	0.277

Mitigated Landuse Totals for POC #1

Total Pervious Area:	0.36
Total Impervious Area:	0.315

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.124603
5 year	0.170905
10 year	0.205122
25 year	0.252584
50 year	0.291129
100 year	0.332507

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.110969
5 year	0.15034
10 year	0.17916
25 year	0.218831
50 year	0.250831
100 year	0.285

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.112	0.107
1950	0.142	0.134
1951	0.143	0.128
1952	0.115	0.104
1953	0.126	0.132
1954	0.239	0.186
1955	0.148	0.127
1956	0.107	0.060
1957	0.145	0.105
1958	0.246	0.248

1959	0.110	0.101
1960	0.110	0.098
1961	0.315	0.316
1962	0.127	0.125
1963	0.149	0.144
1964	0.097	0.078
1965	0.097	0.087
1966	0.099	0.088
1967	0.201	0.217
1968	0.117	0.115
1969	0.218	0.224
1970	0.092	0.088
1971	0.144	0.122
1972	0.151	0.154
1973	0.123	0.127
1974	0.174	0.155
1975	0.121	0.124
1976	0.086	0.087
1977	0.088	0.087
1978	0.091	0.068
1979	0.183	0.145
1980	0.114	0.089
1981	0.092	0.088
1982	0.096	0.091
1983	0.127	0.118
1984	0.108	0.105
1985	0.146	0.152
1986	0.242	0.153
1987	0.129	0.129
1988	0.112	0.106
1989	0.121	0.109
1990	0.088	0.081
1991	0.115	0.100
1992	0.114	0.105
1993	0.086	0.080
1994	0.092	0.083
1995	0.083	0.079
1996	0.183	0.118
1997	0.276	0.144
1998	0.142	0.140
1999	0.085	0.067
2000	0.249	0.225
2001	0.070	0.077
2002	0.076	0.073
2003	0.105	0.097
2004	0.198	0.197
2005	0.085	0.090
2006	0.206	0.127
2007	0.185	0.123
2008	0.140	0.091
2009	0.085	0.091

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.3151	0.3159
2	0.2757	0.2479
3	0.2487	0.2245

4	0.2462	0.2241
5	0.2417	0.2171
6	0.2393	0.1967
7	0.2178	0.1861
8	0.2058	0.1554
9	0.2013	0.1545
10	0.1977	0.1534
11	0.1852	0.1516
12	0.1833	0.1445
13	0.1827	0.1442
14	0.1741	0.1440
15	0.1506	0.1395
16	0.1489	0.1339
17	0.1476	0.1325
18	0.1459	0.1291
19	0.1446	0.1278
20	0.1443	0.1274
21	0.1433	0.1274
22	0.1425	0.1266
23	0.1422	0.1254
24	0.1397	0.1243
25	0.1287	0.1233
26	0.1267	0.1215
27	0.1265	0.1183
28	0.1261	0.1179
29	0.1230	0.1146
30	0.1215	0.1087
31	0.1206	0.1066
32	0.1169	0.1058
33	0.1147	0.1051
34	0.1145	0.1050
35	0.1144	0.1047
36	0.1137	0.1037
37	0.1125	0.1006
38	0.1123	0.1001
39	0.1099	0.0979
40	0.1097	0.0975
41	0.1076	0.0912
42	0.1069	0.0912
43	0.1046	0.0911
44	0.0992	0.0899
45	0.0972	0.0887
46	0.0970	0.0883
47	0.0958	0.0877
48	0.0923	0.0876
49	0.0918	0.0874
50	0.0917	0.0870
51	0.0906	0.0867
52	0.0876	0.0833
53	0.0876	0.0806
54	0.0863	0.0802
55	0.0858	0.0793
56	0.0852	0.0782
57	0.0850	0.0772
58	0.0848	0.0731
59	0.0834	0.0682
60	0.0758	0.0671
61	0.0700	0.0596

Duration Flows

The Facility PASSED

Flow(cfs)	**Predev**	**Mit**	**Percentage**	**Pass/Fail**
0.0623	3882	1223	31	Pass
0.0646	3448	1074	31	Pass
0.0669	3080	966	31	Pass
0.0692	2787	859	30	Pass
0.0715	2515	769	30	Pass
0.0739	2297	686	29	Pass
0.0762	2051	602	29	Pass
0.0785	1896	532	28	Pass
0.0808	1739	466	26	Pass
0.0831	1593	426	26	Pass
0.0854	1469	371	25	Pass
0.0877	1346	339	25	Pass
0.0900	1234	308	24	Pass
0.0923	1135	279	24	Pass
0.0947	1031	258	25	Pass
0.0970	956	233	24	Pass
0.0993	881	213	24	Pass
0.1016	818	193	23	Pass
0.1039	760	180	23	Pass
0.1062	725	163	22	Pass
0.1085	681	149	21	Pass
0.1108	641	140	21	Pass
0.1132	605	129	21	Pass
0.1155	568	116	20	Pass
0.1178	538	111	20	Pass
0.1201	506	102	20	Pass
0.1224	475	91	19	Pass
0.1247	457	81	17	Pass
0.1270	425	79	18	Pass
0.1293	398	77	19	Pass
0.1316	375	70	18	Pass
0.1340	361	68	18	Pass
0.1363	346	64	18	Pass
0.1386	332	64	19	Pass
0.1409	321	61	19	Pass
0.1432	305	56	18	Pass
0.1455	291	51	17	Pass
0.1478	272	43	15	Pass
0.1501	257	40	15	Pass
0.1524	249	40	16	Pass
0.1548	237	36	15	Pass
0.1571	226	35	15	Pass
0.1594	216	33	15	Pass
0.1617	207	32	15	Pass
0.1640	194	27	13	Pass
0.1663	183	24	13	Pass
0.1686	166	20	12	Pass
0.1709	159	20	12	Pass
0.1732	153	18	11	Pass
0.1756	141	16	11	Pass
0.1779	128	14	10	Pass
0.1802	121	12	9	Pass
0.1825	114	12	10	Pass

0.1848	102	11	10	Pass
0.1871	97	11	11	Pass
0.1894	92	11	11	Pass
0.1917	86	11	12	Pass
0.1941	81	10	12	Pass
0.1964	75	10	13	Pass
0.1987	71	10	14	Pass
0.2010	68	10	14	Pass
0.2033	62	10	16	Pass
0.2056	56	10	17	Pass
0.2079	54	9	16	Pass
0.2102	52	9	17	Pass
0.2125	47	9	19	Pass
0.2149	44	9	20	Pass
0.2172	44	8	18	Pass
0.2195	43	8	18	Pass
0.2218	42	8	19	Pass
0.2241	39	8	20	Pass
0.2264	34	8	23	Pass
0.2287	32	7	21	Pass
0.2310	29	6	20	Pass
0.2333	25	6	24	Pass
0.2357	24	6	25	Pass
0.2380	22	6	27	Pass
0.2403	20	6	30	Pass
0.2426	19	6	31	Pass
0.2449	17	6	35	Pass
0.2472	16	6	37	Pass
0.2495	16	6	37	Pass
0.2518	15	5	33	Pass
0.2541	12	5	41	Pass
0.2565	11	5	45	Pass
0.2588	11	5	45	Pass
0.2611	10	3	30	Pass
0.2634	10	3	30	Pass
0.2657	10	3	30	Pass
0.2680	10	3	30	Pass
0.2703	9	3	33	Pass
0.2726	8	3	37	Pass
0.2749	8	3	37	Pass
0.2773	8	3	37	Pass
0.2796	7	3	42	Pass
0.2819	6	3	50	Pass
0.2842	6	3	50	Pass
0.2865	5	3	60	Pass
0.2888	4	2	50	Pass
0.2911	4	2	50	Pass

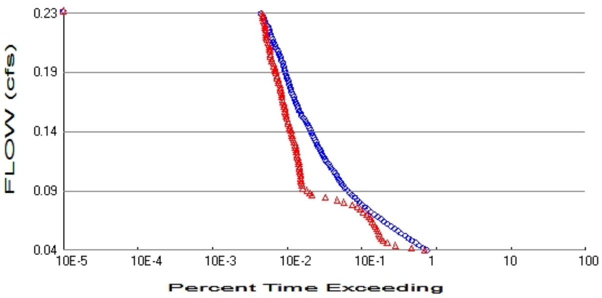
Water Quality

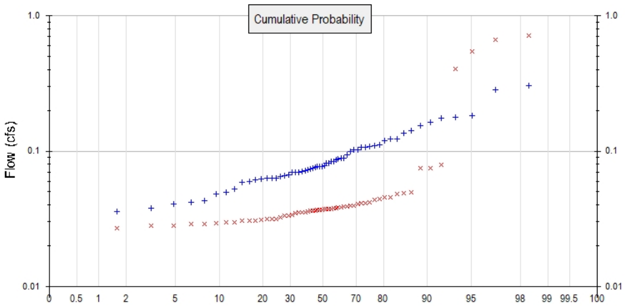
Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.0294 acre-feet
On-line facility target flow: 0.0394 cfs.
Adjusted for 15 min: 0.0394 cfs.
Off-line facility target flow: 0.0222 cfs.
Adjusted for 15 min: 0.0222 cfs.

LID Report

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

POC 2





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2

Total Pervious Area:	5.51
Total Impervious Area:	0.095

Mitigated Landuse Totals for POC #2

Total Pervious Area:	2.744
Total Impervious Area:	5.514

Flow Frequency Method:	Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.080775
5 year	0.121803
10 year	0.153039
25 year	0.197279
50 year	0.233804
100 year	0.273478

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	0.040262
5 year	0.077617
10 year	0.115863
25 year	0.185884
50 year	0.258825
100 year	0.354766

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	**Predeveloped**	**Mitigated**
1949	0.041	0.031
1950	0.094	0.041
1951	0.089	0.036
1952	0.066	0.030
1953	0.063	0.030
1954	0.175	0.040
1955	0.135	0.541
1956	0.109	0.715
1957	0.119	0.037
1958	0.103	0.039
1959	0.087	0.037

1960	0.077	0.033
1961	0.109	0.041
1962	0.052	0.029
1963	0.084	0.033
1964	0.071	0.033
1965	0.074	0.038
1966	0.043	0.031
1967	0.106	0.036
1968	0.107	0.039
1969	0.082	0.035
1970	0.060	0.035
1971	0.112	0.079
1972	0.081	0.031
1973	0.058	0.038
1974	0.123	0.041
1975	0.063	0.032
1976	0.063	0.037
1977	0.036	0.029
1978	0.070	0.031
1979	0.141	0.029
1980	0.070	0.031
1981	0.070	0.027
1982	0.084	0.039
1983	0.099	0.037
1984	0.075	0.044
1985	0.123	0.074
1986	0.282	0.049
1987	0.102	0.045
1988	0.063	0.037
1989	0.072	0.028
1990	0.078	0.037
1991	0.088	0.038
1992	0.065	0.036
1993	0.042	0.028
1994	0.038	0.036
1995	0.077	0.042
1996	0.183	0.045
1997	0.305	0.661
1998	0.050	0.035
1999	0.077	0.044
2000	0.087	0.038
2001	0.024	0.021
2002	0.074	0.049
2003	0.049	0.032
2004	0.071	0.039
2005	0.062	0.034
2006	0.177	0.402
2007	0.155	0.075
2008	0.164	0.048
2009	0.065	0.035

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	0.3054	0.7148
2	0.2824	0.6613
3	0.1834	0.5412
4	0.1768	0.4022

5	0.1746	0.0793
6	0.1635	0.0746
7	0.1548	0.0745
8	0.1407	0.0493
9	0.1349	0.0487
10	0.1229	0.0482
11	0.1225	0.0453
12	0.1191	0.0453
13	0.1117	0.0442
14	0.1094	0.0435
15	0.1086	0.0418
16	0.1072	0.0410
17	0.1062	0.0410
18	0.1026	0.0408
19	0.1016	0.0396
20	0.0993	0.0395
21	0.0944	0.0392
22	0.0887	0.0387
23	0.0883	0.0386
24	0.0868	0.0382
25	0.0867	0.0381
26	0.0842	0.0379
27	0.0840	0.0375
28	0.0815	0.0375
29	0.0811	0.0374
30	0.0779	0.0373
31	0.0769	0.0369
32	0.0768	0.0368
33	0.0768	0.0367
34	0.0754	0.0362
35	0.0744	0.0362
36	0.0739	0.0361
37	0.0723	0.0360
38	0.0715	0.0353
39	0.0711	0.0352
40	0.0701	0.0352
41	0.0700	0.0348
42	0.0697	0.0338
43	0.0663	0.0332
44	0.0654	0.0332
45	0.0648	0.0325
46	0.0635	0.0316
47	0.0634	0.0316
48	0.0630	0.0314
49	0.0625	0.0309
50	0.0617	0.0308
51	0.0599	0.0307
52	0.0584	0.0307
53	0.0523	0.0299
54	0.0497	0.0299
55	0.0485	0.0292
56	0.0429	0.0290
57	0.0419	0.0288
58	0.0407	0.0281
59	0.0380	0.0280
60	0.0360	0.0271
61	0.0242	0.0215

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0404	15841	14827	93	Pass
0.0423	14065	9899	70	Pass
0.0443	12495	6047	48	Pass
0.0462	11163	4667	41	Pass
0.0482	10016	4132	41	Pass
0.0502	9000	3871	43	Pass
0.0521	8089	3773	46	Pass
0.0541	7270	3640	50	Pass
0.0560	6530	3499	53	Pass
0.0580	5843	3379	57	Pass
0.0599	5236	3253	62	Pass
0.0619	4691	3121	66	Pass
0.0638	4233	2992	70	Pass
0.0658	3831	2834	73	Pass
0.0677	3450	2682	77	Pass
0.0697	3131	2488	79	Pass
0.0716	2834	2218	78	Pass
0.0736	2556	2032	79	Pass
0.0756	2334	1862	79	Pass
0.0775	2141	1588	74	Pass
0.0795	1997	1237	61	Pass
0.0814	1853	999	53	Pass
0.0834	1713	690	40	Pass
0.0853	1579	456	28	Pass
0.0873	1463	426	29	Pass
0.0892	1361	394	28	Pass
0.0912	1265	348	27	Pass
0.0931	1196	336	28	Pass
0.0951	1135	332	29	Pass
0.0970	1086	328	30	Pass
0.0990	1041	325	31	Pass
0.1010	989	322	32	Pass
0.1029	940	319	33	Pass
0.1049	900	316	35	Pass
0.1068	845	313	37	Pass
0.1088	806	312	38	Pass
0.1107	755	305	40	Pass
0.1127	718	304	42	Pass
0.1146	687	299	43	Pass
0.1166	664	296	44	Pass
0.1185	628	288	45	Pass
0.1205	609	284	46	Pass
0.1224	590	281	47	Pass
0.1244	563	276	49	Pass
0.1264	538	274	50	Pass
0.1283	521	266	51	Pass
0.1303	501	260	51	Pass
0.1322	486	252	51	Pass
0.1342	470	247	52	Pass
0.1361	454	244	53	Pass
0.1381	443	239	53	Pass
0.1400	428	232	54	Pass
0.1420	408	229	56	Pass

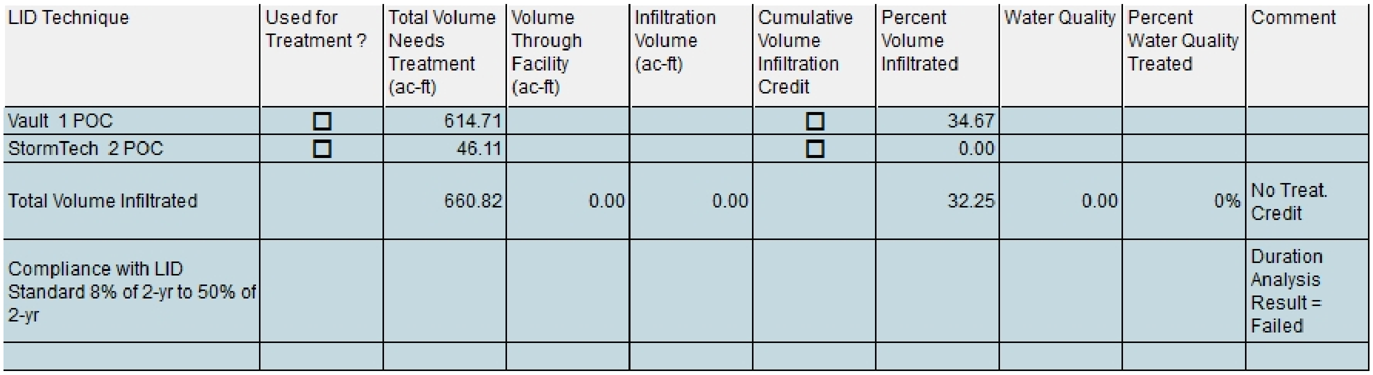
0.1439	395	222	56	Pass
0.1459	376	219	58	Pass
0.1478	356	212	59	Pass
0.1498	336	207	61	Pass
0.1517	326	204	62	Pass
0.1537	314	202	64	Pass
0.1557	302	199	65	Pass
0.1576	294	195	66	Pass
0.1596	284	193	67	Pass
0.1615	274	189	68	Pass
0.1635	266	184	69	Pass
0.1654	259	180	69	Pass
0.1674	250	180	72	Pass
0.1693	245	177	72	Pass
0.1713	240	175	72	Pass
0.1732	236	174	73	Pass
0.1752	230	172	74	Pass
0.1771	223	165	73	Pass
0.1791	220	163	74	Pass
0.1811	213	159	74	Pass
0.1830	209	156	74	Pass
0.1850	203	150	73	Pass
0.1869	200	148	74	Pass
0.1889	196	146	74	Pass
0.1908	193	143	74	Pass
0.1928	188	139	73	Pass
0.1947	181	134	74	Pass
0.1967	176	132	75	Pass
0.1986	171	127	74	Pass
0.2006	167	127	76	Pass
0.2025	160	126	78	Pass
0.2045	156	125	80	Pass
0.2065	148	124	83	Pass
0.2084	144	122	84	Pass
0.2104	139	117	84	Pass
0.2123	135	113	83	Pass
0.2143	132	112	84	Pass
0.2162	129	111	86	Pass
0.2182	124	110	88	Pass
0.2201	122	110	90	Pass
0.2221	120	109	90	Pass
0.2240	115	107	93	Pass
0.2260	109	106	97	Pass
0.2279	106	103	97	Pass
0.2299	103	101	98	Pass
0.2319	100	100	100	Pass
0.2338	94	99	105	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #2

On-line facility volume:	0.0696 acre-feet
On-line facility target flow:	0.0352 cfs.
Adjusted for 15 min:	0.0352 cfs.
Off-line facility target flow:	0.0237 cfs.
Adjusted for 15 min:	0.0237 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
Vault 1 POC	☐	614.71			☐	34.67			
StormTech 2 POC	☐	46.11			☐	0.00			
Total Volume Infiltrated		660.82	0.00	0.00		32.25	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

POC 3

POC #3 was not reported because POC must exist in both scenarios and both scenarios must have been run.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

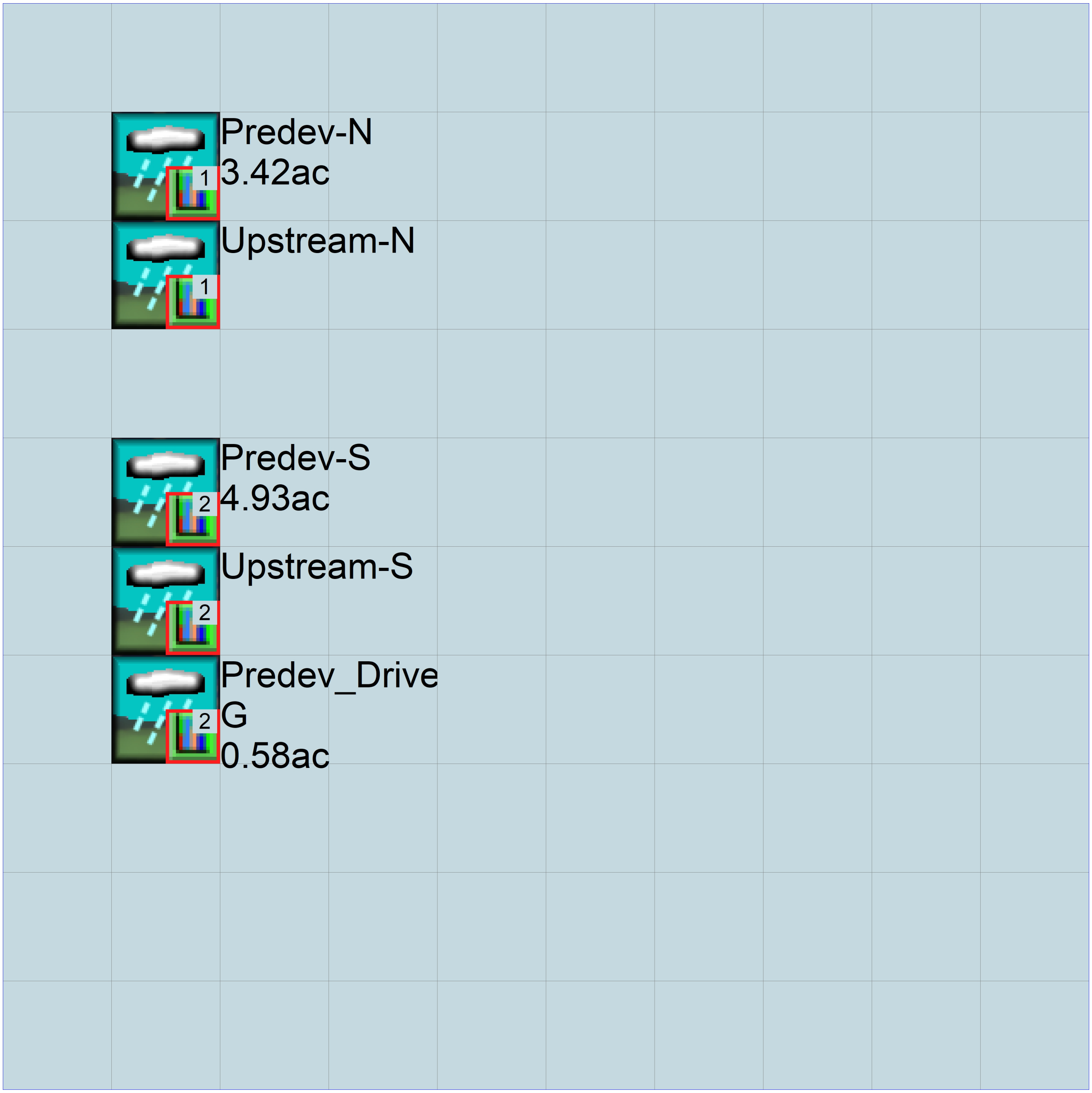
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
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   211217_Vault Sizing.wdm
MESSU      25   Pre211217_Vault Sizing.MES
           27   Pre211217_Vault Sizing.L61
           28   Pre211217_Vault Sizing.L62
           30   POC211217_Vault Sizing1.dat
           31   POC211217_Vault Sizing2.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      11
      IMPLND       2
      COPY       501
      COPY       502
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Predev-N                    MAX                        1    2   30    9
    2        Predev-S                    MAX                        1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  502         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out            ***
   11     C, Forest, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   11         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  *********
   11         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 ***
   11         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
   11              0       4.5      0.08       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   11              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   11            0.2       0.5      0.35         6       0.5       0.7
  END PWAT-PARM4

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

END PERLND

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

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    2         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    2         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     ***
    2         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    2            400      0.05       0.1      0.08
  END IWAT-PARM2
```

```
  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    2              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    2              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Predev-N***
PERLND  11                        3.42     COPY   501     12
PERLND  11                        3.42     COPY   501     13
Predev-S***
PERLND  11                        4.93     COPY   502     12
PERLND  11                        4.93     COPY   502     13
Upstream-N***
IMPLND   2                       0.277     COPY   501     15
Upstream-S***
IMPLND   2                       0.095     COPY   502     15
Predev_Drive G***
PERLND  11                        0.58     COPY   502     12
PERLND  11                        0.58     COPY   502     13

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

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1



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

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

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

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

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

```
  END HYDR-PARM1

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    0.8            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.8            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
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    502 FLOW     ENGL      REPL
END EXT TARGETS

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

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

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


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   211217_Vault Sizing.wdm
MESSU      25   Mit211217_Vault Sizing.MES
           27   Mit211217_Vault Sizing.L61
           28   Mit211217_Vault Sizing.L62
           30   POC211217_Vault Sizing1.dat
           31   POC211217_Vault Sizing2.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      14
      IMPLND       4
      IMPLND       9
      IMPLND       2
      RCHRES       1
      RCHRES       2
      COPY       501
      COPY         2
      COPY       502
      COPY       602
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Dev-N                     MAX                     1    2   30    9
    2        StormTech  2              MAX                     1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
    2         1    1
  502         1    1
  602         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           ***
   14     C, Pasture, Mod         1    1    1    1   27    0
  END GEN-INFO
```

```
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   14         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  *********
   14         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 ***
   14         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
   14              0       4.5      0.06       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   14              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   14           0.15       0.4       0.3         6       0.5       0.4
  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
   14              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                    User  t-series Engl Metr ***
                                      in  out           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
    9      SIDEWALKS/MOD          1    1    1   27    0
    2      ROADS/MOD              1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    9         0    0    1    0    0    0
    2         0    0    1    0    0    0
  END ACTIVITY

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

```
    2         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     ***
    4         0    0    0    0    0
    9         0    0    0    0    0
    2         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    9            400      0.05       0.1      0.08
    2            400      0.05       0.1      0.08
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    9              0         0
    2              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    9              0         0
    2              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Dev-S***
PERLND  14                       2.113     RCHRES   2      2
PERLND  14                       2.113     RCHRES   2      3
IMPLND   2                        2.18     RCHRES   2      5
IMPLND   4                       1.849     RCHRES   2      5
IMPLND   9                       0.606     RCHRES   2      5
Upstream-S***
IMPLND   2                       0.309     RCHRES   2      5
Offsite-Dev S***
PERLND  14                       0.377     RCHRES   2      2
PERLND  14                       0.377     RCHRES   2      3
IMPLND   2                       0.185     RCHRES   2      5
Drive G_Dev***
PERLND  14                       0.195     RCHRES   1      2
PERLND  14                       0.195     RCHRES   1      3
IMPLND   2                       0.158     RCHRES   1      5
IMPLND   4                       0.227     RCHRES   1      5
Dev-N***
PERLND  14                        0.36     COPY   501     12
PERLND  14                        0.36     COPY   501     13
IMPLND   4                       0.195     COPY   501     15
IMPLND   9                       0.015     COPY   501     15
Upstream-N***
IMPLND   2                       0.062     COPY   501     15
Bypass-N***
IMPLND   2                       0.043     COPY   501     15
Bypass-S***
PERLND  14                       0.059     COPY   502     12
PERLND  14                       0.059     COPY   602     12
PERLND  14                       0.059     COPY   502     13
```

```
PERLND  14                       0.059     COPY   602     13

******Routing******
PERLND  14                       2.113     COPY     2     12
IMPLND   2                        2.18     COPY     2     15
IMPLND   4                       1.849     COPY     2     15
IMPLND   9                       0.606     COPY     2     15
PERLND  14                       2.113     COPY     2     13
IMPLND   2                       0.309     COPY     2     15
PERLND  14                       0.377     COPY     2     12
IMPLND   2                       0.185     COPY     2     15
PERLND  14                       0.377     COPY     2     13
PERLND  14                       0.195     COPY     2     12
IMPLND   2                       0.158     COPY     2     15
IMPLND   4                       0.227     COPY     2     15
PERLND  14                       0.195     COPY     2     13
RCHRES   2                           1     COPY   502     17
RCHRES   1                           1     COPY   502     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1



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

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                         in  out                             ***
    1     StormTech  2           1    1    1    1   28    0    1
    2     Vault  1               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
    2         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

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

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    2        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       3.0       0.5       0.0
    2              2      0.02       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  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2           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      2
   91    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.193388  0.000000  0.000000  0.000000
  0.172222  0.193388  0.033306  0.004225  0.007800
  0.344444  0.193388  0.066612  0.005975  0.007800
  0.516667  0.193388  0.099917  0.007318  0.007800
  0.688889  0.193388  0.133223  0.008450  0.007800
  0.861111  0.193388  0.166529  0.009447  0.007800
  1.033333  0.193388  0.199835  0.010349  0.007800
  1.205556  0.193388  0.233140  0.011178  0.007800
  1.377778  0.193388  0.266446  0.011950  0.007800
  1.550000  0.193388  0.299752  0.012675  0.007800
  1.722222  0.193388  0.333058  0.013360  0.007800
  1.894444  0.193388  0.366364  0.014012  0.007800
  2.066667  0.193388  0.399669  0.014635  0.007800
  2.238889  0.193388  0.432975  0.015233  0.007800
  2.411111  0.193388  0.466281  0.015808  0.007800
  2.583333  0.193388  0.499587  0.016363  0.007800
  2.755556  0.193388  0.532893  0.016900  0.007800
  2.927778  0.193388  0.566198  0.017420  0.007800
  3.100000  0.193388  0.599504  0.017925  0.007800
  3.272222  0.193388  0.632810  0.018416  0.007800
  3.444444  0.193388  0.666116  0.018894  0.007800
  3.616667  0.193388  0.699421  0.019361  0.007800
  3.788889  0.193388  0.732727  0.019816  0.007800
  3.961111  0.193388  0.766033  0.020262  0.007800
  4.133333  0.193388  0.799339  0.020698  0.007800
  4.305556  0.193388  0.832645  0.021124  0.007800
  4.477778  0.193388  0.865950  0.021543  0.007800
  4.650000  0.193388  0.899256  0.021953  0.007800
  4.822222  0.193388  0.932562  0.022356  0.007800
  4.994444  0.193388  0.965868  0.022752  0.007800
  5.166667  0.193388  0.999174  0.023141  0.007800
  5.338889  0.193388  1.032479  0.023523  0.007800
  5.511111  0.193388  1.065785  0.023900  0.007800
  5.683333  0.193388  1.099091  0.024270  0.007800
  5.855556  0.193388  1.132397  0.024635  0.007800
  6.027778  0.193388  1.165702  0.024995  0.007800
  6.200000  0.193388  1.199008  0.025349  0.007800
  6.372222  0.193388  1.232314  0.025699  0.007800
  6.544444  0.193388  1.265620  0.026044  0.007800
  6.716667  0.193388  1.298926  0.026384  0.007800
  6.888889  0.193388  1.332231  0.026721  0.007800
  7.061111  0.193388  1.365537  0.027053  0.007800
  7.233333  0.193388  1.398843  0.027380  0.007800
  7.405556  0.193388  1.432149  0.027704  0.007800
  7.577778  0.193388  1.465455  0.028025  0.007800
  7.750000  0.193388  1.498760  0.028341  0.007800
  7.922222  0.193388  1.532066  0.028655  0.007800
  8.094444  0.193388  1.565372  0.028964  0.007800
  8.266667  0.193388  1.598678  0.029271  0.007800
  8.438889  0.193388  1.631983  0.029574  0.007800
  8.611111  0.193388  1.665289  0.029874  0.007800
  8.783333  0.193388  1.698595  0.030172  0.007800
```

```
8.955556  0.193388  1.731901  0.030466  0.007800
9.127778  0.193388  1.765207  0.030758  0.007800
9.300000  0.193388  1.798512  0.031046  0.007800
9.472222  0.193388  1.831818  0.031333  0.007800
9.644444  0.193388  1.865124  0.031616  0.007800
9.816667  0.193388  1.898430  0.031897  0.007800
9.988889  0.193388  1.931736  0.032176  0.007800
10.16111  0.193388  1.965041  0.032452  0.007800
10.33333  0.193388  1.998347  0.032726  0.007800
10.50556  0.193388  2.031653  0.032997  0.007800
10.67778  0.193388  2.064959  0.033267  0.007800
10.85000  0.193388  2.098264  0.033534  0.007800
11.02222  0.193388  2.131570  0.033799  0.007800
11.19444  0.193388  2.164876  0.034062  0.007800
11.36667  0.193388  2.198182  0.034323  0.007800
11.53889  0.193388  2.231488  0.034582  0.007800
11.71111  0.193388  2.264793  0.034839  0.007800
11.88333  0.193388  2.298099  0.035095  0.007800
12.05556  0.193388  2.331405  0.035348  0.007800
12.22778  0.193388  2.364711  0.035600  0.007800
12.40000  0.193388  2.398017  0.035849  0.007800
12.57222  0.193388  2.431322  0.036097  0.007800
12.74444  0.193388  2.464628  0.036344  0.007800
12.91667  0.193388  2.497934  0.036589  0.007800
13.08889  0.193388  2.531240  0.036832  0.007800
13.26111  0.193388  2.564545  0.039934  0.007800
13.43333  0.193388  2.597851  0.048933  0.007800
13.60556  0.193388  2.631157  0.053733  0.007800
13.77778  0.193388  2.664463  0.057503  0.007800
13.95000  0.193388  2.697769  0.060728  0.007800
14.12222  0.193388  2.731074  0.063602  0.007800
14.29444  0.193388  2.764380  0.066224  0.007800
14.46667  0.193388  2.797686  0.068654  0.007800
14.63889  0.193388  2.830992  0.070933  0.007800
14.81111  0.193388  2.864298  0.073086  0.007800
14.98333  0.193388  2.897603  0.075134  0.007800
15.15556  0.193388  2.930909  1.047094  0.007800
15.32778  0.193388  2.964215  2.897944  0.007800
15.50000  0.193388  2.997521  4.719878  0.007800
END FTABLE  2
FTABLE      1
 66    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.038504  0.000000  0.000000
0.083333  0.038504  0.001283  0.001958
0.166667  0.038504  0.002567  0.002770
0.250000  0.038504  0.003850  0.003392
0.333333  0.038504  0.005134  0.003917
0.416667  0.038504  0.006417  0.004379
0.500000  0.038504  0.007701  0.004797
0.583333  0.038504  0.008984  0.005182
0.666667  0.038504  0.010267  0.005539
0.750000  0.038504  0.011551  0.005875
0.833333  0.038504  0.014396  0.006193
0.916667  0.038504  0.017228  0.006495
1.000000  0.038504  0.020050  0.006784
1.083333  0.038504  0.022864  0.007061
1.166667  0.038504  0.025667  0.007328
1.250000  0.038504  0.028460  0.007585
1.333333  0.038504  0.031244  0.007834
1.416667  0.038504  0.034015  0.008075
1.500000  0.038504  0.036775  0.008309
1.583333  0.038504  0.039522  0.008537
1.666667  0.038504  0.042257  0.008758
1.750000  0.038504  0.044978  0.008975
1.833333  0.038504  0.047684  0.009186
1.916667  0.038504  0.050376  0.009392
2.000000  0.038504  0.053051  0.009594
2.083333  0.038504  0.055711  0.009792
```

```
  2.166667  0.038504  0.058352  0.009986
  2.250000  0.038504  0.060975  0.010176
  2.333333  0.038504  0.063579  0.010363
  2.416667  0.038504  0.066162  0.010546
  2.500000  0.038504  0.068723  0.010727
  2.583333  0.038504  0.071262  0.010904
  2.666667  0.038504  0.073777  0.011079
  2.750000  0.038504  0.076267  0.011250
  2.833333  0.038504  0.078730  0.011420
  2.916667  0.038504  0.081166  0.011586
  3.000000  0.038504  0.083572  0.011751
  3.083333  0.038504  0.085946  0.011913
  3.166667  0.038504  0.088289  0.012073
  3.250000  0.038504  0.090597  0.012230
  3.333333  0.038504  0.092869  0.012386
  3.416667  0.038504  0.095098  0.012540
  3.500000  0.038504  0.097288  0.012692
  3.583333  0.038504  0.099431  0.012842
  3.666667  0.038504  0.101526  0.012991
  3.750000  0.038504  0.103565  0.013138
  3.833333  0.038504  0.105546  0.013283
  3.916667  0.038504  0.107461  0.013426
  4.000000  0.038504  0.109298  0.013568
  4.083333  0.038504  0.111036  0.013709
  4.166667  0.038504  0.112625  0.013848
  4.250000  0.038504  0.114088  0.013986
  4.333333  0.038504  0.115502  0.014122
  4.416667  0.038504  0.116872  0.014258
  4.500000  0.038504  0.118182  0.014391
  4.583333  0.038504  0.119491  0.014524
  4.666667  0.038504  0.120774  0.014656
  4.750000  0.038504  0.122058  0.014786
  4.833333  0.038504  0.123341  0.269207
  4.916667  0.038504  0.124625  0.718475
  5.000000  0.038504  0.125908  1.232725
  5.083333  0.038504  0.127191  1.698764
  5.166667  0.038504  0.128475  2.028505
  5.250000  0.038504  0.129758  2.218879
  5.333333  0.038504  0.131042  2.421237
  5.416667  0.038504  0.132325  2.587451
  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    0.8            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.8            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     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
RCHRES   2 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   2 HYDR   O      1 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   2 HYDR   O      2 1        1      WDM   1003 FLOW     ENGL      REPL
RCHRES   2 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
COPY     2 OUTPUT MEAN   1 1     48.4      WDM    702 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    802 FLOW     ENGL      REPL
COPY   602 OUTPUT MEAN   1 1     48.4      WDM    902 FLOW     ENGL      REPL
RCHRES   1 HYDR   RO     1 1        1      WDM   1004 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1005 STAG     ENGL      REPL
END EXT TARGETS
```

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

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

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

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

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

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

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

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

END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

```
ERROR/WARNING ID:   238   1

The continuity error reported below is greater than 1 part in 1000 and is
therefore considered high.

Did you specify any "special actions"?  If so, they could account for it.

Relevant data are:
DATE/TIME: 1951/ 7/31 24: 0

RCHRES :    2

RELERR       STORS        STOR       MATIN      MATDIF
-1.902E-02     0.00000  0.0000E+00     0.00000  -2.424E-09

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR  is (STOR-STORS) - MATDIF.
REFVAL is the reference value (STORS+MATIN).
STOR   is the storage of material in the processing unit (land-segment or
reach/reservior) at the end of the present interval.
STORS  is the storage of material in the pu at the start of the present
printout reporting period.
MATIN  is the total inflow of material to the pu during the present printout
reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the
present printout reporting period.
```

```
ERROR/WARNING ID:   238   1

The continuity error reported below is greater than 1 part in 1000 and is
therefore considered high.

Did you specify any "special actions"?  If so, they could account for it.

Relevant data are:
DATE/TIME: 1967/ 8/31 24: 0

RCHRES :    2

RELERR       STORS        STOR       MATIN      MATDIF
-8.887E-02     0.00000  0.0000E+00     0.00000  -2.301E-10

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR  is (STOR-STORS) - MATDIF.
REFVAL is the reference value (STORS+MATIN).
STOR   is the storage of material in the processing unit (land-segment or
reach/reservior) at the end of the present interval.
STORS  is the storage of material in the pu at the start of the present
printout reporting period.
MATIN  is the total inflow of material to the pu during the present printout
reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the
present printout reporting period.
```

Disclaimer

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Local (360)943-0304

www.clearcreeksolutions.com

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	220121_88th ST_Frontage_Bypass_WQ
Site Name:	Carrik Court
Site Address:	
City:	
Report Date:	1/21/2022
Gage:	Everett
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.800
Version Date:	2018/10/10
Version:	4.2.16

POC Thresholds

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

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	0.4552
Pervious Total	0.4552
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.4552

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Mod	0.0678
Pervious Total	0.0678
Impervious Land Use	acre
ROADS MOD	0.2586
SIDEWALKS MOD	0.1288
Impervious Total	0.3874
Basin Total	0.4552

Element Flows To:

Surface	Interflow	Groundwater

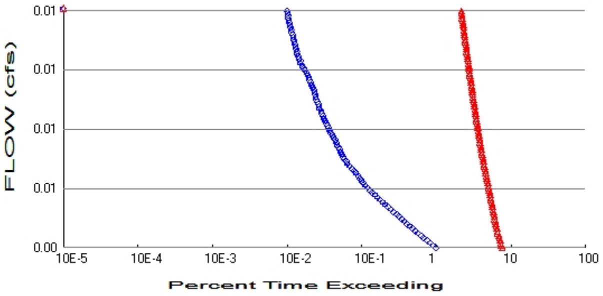
Routing Elements

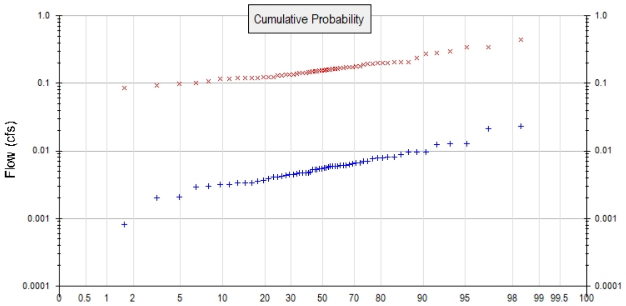
Predeveloped Routing

Mitigated Routing

Analysis Results

POC 1





\+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #1

Total Pervious Area:	0.4552
Total Impervious Area:	0

Mitigated Landuse Totals for POC #1

Total Pervious Area:	0.0678
Total Impervious Area:	0.3874

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.005605
5 year	0.008766
10 year	0.010734
25 year	0.013027
50 year	0.01459
100 year	0.016035

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.154236
5 year	0.207582
10 year	0.246432
25 year	0.299692
50 year	0.342498
100 year	0.388074

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.001	0.155
1950	0.007	0.161
1951	0.005	0.200
1952	0.004	0.151
1953	0.003	0.175
1954	0.010	0.238
1955	0.010	0.194
1956	0.008	0.085
1957	0.009	0.129
1958	0.006	0.342

1959	0.006	0.143
1960	0.005	0.144
1961	0.006	0.440
1962	0.004	0.177
1963	0.005	0.173
1964	0.005	0.100
1965	0.006	0.136
1966	0.003	0.135
1967	0.008	0.281
1968	0.008	0.144
1969	0.004	0.298
1970	0.004	0.124
1971	0.007	0.154
1972	0.006	0.207
1973	0.003	0.168
1974	0.007	0.204
1975	0.005	0.165
1976	0.004	0.120
1977	0.002	0.121
1978	0.004	0.092
1979	0.008	0.188
1980	0.005	0.158
1981	0.004	0.122
1982	0.006	0.134
1983	0.006	0.163
1984	0.005	0.149
1985	0.008	0.203
1986	0.021	0.200
1987	0.007	0.179
1988	0.005	0.156
1989	0.003	0.137
1990	0.006	0.122
1991	0.006	0.160
1992	0.005	0.150
1993	0.003	0.120
1994	0.002	0.129
1995	0.006	0.116
1996	0.013	0.195
1997	0.023	0.167
1998	0.003	0.198
1999	0.006	0.081
2000	0.003	0.346
2001	0.001	0.098
2002	0.006	0.106
2003	0.004	0.146
2004	0.005	0.273
2005	0.005	0.118
2006	0.013	0.174
2007	0.010	0.161
2008	0.012	0.141
2009	0.005	0.118

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0231	0.4403
2	0.0213	0.3462
3	0.0127	0.3418

4	0.0127	0.2985
5	0.0124	0.2812
6	0.0097	0.2730
7	0.0096	0.2384
8	0.0096	0.2070
9	0.0089	0.2038
10	0.0082	0.2031
11	0.0082	0.2004
12	0.0079	0.1997
13	0.0078	0.1979
14	0.0077	0.1951
15	0.0071	0.1937
16	0.0071	0.1875
17	0.0066	0.1794
18	0.0065	0.1768
19	0.0064	0.1754
20	0.0062	0.1736
21	0.0061	0.1731
22	0.0061	0.1677
23	0.0061	0.1670
24	0.0059	0.1649
25	0.0059	0.1632
26	0.0059	0.1615
27	0.0059	0.1606
28	0.0057	0.1597
29	0.0056	0.1581
30	0.0056	0.1563
31	0.0055	0.1548
32	0.0054	0.1537
33	0.0054	0.1505
34	0.0053	0.1500
35	0.0053	0.1495
36	0.0048	0.1463
37	0.0048	0.1442
38	0.0047	0.1441
39	0.0047	0.1432
40	0.0047	0.1407
41	0.0046	0.1369
42	0.0045	0.1358
43	0.0044	0.1352
44	0.0043	0.1337
45	0.0042	0.1292
46	0.0041	0.1291
47	0.0041	0.1240
48	0.0039	0.1218
49	0.0036	0.1216
50	0.0036	0.1209
51	0.0034	0.1201
52	0.0033	0.1197
53	0.0033	0.1182
54	0.0032	0.1177
55	0.0032	0.1162
56	0.0030	0.1058
57	0.0030	0.1004
58	0.0021	0.0976
59	0.0020	0.0916
60	0.0008	0.0847
61	0.0007	0.0806

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0028	21079	163090	773	Fail
0.0029	19222	159325	828	Fail
0.0030	17526	155796	888	Fail
0.0032	15956	152310	954	Fail
0.0033	14502	149101	1028	Fail
0.0034	13270	145957	1099	Fail
0.0035	12149	143155	1178	Fail
0.0036	11109	140482	1264	Fail
0.0038	10170	137958	1356	Fail
0.0039	9332	135669	1453	Fail
0.0040	8607	133573	1551	Fail
0.0041	7931	131456	1657	Fail
0.0042	7328	129488	1767	Fail
0.0044	6727	127584	1896	Fail
0.0045	6207	125745	2025	Fail
0.0046	5702	123927	2173	Fail
0.0047	5230	122130	2335	Fail
0.0048	4791	120376	2512	Fail
0.0049	4391	118622	2701	Fail
0.0051	4057	116975	2883	Fail
0.0052	3754	115328	3072	Fail
0.0053	3474	113660	3271	Fail
0.0054	3206	112035	3494	Fail
0.0055	2945	110495	3751	Fail
0.0057	2723	108869	3998	Fail
0.0058	2541	107286	4222	Fail
0.0059	2383	105725	4436	Fail
0.0060	2248	104163	4633	Fail
0.0061	2120	102559	4837	Fail
0.0063	2002	101105	5050	Fail
0.0064	1903	99650	5236	Fail
0.0065	1789	98196	5488	Fail
0.0066	1684	96720	5743	Fail
0.0067	1590	95351	5996	Fail
0.0069	1486	94025	6327	Fail
0.0070	1384	92678	6696	Fail
0.0071	1321	91330	6913	Fail
0.0072	1251	90047	7198	Fail
0.0073	1201	88849	7397	Fail
0.0074	1157	87673	7577	Fail
0.0076	1119	86518	7731	Fail
0.0077	1075	85448	7948	Fail
0.0078	1031	84379	8184	Fail
0.0079	993	83309	8389	Fail
0.0080	964	82261	8533	Fail
0.0082	929	81235	8744	Fail
0.0083	895	80251	8966	Fail
0.0084	857	79267	9249	Fail
0.0085	822	78347	9531	Fail
0.0086	791	77427	9788	Fail
0.0088	757	76593	10117	Fail
0.0089	732	75716	10343	Fail
0.0090	706	74839	10600	Fail
0.0091	683	73962	10828	Fail

0.0092	664	73150	11016	Fail
0.0094	645	72316	11211	Fail
0.0095	626	71546	11429	Fail
0.0096	607	70776	11659	Fail
0.0097	584	70048	11994	Fail
0.0098	567	69278	12218	Fail
0.0099	556	68508	12321	Fail
0.0101	541	67867	12544	Fail
0.0102	527	67118	12735	Fail
0.0103	515	66391	12891	Fail
0.0104	505	65664	13002	Fail
0.0105	495	64958	13122	Fail
0.0107	483	64273	13307	Fail
0.0108	472	63632	13481	Fail
0.0109	459	63011	13727	Fail
0.0110	444	62348	14042	Fail
0.0111	428	61707	14417	Fail
0.0113	417	61044	14638	Fail
0.0114	405	60381	14908	Fail
0.0115	388	59803	15413	Fail
0.0116	371	59161	15946	Fail
0.0117	355	58563	16496	Fail
0.0119	339	57985	17104	Fail
0.0120	325	57365	17650	Fail
0.0121	319	56830	17815	Fail
0.0122	307	56274	18330	Fail
0.0123	302	55696	18442	Fail
0.0124	293	55140	18819	Fail
0.0126	287	54584	19018	Fail
0.0127	279	54028	19364	Fail
0.0128	274	53515	19531	Fail
0.0129	268	52980	19768	Fail
0.0130	265	52445	19790	Fail
0.0132	262	51889	19804	Fail
0.0133	257	51333	19973	Fail
0.0134	253	50863	20103	Fail
0.0135	245	50306	20533	Fail
0.0136	242	49815	20584	Fail
0.0138	237	49323	20811	Fail
0.0139	231	48852	21148	Fail
0.0140	227	48381	21313	Fail
0.0141	224	47847	21360	Fail
0.0142	222	47398	21350	Fail
0.0144	220	46927	21330	Fail
0.0145	217	46456	21408	Fail
0.0146	211	46007	21804	Fail

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

Water Quality

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.0321 acre-feet
On-line facility target flow: 0.0546 cfs.
Adjusted for 15 min: 0.0546 cfs.
Off-line facility target flow: 0.0309 cfs.
Adjusted for 15 min: 0.0309 cfs.

LID Report

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

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

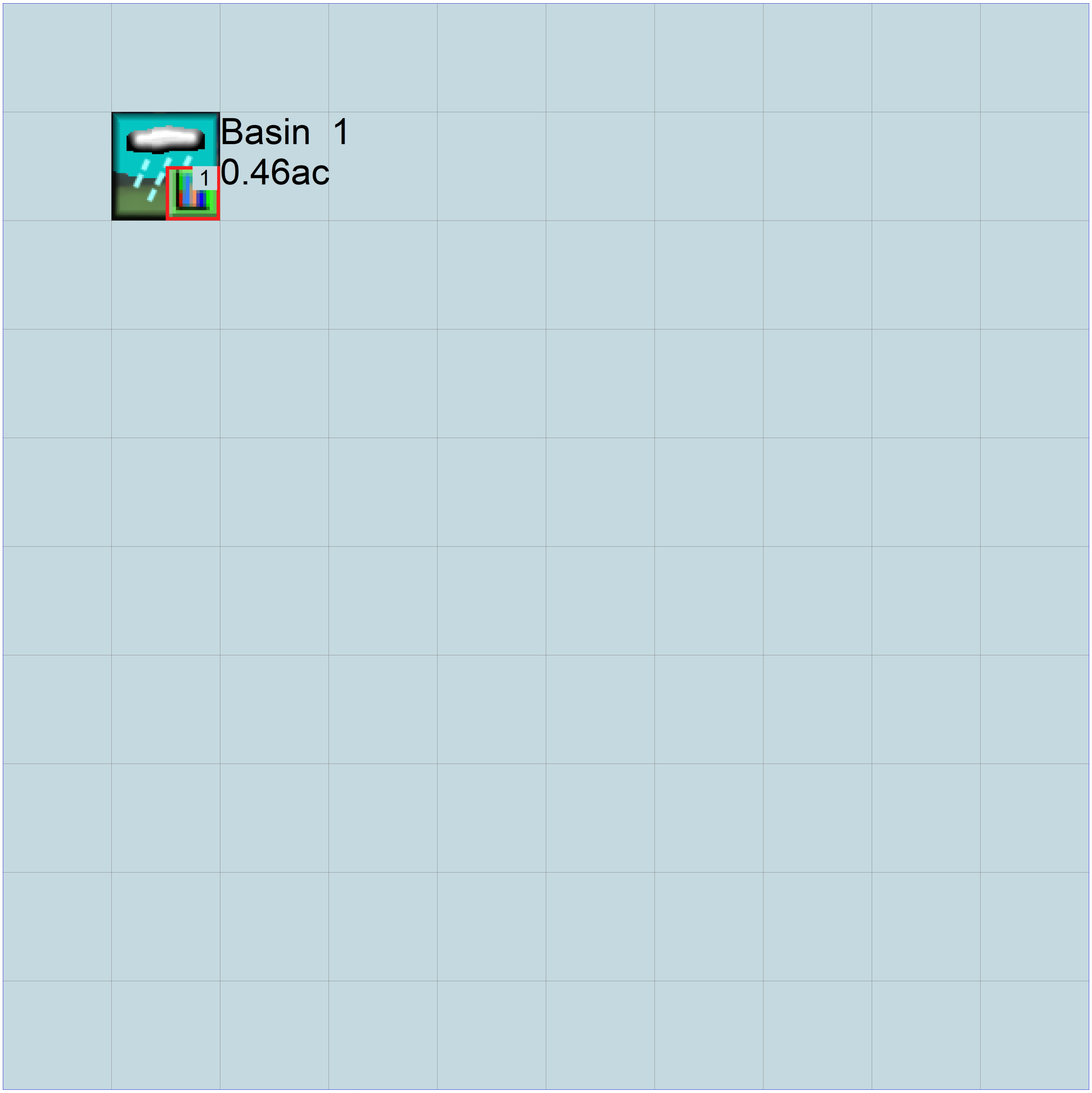
No PERLND changes have been made.

IMPLND Changes

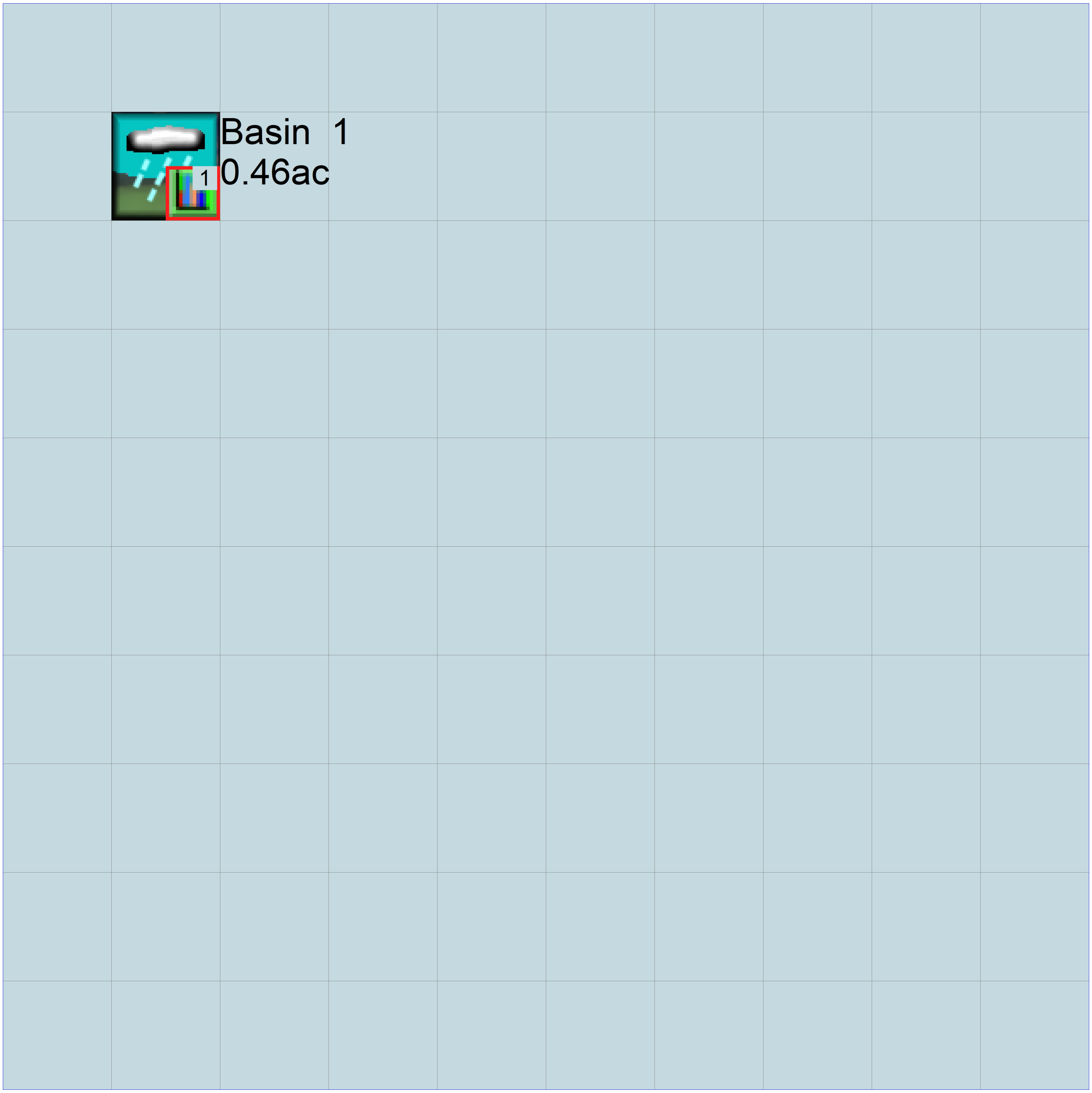
No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       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   220121_88th ST_Frontage_Bypass_WQ.wdm
MESSU      25   Pre220121_88th ST_Frontage_Bypass_WQ.MES
           27   Pre220121_88th ST_Frontage_Bypass_WQ.L61
           28   Pre220121_88th ST_Frontage_Bypass_WQ.L62
           30   POC220121_88th ST_Frontage_Bypass_WQ1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      11
      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           ***
   11     C, Forest, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   11         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  *********
   11         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 ***
   11         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
   11              0       4.5      0.08       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   11              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   11            0.2       0.5      0.35         6       0.5       0.7
  END PWAT-PARM4

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

END PERLND

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

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

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

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

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

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

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

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  11                      0.4552     COPY   501     12
PERLND  11                      0.4552     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    0.8            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.8            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   220121_88th ST_Frontage_Bypass_WQ.wdm
MESSU      25   Mit220121_88th ST_Frontage_Bypass_WQ.MES
           27   Mit220121_88th ST_Frontage_Bypass_WQ.L61
           28   Mit220121_88th ST_Frontage_Bypass_WQ.L62
           30   POC220121_88th ST_Frontage_Bypass_WQ1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      14
      IMPLND       2
      IMPLND       9
      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           ***
   14     C, Pasture, Mod         1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   14         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  *********
   14         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 ***
   14         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
   14              0       4.5      0.06       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   14              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   14           0.15       0.4       0.3         6       0.5       0.4
  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
   14              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out         ***
    2      ROADS/MOD              1    1    1   27    0
    9      SIDEWALKS/MOD          1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    2         0    0    1    0    0    0
    9         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    2         0    0    4    0    0    0    1    9
    9         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     ***
    2         0    0    0    0    0
    9         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    2            400      0.05       0.1      0.08
    9            400      0.05       0.1      0.08
```

```
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    2             0         0
    9             0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    2             0         0
    9             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  14                      0.0678     COPY   501     12
PERLND  14                      0.0678     COPY   501     13
IMPLND   2                      0.2586     COPY   501     15
IMPLND   9                      0.1288     COPY   501     15

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

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



<-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    0.8            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.8            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     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       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

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

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


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

Legal Notice

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Local (360)943-0304

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APPENDIX C

LAND USE SPREADSHEET

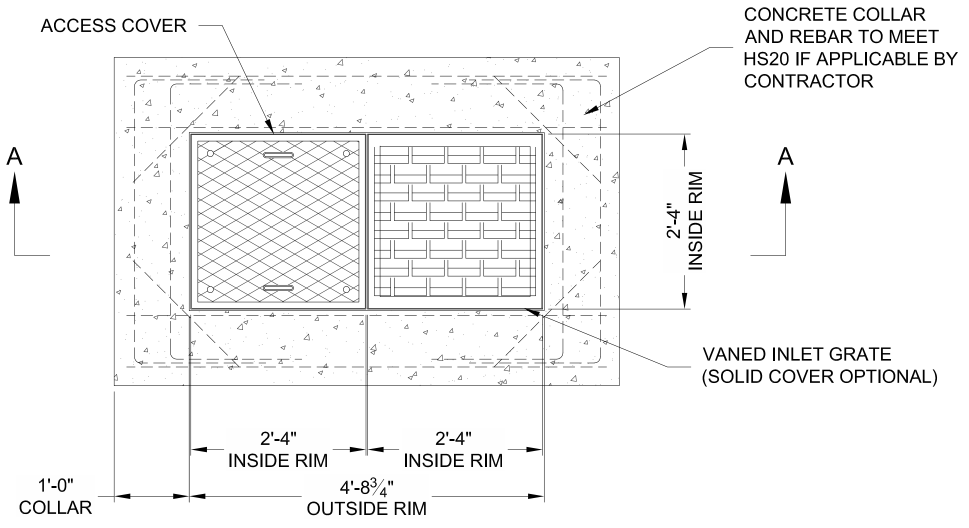
	Carrik Court-Snohomish County	Impervious Till						Pervious Till				Total SF	Total AC
POC	Subbasin	Road		Roof		Sidewalk		Pasture		Lawn			
		sf	ac	sf	ac	sf	ac	sf	ac	sf	ac		
1	North	0	0	8512	0.195409	632	0.014509	15688	0.360147	0	0	24832	0.570064
	Upstream North	5124	0.117631	0	0	0	0	0	0	0	0	5124	0.117631
	Bypass North	1869	0.042906	0	0	0	0	0	0	0	0	1869	0.042906
	Total	5124	0.117631	8512	0.195409	632	0.014509	15688	0.360147	0	0	29956	0.687695
2	South	98778	2.267631	62928	1.444628	26419	0.606497	101772	2.336364	0	0	289897	6.655119
	Upstream South	11078	0.254316	0	0	0	0	0	0	0	0	11078	0.254316
	Offsite South	5178	0.118871	0	0	2858	0.065611	16443	0.377479	0	0	24479	0.561961
	Bypass South	9203	0.211272	0	0	5611	0.128811	2583	0.059298	0	0	17397	0.39938
	Total	115034	2.640817	62928	1.444628	29277	0.672107	118215	2.77314	0	0	325454	7.530693
2	Drive F	6891	0.158196	12768	0.293113	1176	0.026997	8004	0.183747	0	0	28839	0.662052
	Drive G	6891	0.158196	9880	0.226814	0	0	8505	0.195248	0	0	25276	0.580257
	Drive H	5419	0.124403	12768	0.293113	2799	0.064256	14516	0.333242	0	0	35502	0.815014
2	Drive D	6044	0.138751	17024	0.390817	1745	0.04006	15767	0.361961	0	0	40580	0.931589
	Drive J	5814	0.133471	14820	0.34022	1673	0.038407	17455	0.400712	0	0	39762	0.91281
	Total	34709	0.796809	72189	1.657231	7519	0.172612	71859	1.649656	0	0	186276	4.276309
2	Commerical	25619	0.588131	18240	0.418733	6428	0.147567	14195	0.325872	0	0	64482	1.480303
	Total	25619	0.588131	18240	0.418733	6428	0.147567	14195	0.325872	0	0	64482	1.480303

C|P|H
CONSULTANTS

APPENDIX D

WATER QUALITY DETAILS

Site Planning
Civil Engineering
Land Use Consulting
Project Management
Landscape Architecture



PLAN VIEW

STORMFILTER STEEL CATCHBASIN DESIGN NOTES

STORMFILTER TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. 1 CARTRIDGE CATCHBASIN HAS A MAXIMUM OF ONE CARTRIDGE. SYSTEM IS SHOWN WITH A 27" CARTRIDGE, AND IS ALSO AVAILABLE WITH AN 18" CARTRIDGE. STORMFILTER CATCHBASIN CONFIGURATIONS ARE AVAILABLE WITH A DRY INLET BAY FOR VECTOR CONTROL.
PEAK HYDRAULIC CAPACITY PER TABLE BELOW. IF THE SITE CONDITIONS EXCEED PEAK HYDRAULIC CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"			18"			18" DEEP		
RECOMMENDED HYDRAULIC DROP (H)	3.05'			2.3'			3.3'		
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf
CARTRIDGE FLOW RATE (gpm)	22.5	18.79	11.25	15	12.53	7.5	15	12.53	7.5
PEAK HYDRAULIC CAPACITY	1.0			1.0			1.8		
INLET PERMANENT POOL LEVEL (A)	1'-0"			1'-0"			2'-0"		
OVERALL STRUCTURE HEIGHT (B)	4'-9"			3'-9"			4'-9"		

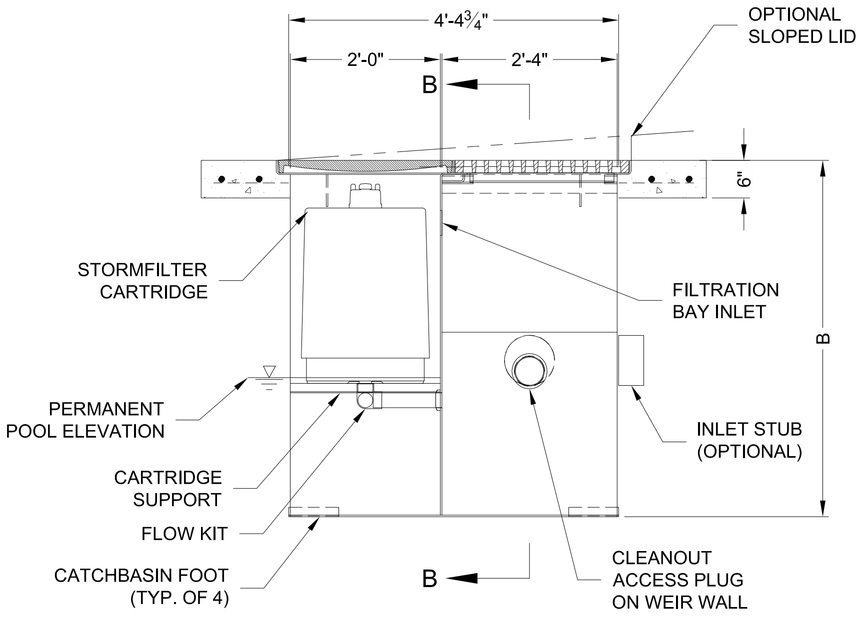
* 1.67 gpm/sf SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB® (PSORB) MEDIA ONLY

GENERAL NOTES

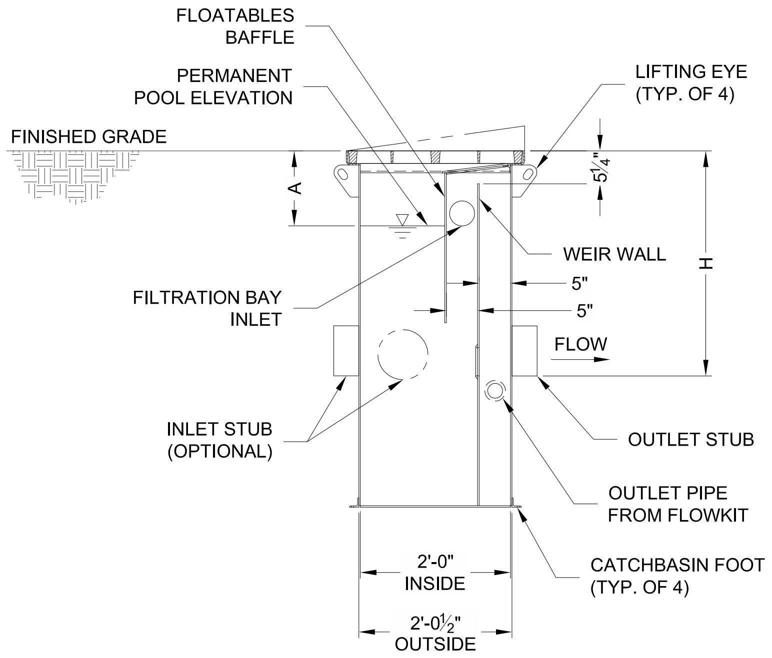
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STORMFILTER CATCHBASIN STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
3. STORMFILTER CATCHBASIN WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
4. INLET SHOULD NOT BE LOWER THAN OUTLET. INLET (IF APPLICABLE) AND OUTLET PIPING TO BE SPECIFIED BY ENGINEER AND PROVIDED BY CONTRACTOR.
5. MANUFACTURER TO APPLY A SURFACE BEAD WELD IN THE SHAPE OF THE LETTER "O" ABOVE THE OUTLET PIPE STUB ON THE EXTERIOR SURFACE OF THE STEEL SFCB.
6. STORMFILTER CATCHBASIN EQUIPPED WITH 4 INCH (APPROXIMATE) LONG STUBS FOR INLET (IF APPLICABLE) AND OUTLET PIPING. STANDARD OUTLET STUB IS 8 INCHES IN DIAMETER. MAXIMUM OUTLET STUB IS 15 INCHES IN DIAMETER. CONNECTION TO COLLECTION PIPING CAN BE MADE USING FLEXIBLE COUPLING BY CONTRACTOR.
7. STEEL STRUCTURE TO BE MANUFACTURED OF 1/4 INCH STEEL PLATE. CASTINGS SHALL MEET AASHTO M306 LOAD RATING. TO MEET HS20 LOAD RATING ON STRUCTURE, A CONCRETE COLLAR IS REQUIRED. WHEN REQUIRED, CONCRETE COLLAR WITH #4 REINFORCING BARS TO BE PROVIDED BY CONTRACTOR.
8. FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 38 SECONDS.
9. SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft).

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CATCHBASIN (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.



SECTION A-A



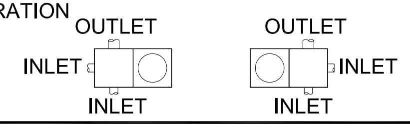
SECTION B-B

1-CARTRIDGE CATCHBASIN STORMFILTER DATA

STRUCTURE ID	XXX
WATER QUALITY FLOW RATE (cfs)	X.XX
PEAK FLOW RATE (<1 cfs)	X.XX
RETURN PERIOD OF PEAK FLOW (yrs)	XXX
CARTRIDGE HEIGHT (27", 18", 18" DEEP)	XX
CARTRIDGE FLOW RATE (gpm)	XX
MEDIA TYPE (PERLITE, ZPG, PSORB)	XXXXX
RIM ELEVATION	XXX.XX'

PIPE DATA:	I.E.	DIAMETER
INLET STUB	XXX.XX'	XX"
OUTLET STUB	XXX.XX'	XX"

CONFIGURATION



SLOPED LID	YES\NO
SOLID COVER	YES\NO

NOTES/SPECIAL REQUIREMENTS:

The Stormwater Management StormFilter®

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,322,629; 5,524,576; 5,707,527; 5,985,157; 6,027,639; 6,649,048; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

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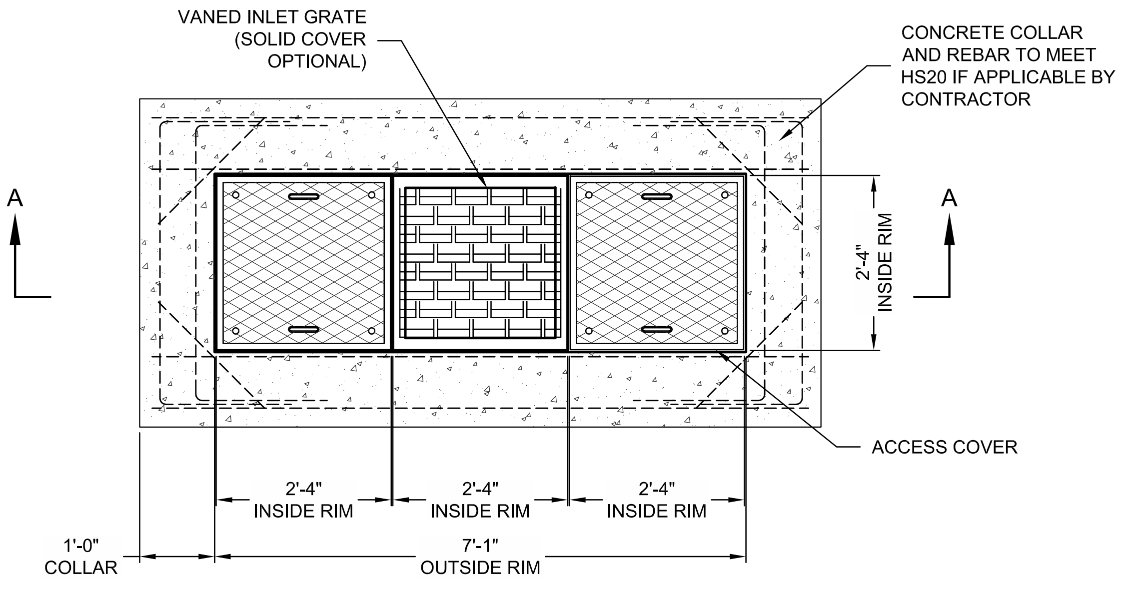
1 CARTRIDGE CATCHBASIN
STORMFILTER
STANDARD DETAIL

I:\COMMON\CAD\TREATMENT\10 STORMFILTER\40 STANDARD DRAWINGS\SFCB\SFCB-S\DWG\SFCB1-DTL.DWG 7/8/2016 2:42 PM



PLAN VIEW

STORMFILTER STEEL CATCHBASIN DESIGN NOTES

STORMFILTER TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. 2 CARTRIDGE CATCHBASIN HAS A MAXIMUM OF TWO CARTRIDGES. SYSTEM IS SHOWN WITH A 27" CARTRIDGE, AND IS ALSO AVAILABLE WITH AN 18" CARTRIDGE. STORMFILTER CATCHBASIN CONFIGURATIONS ARE AVAILABLE WITH A DRY INLET BAY FOR VECTOR CONTROL.
PEAK HYDRAULIC CAPACITY PER TABLE BELOW. IF THE SITE CONDITIONS EXCEED PEAK HYDRAULIC CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"			18"			18" DEEP		
RECOMMENDED HYDRAULIC DROP (H)	3.05'			2.3'			3.3'		
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf
CARTRIDGE FLOW RATE (gpm)	22.5	18.79	11.25	15	12.53	7.5	15	12.53	7.5
PEAK HYDRAULIC CAPACITY	1.0			1.0			1.8		
INLET PERMANENT POOL LEVEL (A)	1'-0"			1'-0"			2'-0"		
OVERALL STRUCTURE HEIGHT (B)	4'-9"			3'-9"			4'-9"		

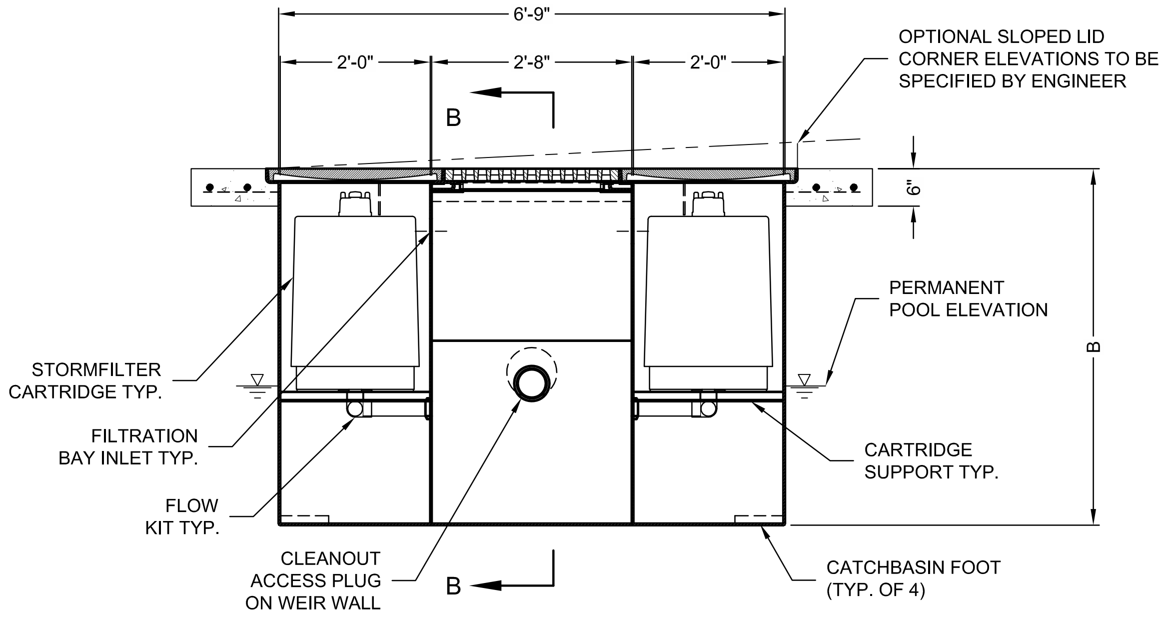
* 1.67 gpm/sf SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB® (PSORB) MEDIA ONLY

GENERAL NOTES

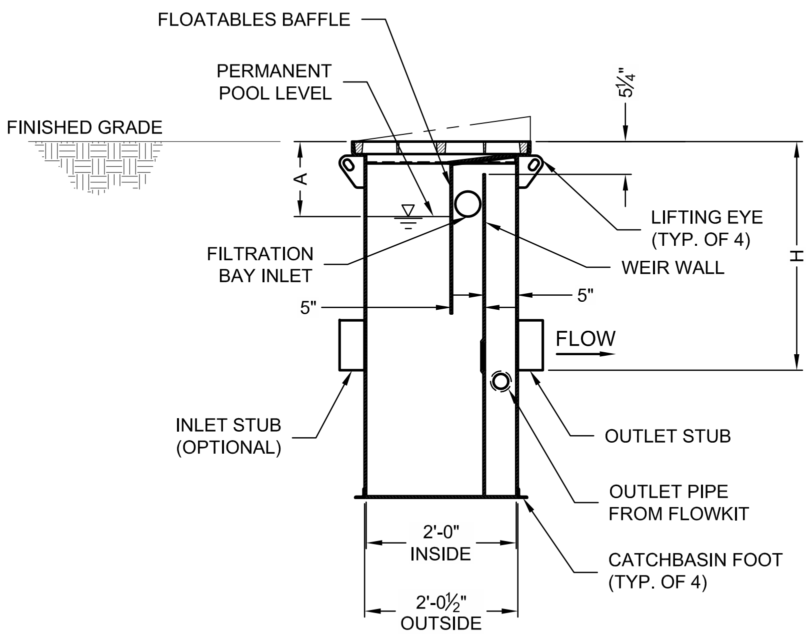
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STORMFILTER CATCHBASIN STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. WWW.CONTECHES.COM
3. STORMFILTER CATCHBASIN WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
4. INLET SHOULD NOT BE LOWER THAN OUTLET. INLET (IF APPLICABLE) AND OUTLET PIPING TO BE SPECIFIED BY ENGINEER AND PROVIDED BY CONTRACTOR.
5. MANUFACTURER TO APPLY A SURFACE BEAD WELD IN THE SHAPE OF THE LETTER "O" ABOVE THE OUTLET PIPE STUB ON THE EXTERIOR SURFACE OF THE STEEL SFCB.
6. STORMFILTER CATCHBASIN EQUIPPED WITH 4 INCH (APPROXIMATE) LONG STUBS FOR INLET (IF APPLICABLE) AND OUTLET PIPING. STANDARD OUTLET STUB IS 8 INCHES IN DIAMETER. MAXIMUM OUTLET STUB IS 15 INCHES IN DIAMETER. CONNECTION TO COLLECTION PIPING CAN BE MADE USING FLEXIBLE COUPLING BY CONTRACTOR.
7. STEEL STRUCTURE TO BE MANUFACTURED OF 1/4 INCH STEEL PLATE. CASTINGS SHALL MEET AASHTO M306 LOAD RATING. TO MEET HS20 LOAD RATING ON STRUCTURE, A CONCRETE COLLAR IS REQUIRED. WHEN REQUIRED, CONCRETE COLLAR WITH #4 REINFORCING BARS TO BE PROVIDED BY CONTRACTOR.
8. FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 38 SECONDS.
9. SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft).

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CATCHBASIN (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.



SECTION A-A



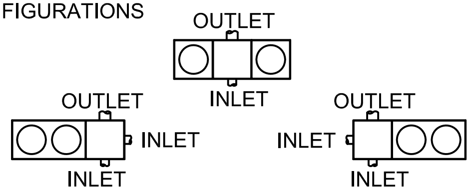
SECTION B-B

2-CARTRIDGE DEEP CATCHBASIN STORMFILTER DATA

STRUCTURE ID	XXX
WATER QUALITY FLOW RATE (cfs)	X.XX
PEAK FLOW RATE (<1.8 cfs)	X.XX
RETURN PERIOD OF PEAK FLOW (yrs)	XXX
CARTRIDGE FLOW RATE (gpm)	XX
MEDIA TYPE (PERLITE, ZPG, PSORB)	XXXXX
RIM ELEVATION	XXX.XX'

PIPE DATA:	I.E.	DIAMETER
INLET STUB	XXX.XX'	XX"
OUTLET STUB	XXX.XX'	XX"

CONFIGURATIONS



SLOPED LID	YES\NO
SOLID COVER	YES\NO

NOTES/SPECIAL REQUIREMENTS:

The Stormwater Management StormFilter®

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,322,629; 5,524,576; 5,707,527; 5,985,157; 6,027,639; 6,649,048; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

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2 CARTRIDGE CATCHBASIN
STORMFILTER
STANDARD DETAIL

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APPENDIX E

DOWNSTREAM ANALYSIS

(WILL BE PROVIDED WITH FINAL ENGINEERING)

APPENDIX F

OPERATIONS AND MAINTENANCE

(WILL BE PROVIDED WITH FINAL ENGINEERING)