

Creekside PRD

Preliminary Drainage Report

Prepared for

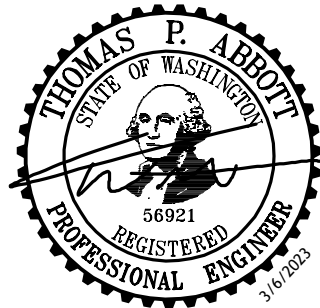
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Prepared by

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March 2023

Job No: C22-173

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APPENDICES

#	Title
1	Project Overview
3	Resource Review
4	Site Hydrology

SECTION 1.0: PROJECT OVERVIEW

This proposal is for the project site located on three Snohomish County parcels on the west side of 79th Ave NE on the block between Line Rd and 40th St NE in the City of Marysville. Parcels included are 29050200100200, 29050200100300, and 29050200100400. Creekside is a proposed Planned Residential Development (PRD) of 51 detached single-family residential lots with open space in Marysville, WA. The existing home located on Parcel 29050200100200 is proposed to remain by way of a boundary line adjustment (BLA). The project site lies within the NW ¼ of the NE ¼ of Section 02, Township 29 N, Range 05 E within the City of Marysville. See Vicinity Map in Appendix 1 for relative location.

1.1 EXISTING SITE

The existing site consists of three adjacent parcels covering a total area of approximately 16.19 acres. The site addresses are 7811 and 7715 40th St NE and 7808 44th St NE, Marysville, WA. The property is bordered by 40th St NE to the south, 79th Ave NE to the east, 44th St NE to the north, and residential properties to the west. The use of the site is currently for single-family residences located within the northern and southern portions of the site. Most of the proposed development is forested with scattered mapped wetland areas, the largest being associated with the creek running along the eastern portion of the site. The site is currently located in R6.5 Single Family High zoning.

Topographically, the site is relatively level to gently sloping, with a few very small, isolated steep slopes. These slopes were generally less than 10 feet in height and did not appear to constitute a landslide hazard. Vegetation across the site consists of some grass yard areas, with a moderate density of evergreen and deciduous trees and native shrubs.

A site soil survey by Nelson Geotechnical Associates, Inc. determined that groundwater seepage was not encountered within any of the explorations. If groundwater is encountered within the site during construction, this water is interpreted to be perched water. The depth to the seasonal high groundwater across the site is unknown, but the installation of two piezometers within two of the test pits will monitor the depth to seasonal high groundwater in the wet season as needed. The site subsurface soil explorations indicate that the site is underlain by competent native glacial soils at relatively shallow depths, below a layer of undocumented fill and/or topsoil. The

subsurface native glacial till soils generally consisted of silty, fine to medium sand with varying amounts of gravel and cobbles in a medium dense to dense condition. A long-term design infiltration rate was calculated to be 3.29 in/hr in a large cap of recessional outwash near the northern portion of the site. However, based on observations, results of the onsite testing, and the relatively silty and dense nature of the native glacial till deposits that are interpreted to underlie the site, the on-site native glacial till soils on the site are not conducive for traditional stormwater infiltration systems, but rather limited infiltration systems. NRCS web soils survey similarly categorizes site soils as mostly Tokul gravelly medial loam (0 to 8 percent slopes, and a small area of 8 to 15 percent slopes) and Norma loam, which is consistent with generally low infiltration capacity.

1.2 DOWNSTREAM ANALYSIS

A downstream analysis was performed on January 10th, 2023. The northern and southern portions of the project site were observed for potential upstream runoff and downstream flow paths. Onsite access was not available. All site runoff from the development area flows southeasterly into King Creek, which travels south along the eastern side of the project site. King Creek continues offsite to the south and beyond the quarter mile boundary of analysis. This site flow is located within a single threshold discharge area (TDA). See Section 3.0 of this report for more information.

1.3 PROPOSED DEVELOPMENT

The proposed Creekside project will be developed with residences on 51 single-family lots, and will include clearing and grading, wetland creation, construction and dedication of a 50-foot-wide ROW and associated drainage facilities, utility extension and modification, road extension and driveways, landscaping, and frontage improvements. Project development will disturb approximately 7.95 acres. Overall project impact will create 5.63 acres of new plus replaced hard surfaces, with 2.25 acres being pollution generating hard surfaces (PGHS).

All existing vegetation within the disturbed area will be cleared. The proposed internal access road with 50-foot of dedicated R/W will provide access to all proposed lots and extends from 44th St NE at the northwestern corner of the project site and from 79th Ave NE near the southeastern

corner of the project site. All frontage improvements will be consistent with the Marysville Municipal Code and Engineering Standards.

Side sewer stub connections are proposed for each lot. All onsite sanitary sewer lines will convey to the existing City of Marysville sanitary sewer collection system near the southeastern road connection to 79th Ave NE.

1.4 PROPOSED FLOW CONTROL DESIGN

The proposed project is vested to the requirements of the 2019 Department of Ecology (DOE) Stormwater Management Manual for Western Washington. In compliance with the requirements of the 2019 DOE Manual, runoff from all new and replaced hard surfaces and converted vegetative areas are subject to the Minimum Requirements set forth by the DOE Manual. All developed and disturbed area runoff within the onsite threshold discharge area (TDA) not considered as bypass will be collected, detained, and dispersed utilizing a two-vault detention system and dispersion trench. Detention and dispersion facilities have been modeled using WWHM2012, a continuous runoff simulation. The Onsite Bypass and Frontage Bypass basins consist of onsite and frontage areas where runoff is unable to convey onsite to a detention vault due topographical constraints. See Section 4.0 for additional description and calculations concerning the proposed stormwater flow control measures.

1.5 PROPOSED WATER QUALITY TREATMENT DESIGN

The residential nature of the development requires "Basic" water quality treatment level. All water quality treatment designs have been performed in accordance with Volume 5 of the 2019 DOE Manual. Runoff from pollution generating surfaces will be conveyed to the detention vault(s) and associated Oldcastle Perfilter water quality treatment structure located downstream of detention to fulfill water quality treatment requirements for the site before releasing at mitigated, historic rates through the dispersion trench into native vegetation. An additional Perfilter will be located near the proposed 79th Ave NE intersection to treat Road C PGIS area unable to be collected due to vertical constraints. Refer to Section 4.0 for details.

1.6 EROSION/SEDIMENTATION CONTROL

Erosion control measures that will be utilized during construction will be provided in the SWPPP and TESC plan sheets. A summary can be found in Section 2.0 of this report.

1.7 MINIMUM REQUIREMENTS

Per the 2019 DOE Manual, Minimum Requirements 1-9 apply to all new and replaced hard surfaces and converted vegetative areas.

Minimum Requirement #1: Preparation of Stormwater Site Plans: This report along with the construction plans satisfies this minimum requirement.

Minimum Requirement #2: Construction Stormwater Pollution Prevention (SWPP): A Stormwater Pollution Prevention Plan (SWPPP) has been provided as a separate document. See Section 2 for discussion of the 13 elements.

Minimum Requirement #3: Source Control of Pollution: Permanent source control BMPs are not applicable for the subject site since the associated activities for the new residences as residential developments are not required to implement source control BMP's.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls: The developed site contains one discharge location near the southern edge of the project site that lies within a single TDA. Site runoff historically flows south and east towards the existing wetland areas that connect to King Creek, which lies along the eastern edge of the project site. In the developed condition, runoff within the onsite threshold discharge basin will be collected and routed to the detention vault and dispersion trench. The dispersion trench will fully disperse runoff routed from the detention vault and associated water quality control structure at a mitigated, historic rate into native vegetation near the southeastern border of the project site. All downstream flow paths converge to Ebey Slough outside the quarter-mile boundary of analysis and eventually flows into the Snohomish River, which discharges into the Possession Sound. Thus, the historic flow path will be maintained.

Minimum Requirement #5: Onsite Stormwater Management: Per the Geotechnical evaluation, a long-term design infiltration rate was calculated to be 3.29 in/hr in a large cap of

recessional outwash near the northern portion of the site. However, based on observations, results of the onsite testing, and the relatively silty and dense nature of the native glacial till deposits that are interpreted to underlie the site, the on-site native glacial till soils on the site are not conducive for traditional stormwater infiltration systems, but rather limited infiltration systems. However, where limited infiltration is feasible, areas of fill soil are proposed to make site grades work, thus negating infiltration applicability. The project will exceed the 10,000 SF pollution-generating impervious surface (PGIS) threshold and is required to provide an On-Site Stormwater BMPs to the maximum extent feasible. The detention vault will be installed near the mid-eastern edge of the site and will convey flow to the dispersion trench near the southern edge of the site and will dispersed into Tract 993 at the uphill of King Creek at mitigated rates. BMP T5.13 Post-Construction Soil Quality and Depth will be used on all non-impervious disturbed surfaces. See section 4.3 for additional information.

Minimum Requirement #6: Runoff Treatment: As the project will exceed the 5,000 SF of PGIS, the project is required to provide “basic” water quality treatment per the 2019 DOE Manual. One Oldcastle Perfilter cartridge filtration units will be installed downstream of the detention vaults to meet this requirement, and one will be located near the project frontage improvements to treat PGIS Bypass area.

Minimum Requirement #7: Flow Control: Two detention vaults are proposed near the mid-eastern edge of the site to capture the maximum amount of onsite runoff. Flows will be released at historic, mitigated rates to native vegetation near the southern edge of the site using a dispersion trench. Runoff from the Bypass Basins will not be collected in the detention vault systems. See Onsite Stormwater Management in Section 4.0 of this report for further discussion of flow control modeling and facility sizing parameters.

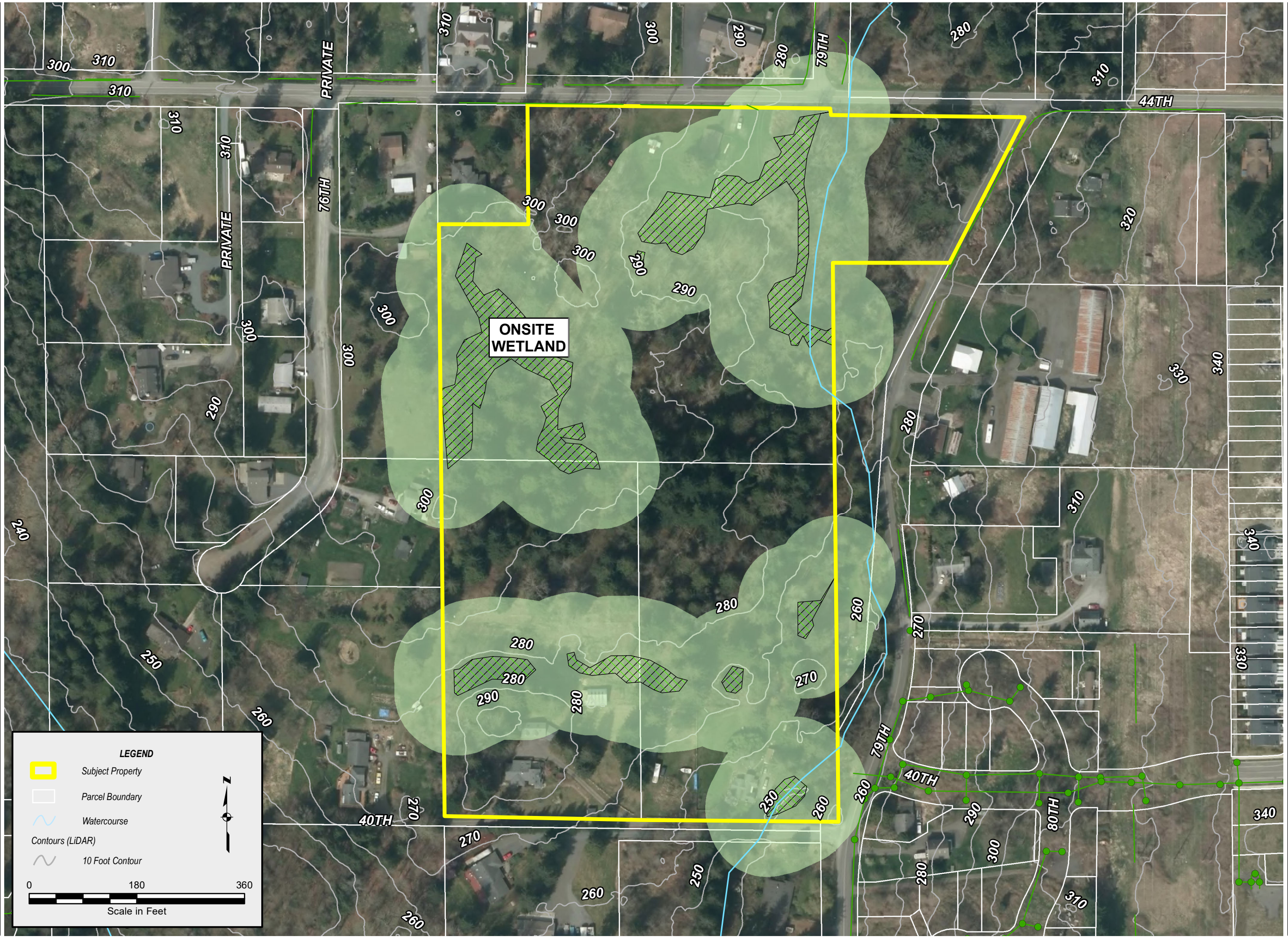
Minimum Requirement #8: Wetlands Protection: Per Soundview Consultants’ critical areas mapping, wetland areas exist throughout the project site including a Category II (Wetland B), five Category III’s, and a Category III pond. Portions of Wetland A, E, and the Pond will be filled (Cat III’s) thus requiring wetland creation. See Soundview Consultants’ full wetland report for detailed wetland creation & mitigation plans. Wetlands contain 75-foot buffers, with a minimum reduced wetland buffer of 56.25-feet. A Type F Stream, titled King Creek, runs south along the

eastern property portion. The Stream contains a 150-foot stream buffer and a minimum reduced stream buffer of 112.5-feet. The dispersion trench outfall from the proposed detention vault is proposed to discharge outside the final developed stream buffer to King Creek and Wetland G which is classified as Category III. Per Appendix I-D of the 2019 DOE Manual, only Category I and II Wetlands require hydrologic modeling. General wetland protection guidelines will still be implemented for all onsite wetlands.

Minimum Requirement #9: Operation and Maintenance: See Operations and Maintenance in Section 6.0 of this report.

Appendix 1: Project Overview

1. Figure 1.0 – Vicinity Map
2. Figure 2.0 – Existing Conditions Map
3. Proposed Development Map



LEGEND

- Subject Property
- Parcel Boundary
- Watercourse
- Contours (LiDAR)
- 10 Foot Contour

0 180 360
Scale in Feet

HORIZON VIEW HOLDINGS, INC.

CREEKSIDE

EXISTING CONDITIONS MAP

NAD 1983 HARN
STATEPLANE WASHINGTON
NORTH FIPS 4601 FEET

REVISION:
JOB NUMBER: C22-173
DRAWING NAME: C22-173-2.0
DESIGNER: TABOTT
DRAWING BY: CDANBY
DATE: 3/2/2023
SCALE: AS SHOWN
JURISDICTION: SNO. COUNTY

FIGURE:

2.0

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SOURCE INFORMATION	
SOURCE AGENCY	DESCRIPTION
SNOHOMISH COUNTY GIS	PARCEL BOUNDARY
SNOHOMISH COUNTY GIS	CONTOURS GENERATED FROM BARE EARTH LIDAR (SNOHOMISH COUNTY). THIS DATA HAS A STATED VERTICAL ACCURACY OF APPROXIMATELY 1 FOOT.

SECTION 2.0: RISK ASSESSMENT ANALYSIS AND TEMPORARY EROSION AND SEDIMENT CONTROL DESIGN

Temporary Erosion and Sediment Control

A Stormwater Pollution Prevention Plan (SWPPP) will be provided under separate cover. The SWPPP report is modeled under the guidelines of Volume II, Section 3 of the 2019 Stormwater Management Manual for Western Washington. Construction SWPPP Element #1 through #13 are addressed below.

Element #1 – Mark Clearing Limits: All clearing limits will be delineated with high visibility plastic/metal or silt fencing. See sheets ER-01 and ER-02 of the construction plans for locations and associated details.

Element #2 – Establish Construction Access: Two construction entrances will serve as access to the site for construction vehicles from 79th Ave NE and Line Road/44th St NE. See sheets ER-01 and ER-02 of the construction plans for locations and details.

Element #3 – Control Flow Rates: Detention of construction period runoff will be provided by means of a temporary erosion and sediment control (TESC) pond located near the mid-eastern edge of the site. See sheets ER-01 of the preliminary plans for location and details for flow and sediment control BMP's.

Element #4 – Install Sediment Controls: Silt fence, catch basin protection, interceptor dike and swale, and the temporary sediment pond will be utilized to contain sediments within the project's clearing limits. See sheets ER-01 and ER-02 of the preliminary plans for locations and details.

Element #5 – Stabilize Soils: Any exposed soils will be stabilized with plastic covering and/or temporary and permanent seeding and as specified in the Grading and Erosion Control Notes. See sheet ER-02 of the construction plan for notes.

Element #6 – Protect Slopes: Slopes shall be protected with plastic covering and/or temporary and permanent seeding where applicable, as specified under Element #5.

Element #7 – Protect Drain Inlets: Storm drain inlet protection will be utilized to contain sediments within the project's clearing limits. See sheets ER-01 and ER-02 of the preliminary plans for locations and details.

Element #8 – Stabilize Channels and Outlets: Temporary channels shall be stabilized with riprap channel lining and check dams. Outlet protection will be utilized to prevent scouring at conveyance outlets and to minimize the potential for downstream erosion by reducing the velocity of concentrated stormwater flows. See sheets ER-01 and ER-02 of the preliminary plans for related erosion control locations and details.

Element #9 – Control Pollutants: Pollutants shall be controlled as specified in Volume IV of the 2021 SCDM-Source Control BMPs to address potential sources of pollution which may exacerbate possible soil/groundwater contamination identified onsite. See sheet ER-02 of the preliminary plans for notes.

Element #10 – Control De-Watering: Disposal options for de-watering water are as specified in the De-Watering Control Notes. Concrete handling will be used for sediment trapping and turbidity reduction. See sheet ER-02 of the construction plans for notes.

Element #11 – Maintain BMPs: Maintenance of the BMPs is specified within the Construction Sequence and Grading and Erosion Control Notes. See sheets ER-01 and ER-02 of the construction plans for the Construction Sequence and notes.

Element #12: Manage the Project: The Grading and Erosion Control Notes specify seasonal work limitations. Maintenance of the BMPs is specified within the Construction Sequence and Grading and Erosion Control Notes. See sheets ER-01 and ER-02 of the construction plans for the Construction Sequence and notes.

Element #13: Protect LID BMPs: The BMPs stated in Elements #1 through #12 shall also be used to protect LID BMPs. Any amended soils on site shall be conducted after final site stabilization to prevent compaction of amended areas by heavy equipment. No other LID or on-site stormwater BMPs are proposed for development.

SECTION 3.0: DOWNSTREAM ANALYSIS REPORT

Task 1. Study Area Definition and Maps

Snohomish County Bare Earth LiDAR, survey, and 2021 aerial photography were the best topographical references available for the area containing the site.

Task 2. Resource Review

The resources below have been reviewed for existing and potential issues near the project site:

- **Adopted Basin Plans**

No Adopted Basin Plans were located that include the project site.

- **Drainage Basin**

This site is in the Sunnyside Ravines subbasin, within the Snohomish watershed. Discharge from the proposed development will flow into King Creek, a stream tributary to Ebey Slough, which in turn eventually discharges into the Snohomish River, which leads to Possession Sound.

- **Floodplain / Floodway (FEMA) maps**

According to FEMA floodplain mapping, the subject property is within an area of minimal floodplain hazard. Reference the FEMA floodplain map (panels #53061C0717G and #53061C0736F) in Appendix 3.

- **Critical Areas Map**

Wetland areas exist throughout the project site. The City of Marysville, WA has identified a Category III wetland near the mid-southern portion of the site. The categorized wetland has a required 75' buffer. Buffer averaging is proposed for the required wetland and stream buffer's boundaries. Buffer averaging on the stream and wetland buffers will be used to provide more buildable space on the site. Reference the critical areas report submitted with this report for additional information regarding the wetland areas onsite.

- **Drainage Complaints**

No drainage complaints were identified near the proposed site.

- **Road Drainage Problems**

No issues were identified near the proposed site.

- **Soil Survey**

A site soil survey by Nelson Geotechnical Associates, Inc. determined that the existing topography of the project site is relatively level to gently sloping, with isolated moderate slopes in different areas of the site, particularly surrounding the north-south trending creek along the eastern portion of the site. Native soils are classified as mostly Tokul gravelly medial loam (0 to 8 percent slopes, and a small area of 8 to 15 percent slopes) and Norma loam. Nelson Geotechnical Associates, Inc. observed the subsurface soils as generally consisting of silty, fine to medium sand with varying amounts of gravel and cobbles in a medium dense to dense condition, which is interpreted as native glacial till soils. The explorations within the site generally encountered surficial undocumented fill/topsoil underlain by glacial till. The till is described as an unsorted mixture of clay, silt, sand, pebbles, and cobbles with occasional large boulders all in varying amounts.

- **Migrating River Studies**

Migrating River Studies are not applicable to the proposed site development.

- **Section 303d List of Polluted Waters**

Washington State Department of Ecology's Water Quality Assessment for Washington contains a single Category 5 Temperature listings for King Creek.

- **Stormwater Compliance Plans**

Not applicable to the proposed project.

Task 3. Field Inspection/Downstream Analysis

On January 10th, 2023, a Downstream Analysis was performed at the site. The following observations were gathered during the site visit:

Upstream Observation:

There are no significant upstream basin areas tributary to the project site from neighboring properties. Any upstream runoff from the west of the project site is interpreted as residential/lawn stormwater sheet flow across gentle slopes onto the project site, which will not incur any flow control or water quality risk considerations. Located east of the project site, there is an insignificant volume of upstream runoff west of 79th Ave NE due to the minimal size of the offsite area. Therefore, there is a negligible volume of upstream stormwater runoff onto the project site. See image 6 in Appendix 3 for description of upstream stormwater runoff analysis.

Downstream Observation:

All site runoff from the development area flows southeasterly into King Creek, which travels south along the eastern side of the project site. King Creek continues offsite to the south and beyond the quarter mile boundary of analysis. This site flow is located within a single threshold discharge area (TDA).

Frontage flows are broken up into the Line Road/44th St NE and 79th Ave NE frontages. The 44th St NE frontage and road has a low point at the inlet location of King Creek near the NE corner of the project site (Images 1 and 2). The 79th Ave NE frontage and road generally slopes south towards the intersection of 40th St NE and 79th Ave NE. Along 40th St NE at the southern edge of the project site, there is a low point at the outlet location of King Creek near the SE corner of the project site (Image 3). All site runoff from the development area flows generally flows in a southeasterly direction. Flow at the Southwest corner continues back Southeast/east back to King Creek (Image 5) along the primary Flow path A. Flow path A continues for approximately 1,600-feet offsite prior to exiting the quarter mile boundary of analysis. These flow paths will remain the same in the developed condition.

Task 4. Drainage System Description and Problem Descriptions

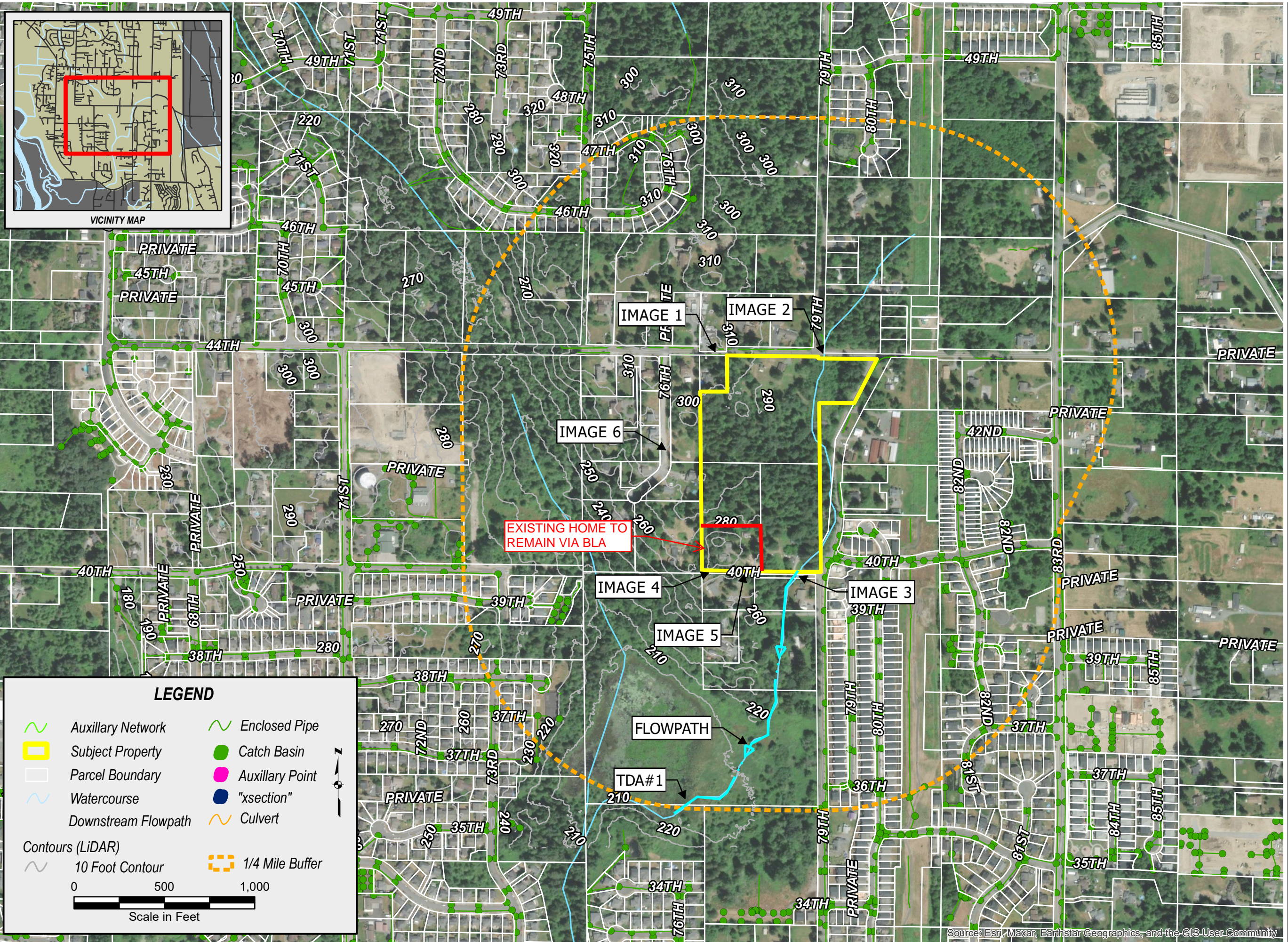
Based on the information and all the resources available including visual inspection of the downstream flow path, there is no evidence of existing or anticipated downstream drainage problems. All flows are adequately dispersed and/or infiltrated along existing flowpaths.

Task 5. Mitigation of Existing or Potential Drainage Problems (not applicable for Level 1 Analysis)

No evidence of existing or potential problems with upstream or downstream drainage pathways were found. Mitigation is not required.

Appendix 3: Resource Review

1. Figure 4.0 – Downstream Analysis Map
2. Downstream Images
3. City of Marysville Critical Areas Map
4. FEMA Floodplain Map
5. USGS Soils Map and Description
6. 303d Listings



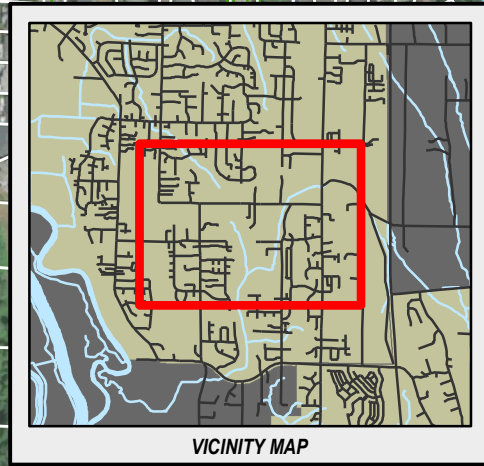
LEGEND

	Auxillary Network		Enclosed Pipe
	Subject Property		Catch Basin
	Parcel Boundary		Auxillary Point
	Watercourse		"xsection"
	Downstream Flowpath		Culvert

Contours (LiDAR)

	10 Foot Contour		1/4 Mile Buffer
--	-----------------	--	-----------------

0 500 1,000
Scale in Feet



SOURCE INFORMATION	
SOURCE AGENCY	DESCRIPTION
SNOHOMISH COUNTY GIS	PARCEL BOUNDARY
SNOHOMISH COUNTY GIS	CONTOURS GENERATED FROM BARE EARTH LIDAR (SNOHOMISH COUNTY). THIS DATA HAS A STATED VERTICAL ACCURACY OF APPROXIMATELY 1 FOOT.

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HORIZON VIEW HOLDINGS, INC.

**CREEKSIDE
DOWNSTREAM ANALYSIS MAP**

MAD 1983 HARN STATEPLANE WASHINGTON NORTH FIPS 4601 FEET	
REVISION:	
JOB NUMBER:	C22-173
DRAWING NAME:	C22-173-4.0
DESIGNER:	TABBOTT
DRAWING BY:	CDANBY
DATE:	3/3/2023
SCALE:	AS SHOWN
JURISDICTION:	SNOHOMISH

**FIGURE:
4.0**

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

DOWNSTREAM IMAGES

44th St NE



Image 1: Facing easterly near the NW corner of the project site where road and topography slopes east towards the low point at the King Creek inlet to the site. Negligible upstream runoff north of 44th St NE. See Image 6 for description of upstream runoff from the west.



Image 2: Facing southerly at the King Creek inlet to the project site at a low point along 44th St NE near the NE corner of project site. King Creek continues through the project site wetland areas near the eastern edge before discharging from the site at the southern edge.

40th St NE



Image 3: Facing southerly at the southern edge of the project site along 40th St NE at the discharge location of King Creek from the project site. King Creek continues south/southwesterly for approximately 1600-feet to the quarter-mile boundary of analysis. King Creek converges with Ebey Slough past the quarter-mile buffer.



Image 4: Facing east at the SW corner of the project site along 40th St NE where road and topography slopes east towards the low point at the King Creek outlet from the site. See Image 5 for description of onsite runoff from the north. See Image 6 for description of upstream runoff from the west.



Image 5: Facing northeasterly at the southern edge of project site along 40th St NE. Onsite stormwater runoff flows south towards 40th St NE or east towards the low point at the King Creek discharge location from the site.

76th Dr NE



Image 6: Facing southeasterly at the uphill of the project site along 76th Dr NE. Upstream runoff from the west of the project site is from residential/lawn area and descends across gentle slopes onto the site.

Critical Areas

2012

1:18,000



Data shown on this map represents known critical areas however, other critical areas may exist. This map is meant for general information purposes only and is not meant to replace critical areas surveys by qualified consultants.

THE CITY OF MARYSVILLE DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR WARRANTY OF FITNESS OF THIS DATA FOR ANY PARTICULAR PURPOSE, EITHER EXPRESSED OR IMPLIED. NO REPRESENTATION OR WARRANTY IS MADE CONCERNING THE ACCURACY, CURRENCY, COMPLETENESS OR QUALITY OF DATA DEPICTED. ANY USER OF THIS DATA ASSUMES ALL RESPONSIBILITY FOR USE THEREOF, AND FURTHER AGREES TO HOLD THE CITY OF MARYSVILLE HARMLESS FROM AND AGAINST ANY DAMAGE, LOSS, OR LIABILITY ARISING FROM ANY USE OF THIS DATA.

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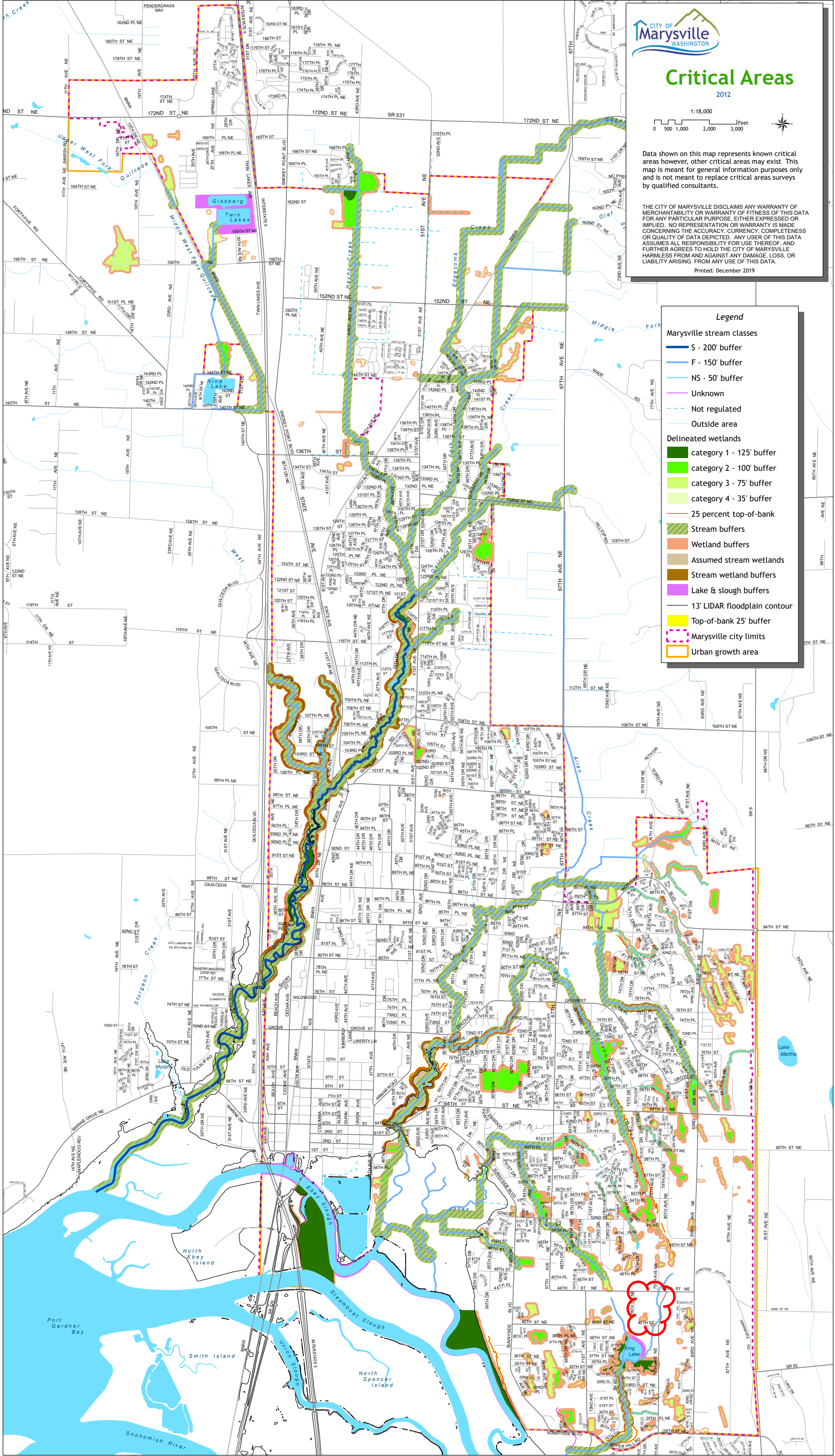
Legend

Marysville stream classes

- S - 200' buffer
- F - 150' buffer
- NS - 50' buffer
- Unknown
- Not regulated
- Outside area

Delineated wetlands

- category 1 - 125' buffer
- category 2 - 100' buffer
- category 3 - 75' buffer
- category 4 - 35' buffer
- 25 percent top-of-bank
- Stream buffers
- Wetland buffers
- Assumed stream wetlands
- Stream wetland buffers
- Lake & slough buffers
- 13' LIDAR floodplain contour
- Top-of-bank 25' buffer
- Marysville city limits
- Urban growth area



National Flood Hazard Layer FIRMMette



122°7'53"W 48°2'12"N



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

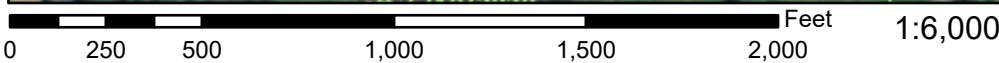
SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) <i>Zone A, V, A99</i>
		With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i>
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile <i>Zone X</i>
		Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i>
		Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i>
		Area with Flood Risk due to Levee <i>Zone D</i>
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i>
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard <i>Zone D</i>
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance
		17.5 Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
MAP PANELS		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

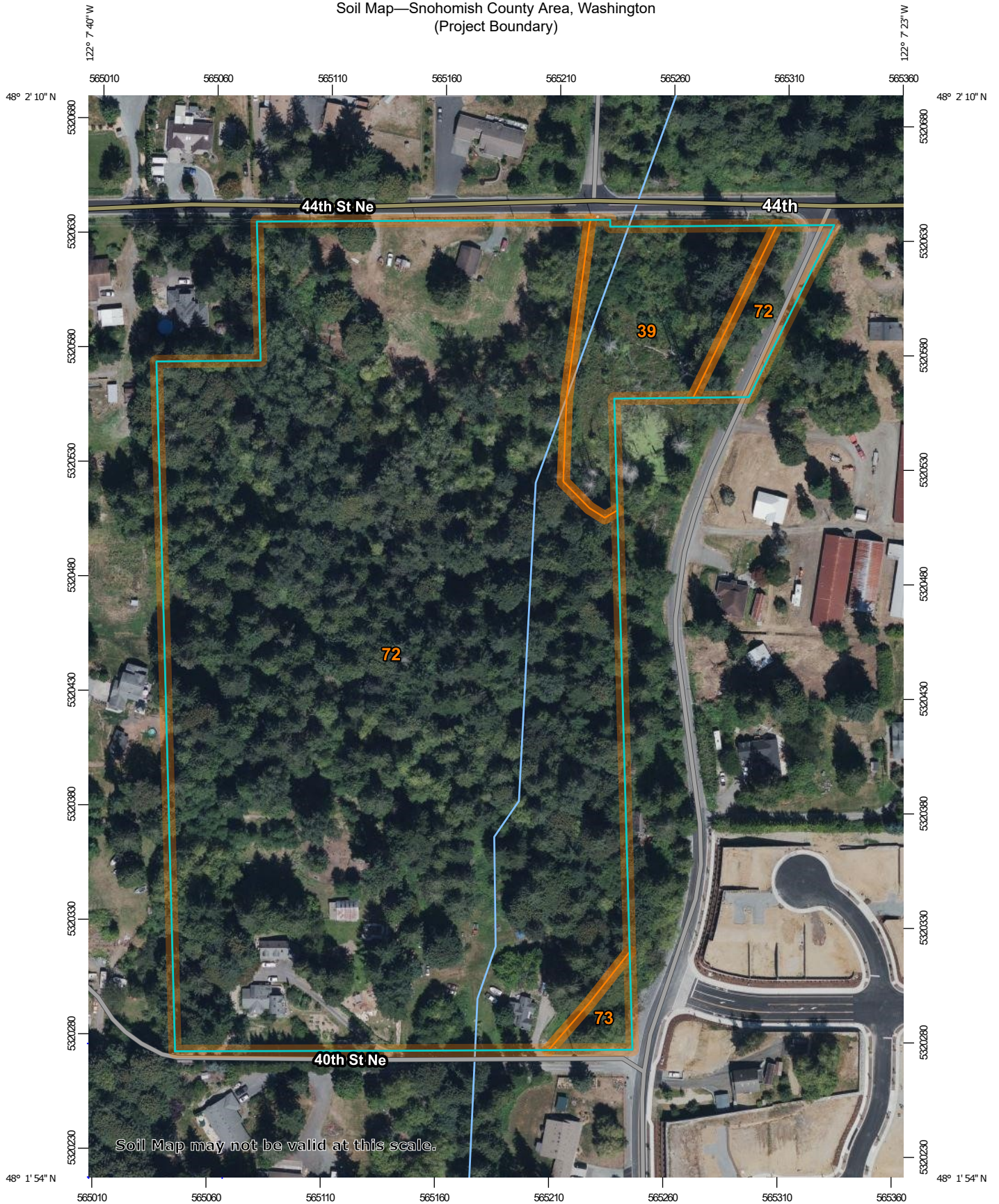
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **1/11/2023 at 11:58 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

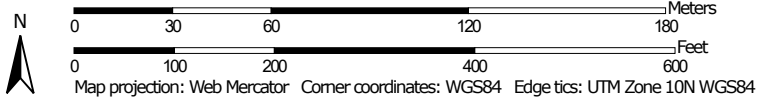


122°7'15"W 48°1'48"N

Soil Map—Snohomish County Area, Washington
(Project Boundary)



Map Scale: 1:2,300 if printed on A portrait (8.5" x 11") sheet.




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



Lava Flow



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



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 24, Sep 8, 2022

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

Date(s) aerial images were photographed: Aug 16, 2020—Aug 19, 2020

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
39	Norma loam	1.5	8.2%
72	Tokul gravelly medial loam, 0 to 8 percent slopes	17.0	90.8%
73	Tokul gravelly medial loam, 8 to 15 percent slopes	0.2	1.0%
Totals for Area of Interest		18.8	100.0%

LISTING_ID	CURRENT_C ATEGORY	WATERBODY_ NAME	PARAMETER_ NAME	MEDIUM_ NAME	DESIGNATED_USE
48639	5	KING CREEK	Temperature	Water	Aquatic Life - Core Summer Salmonid Habitat

SECTION 4.0: FLOW CONTROL AND WATER QUALITY FACILITY ANALYSIS AND DESIGN

The Creekside project proposes a two-vault detention system and Perfilter cartridge filtration structures to provide both flow control and water quality treatment onsite. Since runoff from developed surfaces within the onsite TDA will be detained and dispersed onsite, the onsite basin will coincide with the detention facilities and their respective tributary surfaces in both the predeveloped and developed conditions. The frontage/bypass basin will be modeled to meet the flow control and water quality requirements per the 2019 DOE Manual.

The predeveloped and developed conditions were modeled in WWHM2012, a continuous hydrologic model for the purpose of detention sizing, flow-duration control, and dispersion trench flow rate threshold assessment. Based on the site location, WWHM2012 used a Precipitation Scale factor of 1.2. As the Creekside project does not contain more than 35% existing impervious, the pre-developed condition (forested) is applied to all onsite landcover to be converted for each development. There are no upstream areas tributary to the developed site areas that need to be included in modeling of the detention facilities.

For a visual representation of each of the predeveloped and developed hydrology basins, see Figures 5.0 and 6.0 in Appendix 4. Figure 5.0 depicts the entire onsite basin not associated with frontage improvements for the purpose of stormwater modeling.

4.1 PREDEVELOPED HYDROLOGY

Onsite Basin 1 (Vault A):

The Onsite Basin 1 includes all area within the Creekside project limits that will be disturbed for the development as part of construction to be detained in Detention Vault A. The basin has been modeled in WWHM with the following areas in the predeveloped condition:

Onsite Basin 1	
Land Cover	Area
Forest, Mod	4.84 AC
Forest, Steep	1.50 AC
Total	6.34 AC

Onsite Basin 2 (Vault B):

The Onsite Basin 2 includes all area within the Creekside project limits that will be disturbed for development as part of construction to be detained in Detention Vault B. The basin has been modeled in WWHM with the following areas in the predeveloped condition:

Onsite Basin 2	
Land Cover	Area
Forest, Steep	1.38 AC
Total	1.38 AC

4.2 DEVELOPED SITE HYDROLOGY

Project development consists of impervious surfaces associated with the single-family residences, driveway accesses, public ROW, and associated utilities within Creekside project limits. Minor frontage improvements will take place within the 44th St NE and 79th Ave NE ROW. The Creekside project will produce 4.71 acres of impervious area, 2.25 acres being PGHS. Developed onsite runoff will be detained onsite in Tract 993 and dispersed upslope of King Creek in Tract 992. The frontage and onsite bypass areas at the southeastern and northwestern portions of the project site respectively, will not be detained due to vertical constraints.

Pervious Land Cover

Pervious land cover in each developed basin has been modeled as pasture. In Section 7.1 of the Low Impact Development Technical Guidance Manual for Puget Sound (LID Manual), referenced in Appendix III-C of the 2021 DOE manual, it is prescribed that if landscaped areas are underlain with BMP T5.13 soils, the area may be modeled as pasture. These landscaped areas will be underlain with BMP T5.13 soil mixtures in the developed condition and thus have been modeled as pastureland cover in WWHM.

Onsite Basin 1 (Vault A):

The Onsite Basin 1 includes most of the area north of the proposed lot #27 within the Creekside project limits that will be developed as part of construction. All roof surfaces will be fully infiltrated via infiltration galleries located under their respective driveways. Per Marysville Municipal Code, PRD developments allow 70% maximum impervious lot coverage, thus areas were calculated as such. The basin has been modeled in WWHM as one single unit with the following areas in the developed condition:

Onsite Basin 1	
Land Cover	Area
Roads, Flat	1.25 AC
Rooftops, Flat	2.05 AC
Driveways, Flat	0.43 AC
Sidewalks, Flat	0.56 AC
Pasture, Flat	1.50 AC
Total	5.79 AC

Onsite Bypass Basin (Vault A):

The Onsite Bypass Basin includes most of the area associated with Lots 1-3 at the northwestern corner of the site that will bypass detention as part of development activities due to vertical constraints. The basin has been modeled in WWHM as bypass in the developed condition:

Onsite Bypass Basin	
Land Cover	Area
Rooftops, Flat	0.12 AC
Driveways, Flat	0.02 AC
Pasture, Flat	0.06 AC
Total	0.20 AC

Frontage Bypass Basin (Vault A):

The Frontage Bypass Basin includes area associated with the proposed Road C and 79th Ave NE intersection at the southeastern corner of the site that will bypass detention as part of

development activities due to vertical constraints. The basin has been modeled in WWHM as bypass in the developed condition:

Frontage Bypass Basin	
Land Cover	Area
Roads, Flat	0.13 AC
Roads, Mod	0.10 AC
Sidewalks, Flat	0.06 AC
Pasture, Mod	0.06 AC
Bypass Total	0.35 AC

Onsite Basin 2 (Vault B):

The Onsite Basin 2 includes most of the area south of the proposed lot #28 in addition to lots 18-23 within the Creekside project limits that will be converted into developed homes as part of construction. Per Marysville Municipal Code, PRD developments allow 70% maximum impervious lot coverage, thus areas were calculated as such. The basin has been modeled in WWHM as one single unit with the following areas in the developed condition:

Onsite Basin 2	
Land Cover	Area
Roads, Mod	0.28 AC
Rooftops, Flat	0.49 AC
Driveways, Flat	0.04 AC
Sidewalks, Mod	0.10 AC
Pasture, Mod	0.47 AC
Total	1.38 AC

4.3 WATER QUALITY TREATMENT

All water quality treatment designs have been performed in accordance with Volume 5 of the 2019 DOE Manual. The proposed detention vault and Perkfilter water quality treatment unit near the mid-eastern edge of the project site will be utilized to treat PGHS runoff per DOE Manual specifications. An additional Perkfilter unit will be located near the site’s proposed

intersection with 79th Ave NE to treat bypass from more than 5,000 SF PGIS. The following is a summary of relevant sizing criteria used by Oldcastle to size the Perfilter facilities:

Perfilter (96" diam. Manhole)

Treatment Flow Rate	0.303 cfs
Tributary Impervious Area	3.58 AC
Tributary PGIS	1.68 AC
Treatment Flow Capacity	7.24 cfs
Media Cartridges	8x30"

Perfilter (2'-8" x 10' Concrete Catch Basin)

Treatment Flow Rate	0.060 cfs
Tributary Impervious Area	0.37 AC
Tributary PGIS	0.31 AC
Treatment Flow Capacity	1.30 cfs
Media Cartridges	3x12"

4.4 DETENTION

Flows within the Onsite Basins will be collected and routed to two detention vault facilities at the southern margin of the development. The facilities were designed in compliance with the 2019 DOE Manual to model hydrologic conditions and detention in a continuous runoff model (WWHM2012) where the following evaluation parameters are employed:

"Flow duration is computed by counting the number of flow values that exceed a specified flow level. The specified flow levels used by WWHM in the flow duration analysis are listed below.

1. 50% of the 2-year predevelopment peak flow.
2. 100% of the 2-year predevelopment peak flow.
3. 100% of the 50-year predevelopment peak flow.

There are three criteria by which flow duration values are compared:

1. If the post development flow duration values exceed any of the predevelopment flow levels between 50% and 100% of the 2-year predevelopment peak flow values (100 Percent Threshold) then the flow duration requirement has not been met.
2. If the post development flow duration values exceed any of the predevelopment flow levels between 100% of the 2-year and 100% of the 50-year predevelopment peak flow values more than 10 percent of the time (110 Percent Threshold) then the flow duration requirement has not been met.
3. If more than 50 percent of the flow duration levels exceed the 100 percent threshold then the flow duration requirement has not been met.”

Detention Vault Facilities

Stormwater runoff associated with Onsite Basins 1 and 2 will be collected via series of open grate inlets and closed pipe and routed to either detention vault facility A or B, respectively, at the southern margin of the site. Sizing summaries for the detention vaults as modeled in WWHM2012 are provided below. Detailed WWHM sizing reports are provided in Appendix 4.

Detention Vault A:

Modeled Dimensions (Internal):	47.3' x 152'
Modeled Bottom Area (Internal):	7,190 sf
Riser Height:	16'
Modeled Live Storage:	115,034 cf
Begin Live Storage:	266.0'
Top of Riser Elevation:	282.0'

Detention Vault B:

Modeled Dimensions (Internal):	47.3' x 52'
Modeled Bottom Area (Internal):	2,460 sf
Riser Height:	6'
Modeled Volume:	14,758 cf
Begin Live Storage:	260.0'
Top of Riser Elevation:	266.0'

The following tables provides a summary of flow rates and water surface elevations in the detention vault systems during various storm events:

Table 4.4.1– Detention Vault A: Flow Rates and Water Surface Elevation by Storm Event

Storm Event	Predeveloped Rate (cfs)	Unmitigated Rate (cfs)	Mitigated Rates (cfs)	Water Surface Elevation
2-Year	<i>0.2592</i>	<i>2.3335</i>	<i>0.3038</i>	<i>276.00</i>
10-Year	<i>0.5422</i>	<i>3.7953</i>	<i>0.4777</i>	<i>277.38</i>
50-Year	<i>0.8846</i>	<i>5.3411</i>	<i>0.6622</i>	<i>280.30</i>

Table 4.4.2– Detention Vault B: Flow Rates and Water Surface Elevation by Storm Event

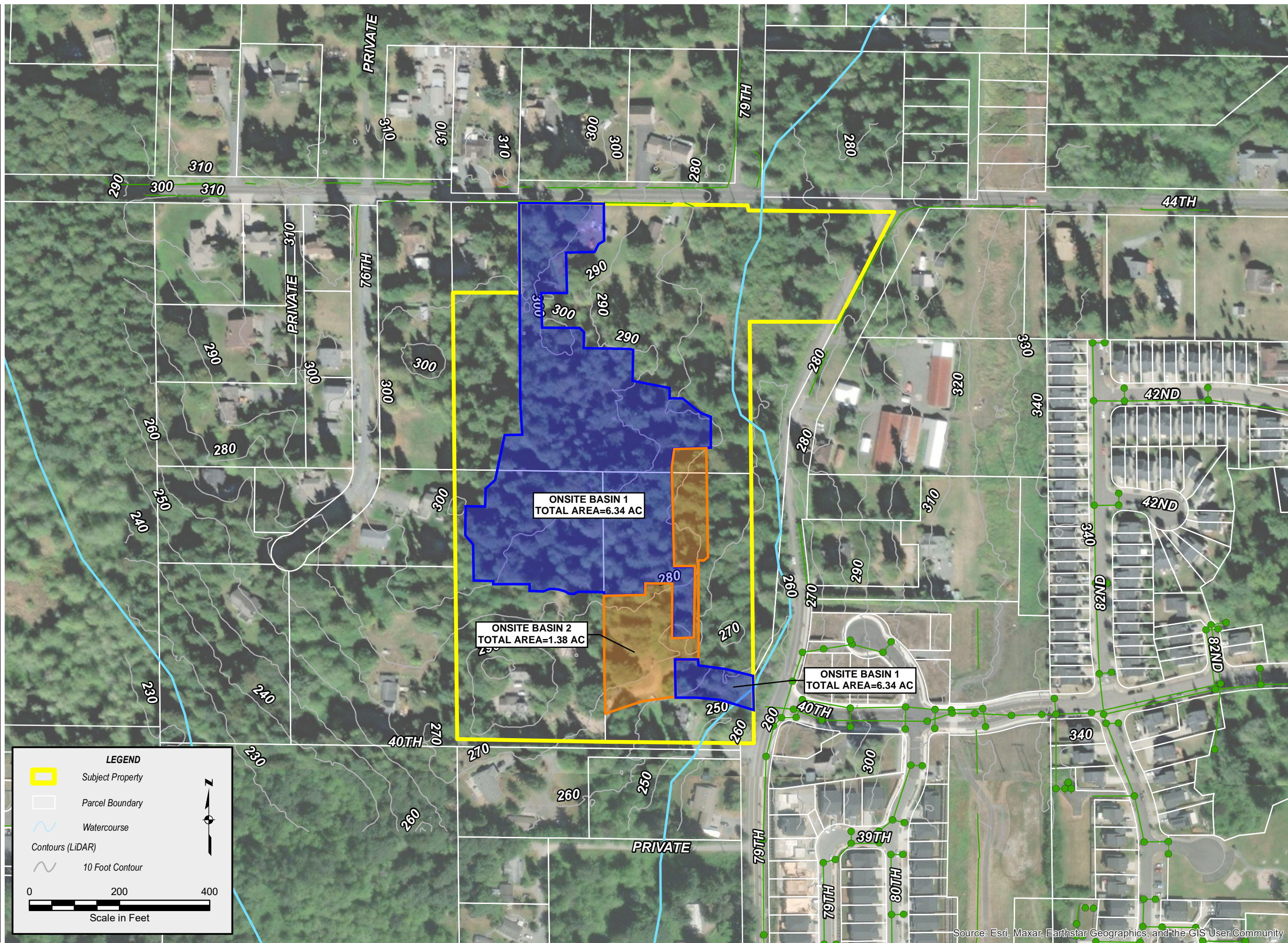
Storm Event	Predeveloped Rate (cfs)	Unmitigated Rate (cfs)	Mitigated Rates (cfs)	Water Surface Elevation
2-Year	<i>0.0727</i>	<i>0.5390</i>	<i>0.0421</i>	<i>263.83</i>
10-Year	<i>0.1574</i>	<i>0.8800</i>	<i>0.0745</i>	<i>265.82</i>
50-Year	<i>0.2708</i>	<i>1.2417</i>	<i>0.1150</i>	<i>266.01</i>

4.5 LOW IMPACT DESIGN FEASIBILITY

The project design has accounted for Low Impact Design as much as is feasible, given site conditions. Section 1-2.5.5 Minimum Requirement #5: On-site Stormwater Management and Section 5-5.3.1 On-site Stormwater Management BMPS from the 2019 DOE was applied to the site to determine LID BMP feasibility. This section of the 2019 DOE Manual directs projects triggering minimum requirements #1-9 to List #2 in section 1-2.5.5 as feasible. BMP T5.13 will be used as a part of List #2. Please see the Geotechnical Report, referenced in Section 7 for further discussion of LID infiltration feasibility. A summary of the BMPs as outlined in the LID List #2 Matrix in Appendix C. **BMP T5.13 Post-Construction Soil Quality and Depth:** BMP will be applied to all non-impervious disturbed surfaces. Refer to Appendix 4.0 for the Soil Management Plan Summary Form.

Appendix 4: Detention and Water Quality Analysis Data

1. Figure 5.0 – Predeveloped Hydrology Map
2. Figure 6.0 – Developed Hydrology Map
3. Detention Vault A WWHM Output
4. Detention Vault B WWHM Output
5. Oldcastle Perfilter Details
6. LID List #2 Matrix



LEGEND

- Subject Property
- Parcel Boundary
- Watercourse
- Contours (LiDAR)
- 10 Foot Contour

0 200 400
Scale in Feet

N
↑

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

HORIZON VIEW HOLDINGS, INC.

**CREEKSIDE
PREDEVELOPED HYDROLOGY MAP**

NAD 1983 HARN
STATEPLANE WASHINGTON
NORTH FIPS 4601 FEET

REVISION:
JOB NUMBER: C22-173
DRAWING NAME: C22-173-2.0
DESIGNER: TABOTT
DRAWING BY: CDANBY
DATE: 2/14/2023
SCALE: AS SHOWN
JURISDICTION: SNO. COUNTY

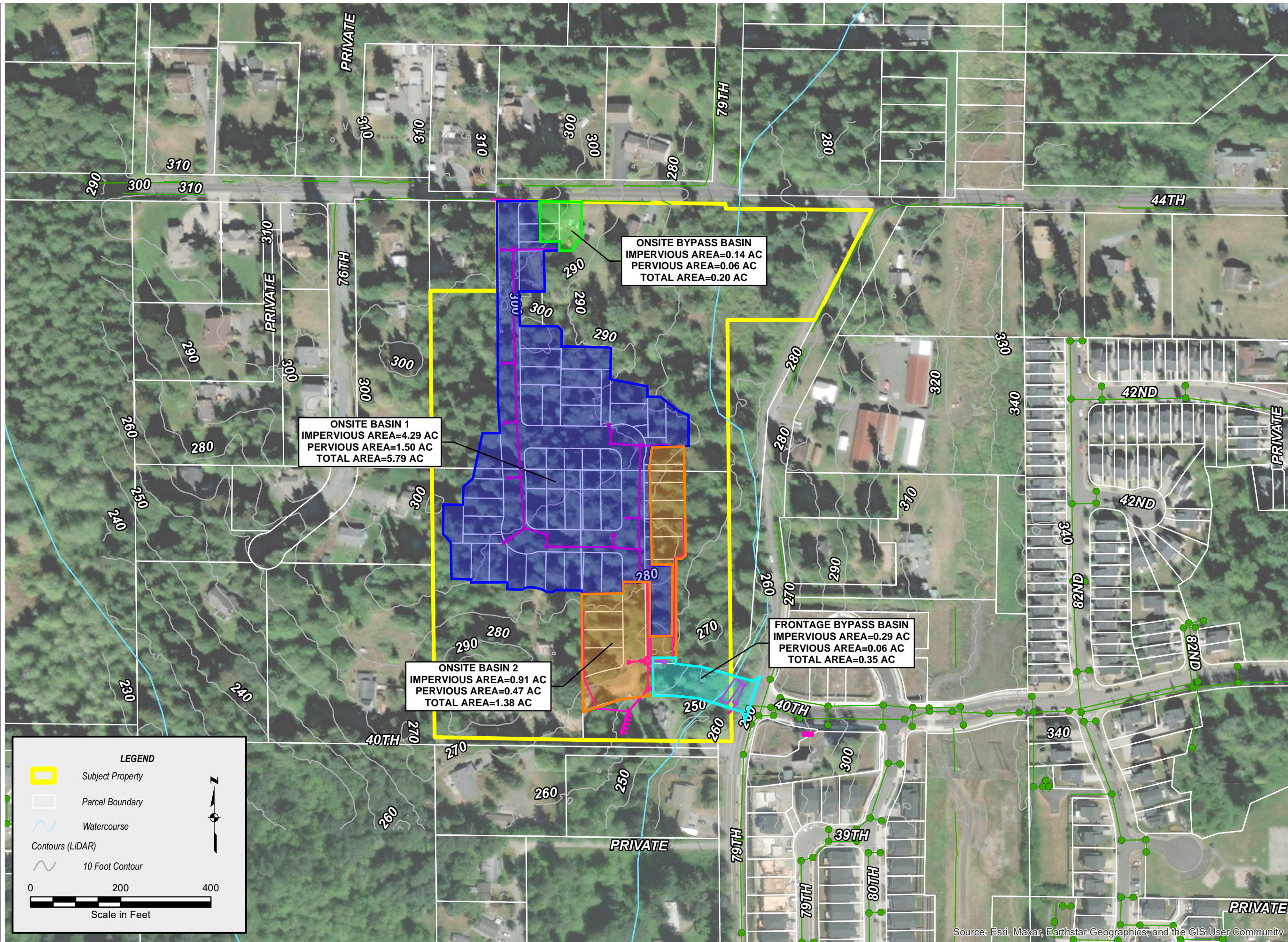
**FIGURE:
4.0**

LDC

Surveying
Engineering
Planning

Kent
1851 Central Pl S, #101
Woodinville, WA 98072
T: 425.386.1869 www.LDCcorp.com F: 425.482.2893

SOURCE AGENCY	DESCRIPTION
SNOHOMISH COUNTY GIS	PARCEL BOUNDARY
SNOHOMISH COUNTY GIS	CONTOURS GENERATED FROM BARE EARTH LIDAR (SNOHOMISH COUNTY). THIS DATA HAS A STATED VERTICAL ACCURACY OF APPROXIMATELY 1 FOOT.



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

HORIZON VIEW HOLDINGS, INC.

**CREEKSIDE
 DEVELOPED HYDROLOGY MAP**

NAD 1983 HARN
 STATEPLANE WASHINGTON
 NORTH FIPS 4601 FEET

REVISION:
 JOB NUMBER: C22-173
 DRAWING NAME: C22-173-2.0
 DESIGNER: TABOTT
 DRAWING BY: CDANBY
 DATE: 2/14/2023
 SCALE: AS SHOWN
 JURISDICTION: SNO. COUNTY

**FIGURE:
 5.0**

LDC

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SOURCE INFORMATION	
SOURCE AGENCY	DESCRIPTION
SNOHOMISH COUNTY GIS	PARCEL BOUNDARY
SNOHOMISH COUNTY GIS	CONTOURS GENERATED FROM BARE EARTH LIDAR (SNOHOMISH COUNTY). THIS DATA HAS A STATED VERTICAL ACCURACY OF APPROXIMATELY 1 FOOT.

**WWHM2012
PROJECT REPORT**

Project Name: Creekside Vault
Site Name:
Site Address:
City :
Report Date: 3/2/2023
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.20
Version Date: 2021/08/18
Version : 4.2.18

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Onsite Basin 1
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Forest, Mod	4.84
C, Forest, Steep	1.5
Pervious Total	6.34
<u>Impervious Land Use</u>	<u>acre</u>
Impervious Total	0
Basin Total	6.34

Element Flows To:

Surface	Interflow	Groundwater
----------------	------------------	--------------------

MITIGATED LAND USE

Name : Onsite Basin 1
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Pasture, Flat	1.5
Pervious Total	1.5
<u>Impervious Land Use</u>	<u>acre</u>
ROADS FLAT	1.25
ROOF TOPS FLAT	2.05
DRIVEWAYS FLAT	0.43
SIDEWALKS FLAT	0.56
Impervious Total	4.29
Basin Total	5.79

Element Flows To:		
Surface	Interflow	Groundwater
Vault A	Vault A	

Name : Vault A
Width : 156 ft.
Length : 46 ft.
Depth: 17 ft.
Discharge Structure
Riser Height: 16 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 1.21875 in. **Elevation**: 0 ft.
Orifice 2 Diameter: 1.71875 in. **Elevation**: 7.2 ft.
Orifice 3 Diameter: 2 in. **Elevation**: 10 ft.

Element Flows To:	
Outlet 1	Outlet 2

Vault Hydraulic Table				
<u>Stage(feet)</u>	<u>Area(ac.)</u>	<u>Volume(ac-ft.)</u>	<u>Discharge(cfs)</u>	<u>Infilt(cfs)</u>
0.0000	0.164	0.000	0.000	0.000
0.1889	0.164	0.031	0.017	0.000
0.3778	0.164	0.062	0.024	0.000
0.5667	0.164	0.093	0.030	0.000
0.7556	0.164	0.124	0.035	0.000
0.9444	0.164	0.155	0.039	0.000
1.1333	0.164	0.186	0.042	0.000
1.3222	0.164	0.217	0.046	0.000
1.5111	0.164	0.248	0.049	0.000
1.7000	0.164	0.280	0.052	0.000
1.8889	0.164	0.311	0.055	0.000
2.0778	0.164	0.342	0.058	0.000

2.2667	0.164	0.373	0.060	0.000
2.4556	0.164	0.404	0.063	0.000
2.6444	0.164	0.435	0.065	0.000
2.8333	0.164	0.466	0.067	0.000
3.0222	0.164	0.497	0.070	0.000
3.2111	0.164	0.529	0.072	0.000
3.4000	0.164	0.560	0.074	0.000
3.5889	0.164	0.591	0.076	0.000
3.7778	0.164	0.622	0.078	0.000
3.9667	0.164	0.653	0.080	0.000
4.1556	0.164	0.684	0.082	0.000
4.3444	0.164	0.715	0.084	0.000
4.5333	0.164	0.746	0.085	0.000
4.7222	0.164	0.777	0.087	0.000
4.9111	0.164	0.809	0.089	0.000
5.1000	0.164	0.840	0.091	0.000
5.2889	0.164	0.871	0.092	0.000
5.4778	0.164	0.902	0.094	0.000
5.6667	0.164	0.933	0.096	0.000
5.8556	0.164	0.964	0.097	0.000
6.0444	0.164	0.995	0.099	0.000
6.2333	0.164	1.026	0.100	0.000
6.4222	0.164	1.058	0.102	0.000
6.6111	0.164	1.089	0.103	0.000
6.8000	0.164	1.120	0.105	0.000
6.9889	0.164	1.151	0.106	0.000
7.1778	0.164	1.182	0.108	0.000
7.3667	0.164	1.213	0.142	0.000
7.5556	0.164	1.244	0.158	0.000
7.7444	0.164	1.275	0.171	0.000
7.9333	0.164	1.306	0.182	0.000
8.1222	0.164	1.338	0.191	0.000
8.3111	0.164	1.369	0.200	0.000
8.5000	0.164	1.400	0.208	0.000
8.6889	0.164	1.431	0.216	0.000
8.8778	0.164	1.462	0.223	0.000
9.0667	0.164	1.493	0.230	0.000
9.2556	0.164	1.524	0.237	0.000
9.4444	0.164	1.555	0.244	0.000
9.6333	0.164	1.587	0.250	0.000
9.8222	0.164	1.618	0.256	0.000
10.011	0.164	1.649	0.273	0.000
10.200	0.164	1.680	0.316	0.000
10.389	0.164	1.711	0.340	0.000
10.578	0.164	1.742	0.360	0.000
10.767	0.164	1.773	0.378	0.000
10.956	0.164	1.804	0.394	0.000
11.144	0.164	1.835	0.409	0.000
11.333	0.164	1.867	0.424	0.000
11.522	0.164	1.898	0.437	0.000
11.711	0.164	1.929	0.450	0.000
11.900	0.164	1.960	0.462	0.000
12.089	0.164	1.991	0.474	0.000
12.278	0.164	2.022	0.485	0.000
12.467	0.164	2.053	0.496	0.000
12.656	0.164	2.084	0.507	0.000
12.844	0.164	2.116	0.518	0.000

13.033	0.164	2.147	0.528	0.000
13.222	0.164	2.178	0.538	0.000
13.411	0.164	2.209	0.547	0.000
13.600	0.164	2.240	0.557	0.000
13.789	0.164	2.271	0.566	0.000
13.978	0.164	2.302	0.575	0.000
14.167	0.164	2.333	0.584	0.000
14.356	0.164	2.364	0.593	0.000
14.544	0.164	2.396	0.602	0.000
14.733	0.164	2.427	0.610	0.000
14.922	0.164	2.458	0.619	0.000
15.111	0.164	2.489	0.627	0.000
15.300	0.164	2.520	0.635	0.000
15.489	0.164	2.551	0.643	0.000
15.678	0.164	2.582	0.651	0.000
15.867	0.164	2.613	0.659	0.000
16.056	0.164	2.645	0.875	0.000
16.244	0.164	2.676	2.552	0.000
16.433	0.164	2.707	4.671	0.000
16.622	0.164	2.738	6.221	0.000
16.811	0.164	2.769	7.079	0.000
17.000	0.164	2.800	7.791	0.000
17.189	0.164	2.831	8.438	0.000
17.378	0.000	0.000	9.036	0.000

Name : Onsite Bypass

Bypass: Yes

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Pasture, Flat	.06
Pervious Total	0.06
<u>Impervious Land Use</u>	<u>acre</u>
ROOF TOPS FLAT	0.12
DRIVEWAYS FLAT	0.02
Impervious Total	0.14
Basin Total	0.2

Element Flows To:

Surface	Interflow	Groundwater
----------------	------------------	--------------------

Name : Frontage Bypass

Bypass: Yes

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Pasture, Mod	.06
 Pervious Total	 0.06
<u>Impervious Land Use</u>	<u>acre</u>
ROADS FLAT	0.13
ROADS MOD	0.1
SIDEWALKS FLAT	0.06
 Impervious Total	 0.29
 Basin Total	 0.35

Element Flows To:		
Surface	Interflow	Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
 Total Pervious Area:6.34
 Total Impervious Area:0

Mitigated Landuse Totals for POC #1
 Total Pervious Area:1.62
 Total Impervious Area:4.72

Flow Frequency Return Periods for Predeveloped. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.25919
5 year	0.416531
10 year	0.542194
25 year	0.726982
50 year	0.88456
100 year	1.0601

Flow Frequency Return Periods for Mitigated. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.303905
5 year	0.404113
10 year	0.477896
25 year	0.579935

50 year 0.6626
100 year 0.751186

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

<u>Year</u>	<u>Predeveloped</u>	<u>Mitigated</u>
1949	0.282	0.313
1950	0.300	0.333
1951	0.239	0.327
1952	0.204	0.276
1953	0.168	0.326
1954	1.000	0.436
1955	0.313	0.322
1956	0.268	0.279
1957	0.368	0.304
1958	0.516	0.601
1959	0.244	0.260
1960	0.248	0.267
1961	0.701	0.763
1962	0.252	0.310
1963	0.421	0.356
1964	0.319	0.209
1965	0.198	0.234
1966	0.124	0.239
1967	0.249	0.508
1968	0.305	0.311
1969	0.914	0.575
1970	0.168	0.251
1971	0.311	0.304
1972	0.201	0.408
1973	0.188	0.318
1974	0.515	0.380
1975	0.208	0.311
1976	0.200	0.263
1977	0.148	0.243
1978	0.177	0.218
1979	0.560	0.377
1980	0.263	0.252
1981	0.173	0.232
1982	0.229	0.249
1983	0.460	0.312
1984	0.224	0.300
1985	0.303	0.359
1986	0.680	0.565
1987	0.304	0.357
1988	0.162	0.269
1989	0.207	0.278
1990	0.211	0.234
1991	0.221	0.253
1992	0.170	0.265
1993	0.169	0.228
1994	0.155	0.231
1995	0.224	0.239
1996	0.440	0.309
1997	0.840	0.699
1998	0.146	0.351

1999	0.183	0.196
2000	0.159	0.545
2001	0.058	0.217
2002	0.209	0.191
2003	0.164	0.248
2004	0.273	0.486
2005	0.194	0.228
2006	0.637	0.366
2007	0.483	0.337
2008	0.580	0.510
2009	0.170	0.271

Stream Protection Duration

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	1.0000	0.7634
2	0.9139	0.6993
3	0.8398	0.6014
4	0.7008	0.5755
5	0.6803	0.5651
6	0.6368	0.5449
7	0.5803	0.5103
8	0.5599	0.5080
9	0.5158	0.4863
10	0.5154	0.4365
11	0.4825	0.4085
12	0.4605	0.3799
13	0.4399	0.3769
14	0.4209	0.3658
15	0.3681	0.3595
16	0.3192	0.3568
17	0.3129	0.3561
18	0.3113	0.3514
19	0.3053	0.3367
20	0.3044	0.3330
21	0.3035	0.3270
22	0.2995	0.3256
23	0.2820	0.3216
24	0.2734	0.3177
25	0.2683	0.3126
26	0.2628	0.3118
27	0.2520	0.3109
28	0.2490	0.3106
29	0.2477	0.3096
30	0.2445	0.3090
31	0.2390	0.3043
32	0.2293	0.3037
33	0.2244	0.3000
34	0.2239	0.2794
35	0.2207	0.2782
36	0.2113	0.2762
37	0.2089	0.2711
38	0.2075	0.2686
39	0.2074	0.2674
40	0.2038	0.2652
41	0.2006	0.2634

42	0.2000	0.2600
43	0.1976	0.2526
44	0.1942	0.2518
45	0.1883	0.2513
46	0.1829	0.2487
47	0.1768	0.2483
48	0.1733	0.2434
49	0.1703	0.2395
50	0.1703	0.2387
51	0.1687	0.2342
52	0.1680	0.2336
53	0.1678	0.2324
54	0.1641	0.2305
55	0.1625	0.2278
56	0.1592	0.2276
57	0.1550	0.2176
58	0.1483	0.2169
59	0.1457	0.2095
60	0.1241	0.1957
61	0.0578	0.1911

Stream Protection Duration

POC #1

The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1296	13257	10943	82	Pass
0.1372	10891	8799	80	Pass
0.1448	9129	7392	80	Pass
0.1525	7454	6126	82	Pass
0.1601	6134	5097	83	Pass
0.1677	5150	4269	82	Pass
0.1754	4329	3566	82	Pass
0.1830	3690	3084	83	Pass
0.1906	3039	2605	85	Pass
0.1982	2567	2205	85	Pass
0.2059	2248	1906	84	Pass
0.2135	1930	1625	84	Pass
0.2211	1646	1424	86	Pass
0.2287	1462	1272	87	Pass
0.2364	1280	1098	85	Pass
0.2440	1117	965	86	Pass
0.2516	1005	844	83	Pass
0.2592	914	747	81	Pass
0.2669	858	673	78	Pass
0.2745	784	620	79	Pass
0.2821	729	557	76	Pass
0.2897	682	526	77	Pass
0.2974	629	492	78	Pass
0.3050	594	466	78	Pass
0.3126	570	433	75	Pass
0.3202	549	403	73	Pass
0.3279	528	387	73	Pass
0.3355	498	370	74	Pass

0.3431	458	357	77	Pass
0.3507	433	346	79	Pass
0.3584	409	326	79	Pass
0.3660	390	313	80	Pass
0.3736	374	298	79	Pass
0.3813	351	284	80	Pass
0.3889	340	270	79	Pass
0.3965	330	255	77	Pass
0.4041	314	238	75	Pass
0.4118	305	223	73	Pass
0.4194	297	211	71	Pass
0.4270	289	198	68	Pass
0.4346	277	184	66	Pass
0.4423	262	169	64	Pass
0.4499	251	156	62	Pass
0.4575	239	147	61	Pass
0.4651	222	137	61	Pass
0.4728	212	129	60	Pass
0.4804	203	115	56	Pass
0.4880	184	108	58	Pass
0.4956	173	97	56	Pass
0.5033	165	90	54	Pass
0.5109	157	81	51	Pass
0.5185	149	74	49	Pass
0.5261	137	69	50	Pass
0.5338	132	62	46	Pass
0.5414	125	58	46	Pass
0.5490	108	52	48	Pass
0.5566	91	48	52	Pass
0.5643	76	46	60	Pass
0.5719	65	39	60	Pass
0.5795	52	33	63	Pass
0.5871	45	28	62	Pass
0.5948	41	26	63	Pass
0.6024	37	20	54	Pass
0.6100	33	16	48	Pass
0.6177	27	14	51	Pass
0.6253	22	12	54	Pass
0.6329	20	10	50	Pass
0.6405	15	9	60	Pass
0.6482	9	8	88	Pass
0.6558	8	5	62	Pass
0.6634	7	3	42	Pass
0.6710	6	3	50	Pass
0.6787	6	3	50	Pass
0.6863	5	3	60	Pass
0.6939	5	2	40	Pass
0.7015	4	1	25	Pass
0.7092	4	1	25	Pass
0.7168	4	1	25	Pass
0.7244	4	1	25	Pass
0.7320	4	1	25	Pass
0.7397	3	1	33	Pass
0.7473	3	1	33	Pass
0.7549	3	1	33	Pass
0.7625	3	1	33	Pass
0.7702	3	0	0	Pass

0.7778	3	0	0	Pass
0.7854	3	0	0	Pass
0.7930	3	0	0	Pass
0.8007	3	0	0	Pass
0.8083	3	0	0	Pass
0.8159	3	0	0	Pass
0.8236	3	0	0	Pass
0.8312	3	0	0	Pass
0.8388	3	0	0	Pass
0.8464	2	0	0	Pass
0.8541	2	0	0	Pass
0.8617	2	0	0	Pass
0.8693	2	0	0	Pass
0.8769	2	0	0	Pass
0.8846	2	0	0	Pass

Water Quality BMP Flow and Volume for POC #1

On-line facility volume: 0.1844 acre-feet
On-line facility target flow: 0.0993 cfs.
Adjusted for 15 min: 0.0993 cfs.
Off-line facility target flow: 0.0636 cfs.
Adjusted for 15 min: 0.0636 cfs.

LID Report

LID Technique	Used for	Total Volume	Volume	Infiltration	Cumulative
Percent	Water Quality	Percent	Through	Volume	Volume
Volume	Treatment?	Needs	Facility	(ac-ft.)	Infiltration
Infiltrated	Water Quality	Treatment	(ac-ft)		Credit
	Treated	(ac-ft)	(ac-ft)		
Vault A POC	N	859.29			N
0.00					
Total Volume Infiltrated		859.29	0.00	0.00	0.00
0.00	0%	No Treat.			Credit
Compliance with LID Standard 8					
Duration Analysis Result = Passed					

PerlnD and Implnd Changes

No changes have been made.

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**WWHM2012
PROJECT REPORT**

Project Name: Creekside vault B PRD
Site Name:
Site Address:
City :
Report Date: 3/2/2023
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.20
Version Date: 2021/08/18
Version : 4.2.18

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Onsite Basin 2
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Forest, Steep	1.38

Pervious Total	1.38
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<u>Impervious Land Use</u>	<u>acre</u>
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Impervious Total	0
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Basin Total	1.38
-------------	------

Element Flows To:

Surface	Interflow	Groundwater
---------	-----------	-------------

MITIGATED LAND USE

Name : Onsite Basin 2
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Pasture, Mod	.47
Pervious Total	0.47
<u>Impervious Land Use</u>	<u>acre</u>
ROADS MOD	0.28
ROOF TOPS FLAT	0.49
DRIVEWAYS FLAT	0.04
SIDEWALKS MOD	0.1
Impervious Total	0.91
Basin Total	1.38

Element Flows To:

Surface	Interflow	Groundwater
Vault B	Vault B	

Name : Vault B
Width : 47.3 ft.
Length : 52 ft.
Depth: 7 ft.
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 0.96875 in. Elevation: 0 ft.
Orifice 2 Diameter: 1.5 in. Elevation: 3.5 ft.

Element Flows To:

Outlet 1	Outlet 2
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Vault Hydraulic Table

<u>Stage(feet)</u>	<u>Area(ac.)</u>	<u>Volume(ac-ft.)</u>	<u>Discharge(cfs)</u>	<u>Infilt(cfs)</u>
0.0000	0.056	0.000	0.000	0.000
0.0778	0.056	0.004	0.007	0.000
0.1556	0.056	0.008	0.010	0.000
0.2333	0.056	0.013	0.012	0.000
0.3111	0.056	0.017	0.014	0.000
0.3889	0.056	0.022	0.015	0.000
0.4667	0.056	0.026	0.017	0.000
0.5444	0.056	0.030	0.018	0.000
0.6222	0.056	0.035	0.020	0.000
0.7000	0.056	0.039	0.021	0.000
0.7778	0.056	0.043	0.022	0.000
0.8556	0.056	0.048	0.023	0.000
0.9333	0.056	0.052	0.024	0.000
1.0111	0.056	0.057	0.025	0.000

1.0889	0.056	0.061	0.026	0.000
1.1667	0.056	0.065	0.027	0.000
1.2444	0.056	0.070	0.028	0.000
1.3222	0.056	0.074	0.029	0.000
1.4000	0.056	0.079	0.030	0.000
1.4778	0.056	0.083	0.031	0.000
1.5556	0.056	0.087	0.031	0.000
1.6333	0.056	0.092	0.032	0.000
1.7111	0.056	0.096	0.033	0.000
1.7889	0.056	0.101	0.034	0.000
1.8667	0.056	0.105	0.034	0.000
1.9444	0.056	0.109	0.035	0.000
2.0222	0.056	0.114	0.036	0.000
2.1000	0.056	0.118	0.036	0.000
2.1778	0.056	0.123	0.037	0.000
2.2556	0.056	0.127	0.038	0.000
2.3333	0.056	0.131	0.038	0.000
2.4111	0.056	0.136	0.039	0.000
2.4889	0.056	0.140	0.040	0.000
2.5667	0.056	0.144	0.040	0.000
2.6444	0.056	0.149	0.041	0.000
2.7222	0.056	0.153	0.042	0.000
2.8000	0.056	0.158	0.042	0.000
2.8778	0.056	0.162	0.043	0.000
2.9556	0.056	0.166	0.043	0.000
3.0333	0.056	0.171	0.044	0.000
3.1111	0.056	0.175	0.044	0.000
3.1889	0.056	0.180	0.045	0.000
3.2667	0.056	0.184	0.046	0.000
3.3444	0.056	0.188	0.046	0.000
3.4222	0.056	0.193	0.047	0.000
3.5000	0.056	0.197	0.047	0.000
3.5778	0.056	0.202	0.065	0.000
3.6556	0.056	0.206	0.072	0.000
3.7333	0.056	0.210	0.078	0.000
3.8111	0.056	0.215	0.083	0.000
3.8889	0.056	0.219	0.088	0.000
3.9667	0.056	0.224	0.092	0.000
4.0444	0.056	0.228	0.096	0.000
4.1222	0.056	0.232	0.099	0.000
4.2000	0.056	0.237	0.103	0.000
4.2778	0.056	0.241	0.106	0.000
4.3556	0.056	0.245	0.109	0.000
4.4333	0.056	0.250	0.112	0.000
4.5111	0.056	0.254	0.115	0.000
4.5889	0.056	0.259	0.118	0.000
4.6667	0.056	0.263	0.121	0.000
4.7444	0.056	0.267	0.123	0.000
4.8222	0.056	0.272	0.126	0.000
4.9000	0.056	0.276	0.128	0.000
4.9778	0.056	0.281	0.131	0.000
5.0556	0.056	0.285	0.133	0.000
5.1333	0.056	0.289	0.135	0.000
5.2111	0.056	0.294	0.138	0.000
5.2889	0.056	0.298	0.140	0.000
5.3667	0.056	0.303	0.142	0.000
5.4444	0.056	0.307	0.144	0.000

5.5222	0.056	0.311	0.146	0.000
5.6000	0.056	0.316	0.148	0.000
5.6778	0.056	0.320	0.150	0.000
5.7556	0.056	0.325	0.152	0.000
5.8333	0.056	0.329	0.154	0.000
5.9111	0.056	0.333	0.156	0.000
5.9889	0.056	0.338	0.158	0.000
6.0667	0.056	0.342	0.342	0.000
6.1444	0.056	0.346	0.735	0.000
6.2222	0.056	0.351	1.210	0.000
6.3000	0.056	0.355	1.675	0.000
6.3778	0.056	0.360	2.047	0.000
6.4556	0.056	0.364	2.283	0.000
6.5333	0.056	0.368	2.471	0.000
6.6111	0.056	0.373	2.635	0.000
6.6889	0.056	0.377	2.789	0.000
6.7667	0.056	0.382	2.934	0.000
6.8444	0.056	0.386	3.072	0.000
6.9222	0.056	0.390	3.204	0.000
7.0000	0.056	0.395	3.331	0.000
7.0778	0.056	0.399	3.453	0.000
7.1556	0.000	0.000	3.570	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1

Total Pervious Area:1.38

Total Impervious Area:0

Mitigated Landuse Totals for POC #1

Total Pervious Area:0.47

Total Impervious Area:0.91

Flow Frequency Return Periods for Predeveloped. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.072718
5 year	0.118642
10 year	0.157409
25 year	0.217306
50 year	0.270787
100 year	0.332694

Flow Frequency Return Periods for Mitigated. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.042108
5 year	0.060017
10 year	0.074509
25 year	0.096172

50 year 0.114991
100 year 0.136332

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

<u>Year</u>	<u>Predeveloped</u>	<u>Mitigated</u>
1949	0.078	0.038
1950	0.090	0.040
1951	0.062	0.037
1952	0.059	0.031
1953	0.054	0.033
1954	0.269	0.041
1955	0.091	0.043
1956	0.074	0.047
1957	0.100	0.047
1958	0.267	0.037
1959	0.066	0.041
1960	0.071	0.044
1961	0.319	0.042
1962	0.074	0.040
1963	0.121	0.036
1964	0.084	0.036
1965	0.052	0.041
1966	0.038	0.034
1967	0.075	0.038
1968	0.093	0.047
1969	0.231	0.036
1970	0.047	0.035
1971	0.084	0.043
1972	0.060	0.041
1973	0.050	0.038
1974	0.141	0.038
1975	0.064	0.035
1976	0.053	0.042
1977	0.047	0.037
1978	0.050	0.031
1979	0.142	0.044
1980	0.067	0.034
1981	0.050	0.037
1982	0.068	0.075
1983	0.121	0.038
1984	0.061	0.046
1985	0.083	0.045
1986	0.185	0.139
1987	0.081	0.095
1988	0.050	0.043
1989	0.063	0.028
1990	0.055	0.044
1991	0.060	0.044
1992	0.051	0.040
1993	0.051	0.035
1994	0.043	0.041
1995	0.060	0.047
1996	0.129	0.046
1997	0.226	0.243
1998	0.043	0.033

1999	0.049	0.041
2000	0.043	0.047
2001	0.019	0.029
2002	0.057	0.041
2003	0.045	0.038
2004	0.073	0.090
2005	0.055	0.041
2006	0.156	0.080
2007	0.127	0.040
2008	0.167	0.150
2009	0.052	0.039

Stream Protection Duration

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.3189	0.2433
2	0.2689	0.1496
3	0.2667	0.1392
4	0.2314	0.0951
5	0.2265	0.0901
6	0.1854	0.0805
7	0.1669	0.0755
8	0.1562	0.0475
9	0.1422	0.0474
10	0.1412	0.0473
11	0.1294	0.0471
12	0.1265	0.0467
13	0.1213	0.0464
14	0.1208	0.0462
15	0.0997	0.0447
16	0.0926	0.0441
17	0.0906	0.0437
18	0.0896	0.0436
19	0.0837	0.0436
20	0.0837	0.0434
21	0.0831	0.0429
22	0.0809	0.0427
23	0.0784	0.0420
24	0.0747	0.0416
25	0.0744	0.0415
26	0.0738	0.0415
27	0.0727	0.0412
28	0.0706	0.0410
29	0.0684	0.0409
30	0.0672	0.0409
31	0.0663	0.0407
32	0.0636	0.0405
33	0.0626	0.0399
34	0.0624	0.0397
35	0.0605	0.0396
36	0.0604	0.0396
37	0.0602	0.0387
38	0.0597	0.0384
39	0.0595	0.0384
40	0.0565	0.0383
41	0.0555	0.0381

42	0.0546	0.0379
43	0.0536	0.0378
44	0.0528	0.0374
45	0.0520	0.0374
46	0.0517	0.0367
47	0.0510	0.0367
48	0.0505	0.0364
49	0.0505	0.0363
50	0.0503	0.0362
51	0.0502	0.0352
52	0.0497	0.0349
53	0.0492	0.0348
54	0.0473	0.0344
55	0.0469	0.0341
56	0.0446	0.0333
57	0.0435	0.0331
58	0.0430	0.0310
59	0.0429	0.0310
60	0.0380	0.0295
61	0.0193	0.0276

Stream Protection Duration

POC #1

The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0364	11193	10767	96	Pass
0.0387	9090	6536	71	Pass
0.0411	7386	4045	54	Pass
0.0435	5933	2550	42	Pass
0.0458	4825	1445	29	Pass
0.0482	3923	707	18	Pass
0.0506	3206	691	21	Pass
0.0529	2642	678	25	Pass
0.0553	2209	669	30	Pass
0.0577	1861	654	35	Pass
0.0600	1597	640	40	Pass
0.0624	1389	629	45	Pass
0.0648	1174	620	52	Pass
0.0671	1030	605	58	Pass
0.0695	897	591	65	Pass
0.0719	805	573	71	Pass
0.0742	718	545	75	Pass
0.0766	661	519	78	Pass
0.0790	608	497	81	Pass
0.0814	569	472	82	Pass
0.0837	526	457	86	Pass
0.0861	499	436	87	Pass
0.0885	472	413	87	Pass
0.0908	448	378	84	Pass
0.0932	430	357	83	Pass
0.0956	408	340	83	Pass
0.0979	379	331	87	Pass
0.1003	344	320	93	Pass

0.1027	329	310	94	Pass
0.1050	312	299	95	Pass
0.1074	300	287	95	Pass
0.1098	285	276	96	Pass
0.1121	275	265	96	Pass
0.1145	265	250	94	Pass
0.1169	255	238	93	Pass
0.1192	245	225	91	Pass
0.1216	236	211	89	Pass
0.1240	226	200	88	Pass
0.1263	213	185	86	Pass
0.1287	200	172	86	Pass
0.1311	192	162	84	Pass
0.1334	175	145	82	Pass
0.1358	166	132	79	Pass
0.1382	155	120	77	Pass
0.1405	145	108	74	Pass
0.1429	135	96	71	Pass
0.1453	122	69	56	Pass
0.1477	112	51	45	Pass
0.1500	98	32	32	Pass
0.1524	85	27	31	Pass
0.1548	77	20	25	Pass
0.1571	64	10	15	Pass
0.1595	55	7	12	Pass
0.1619	46	7	15	Pass
0.1642	32	7	21	Pass
0.1666	22	6	27	Pass
0.1690	18	6	33	Pass
0.1713	12	6	50	Pass
0.1737	11	6	54	Pass
0.1761	9	6	66	Pass
0.1784	9	6	66	Pass
0.1808	9	5	55	Pass
0.1832	9	5	55	Pass
0.1855	7	5	71	Pass
0.1879	7	4	57	Pass
0.1903	7	4	57	Pass
0.1926	7	4	57	Pass
0.1950	7	4	57	Pass
0.1974	7	4	57	Pass
0.1997	7	4	57	Pass
0.2021	6	4	66	Pass
0.2045	6	4	66	Pass
0.2069	6	3	50	Pass
0.2092	6	3	50	Pass
0.2116	6	3	50	Pass
0.2140	6	3	50	Pass
0.2163	6	3	50	Pass
0.2187	6	3	50	Pass
0.2211	6	2	33	Pass
0.2234	5	2	40	Pass
0.2258	5	2	40	Pass
0.2282	4	2	50	Pass
0.2305	4	2	50	Pass
0.2329	3	1	33	Pass
0.2353	3	1	33	Pass

0.2376	3	1	33	Pass
0.2400	3	1	33	Pass
0.2424	3	1	33	Pass
0.2447	3	0	0	Pass
0.2471	3	0	0	Pass
0.2495	3	0	0	Pass
0.2518	3	0	0	Pass
0.2542	3	0	0	Pass
0.2566	3	0	0	Pass
0.2589	3	0	0	Pass
0.2613	3	0	0	Pass
0.2637	3	0	0	Pass
0.2661	3	0	0	Pass
0.2684	2	0	0	Pass
0.2708	1	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.0614 acre-feet
On-line facility target flow: 0.0322 cfs.
Adjusted for 15 min: 0.0322 cfs.
Off-line facility target flow: 0.0204 cfs.
Adjusted for 15 min: 0.0204 cfs.

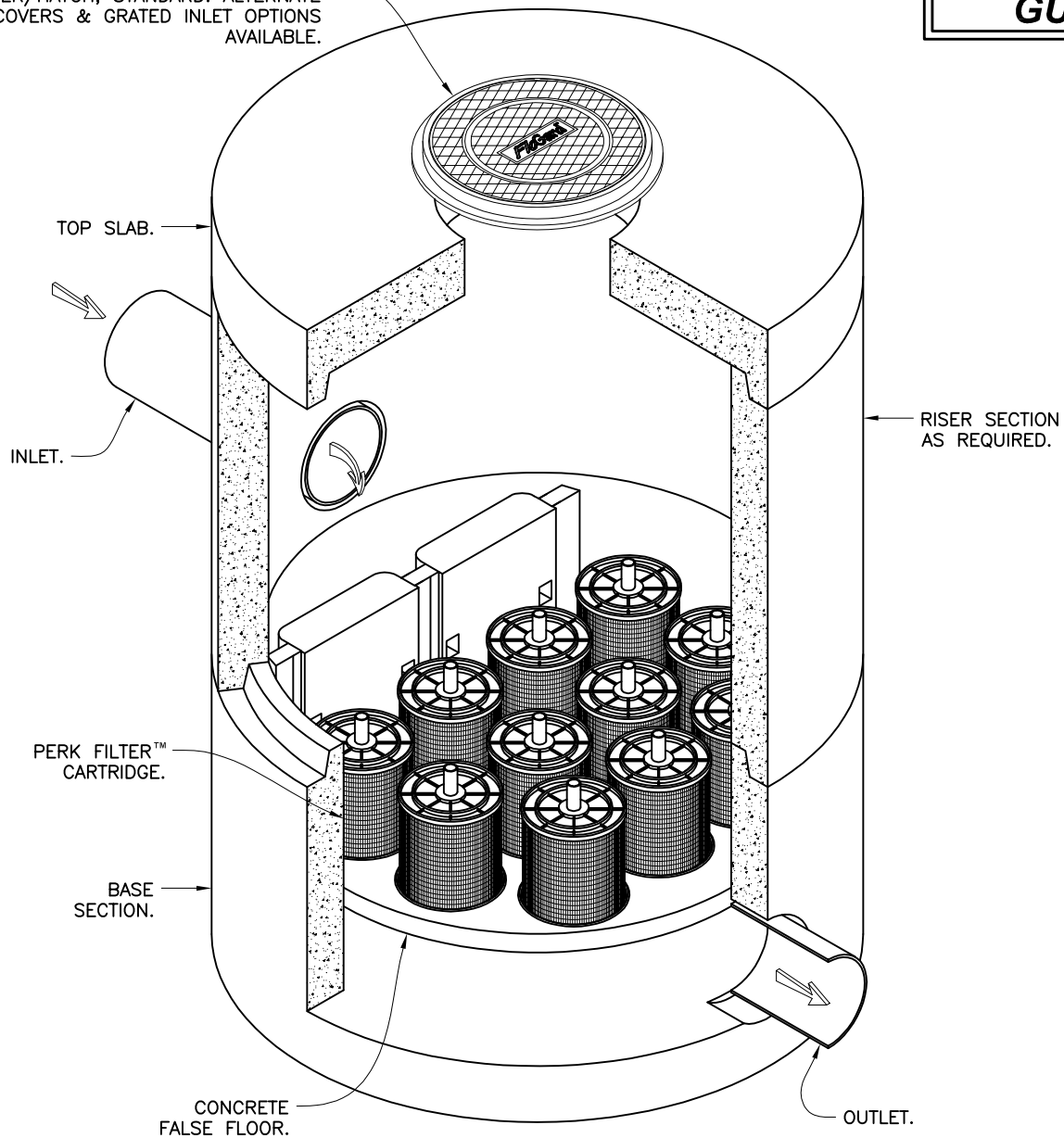
LID Report

LID Technique	Used for	Total Volume	Volume	Infiltration	Cumulative
Percent	Water Quality	Percent	Through	Volume	Volume
Volume	Water Quality	Treatment?	Facility	(ac-ft.)	Infiltration
Infiltrated	Treated	Treatment	(ac-ft)	(ac-ft)	Credit
Vault B POC	N		193.74		N 0.00
Total Volume Infiltrated			193.74	0.00	0.00
0.00	0%	No Treat.			Credit
Compliance with LID Standard 8					
Duration Analysis Result = Passed					

PerlnD and Implnd Changes
 No changes have been made.

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BOLTED & GASKETED ACCESS COVER/HATCH, STANDARD. ALTERNATE COVERS & GRATED INLET OPTIONS AVAILABLE.



Notes:

1. Precast concrete structure shall be manufactured in accordance with ASTM Designation C478.
2. Filter system shall be supplied with traffic rated (H20) bolted & gasketed Ø36" circular access covers with risers as required. Field poured concrete collar required, by others.
3. Inlet & outlet pipe(s) are to be Ø24.00" maximum. Inlet pipes must enter the structure in the inlet bay.
4. Inlet chamber shall be supplied with drain-down device designed to remove standing water between storm events.
5. Minimum separation between invert in & invert out is outlet pipe diameter plus 4.00".
6. For depths less than specified minimums contact Oldcastle® Stormwater Solutions for engineering assistance.

*** Treatment Flow Rates shown conform to Washington State GULD Specifications**



Media Filtration

Perk Filter™
 Ø96.00" Manhole
 Washington State GULD
 One to Eleven Cartridges / Stacks

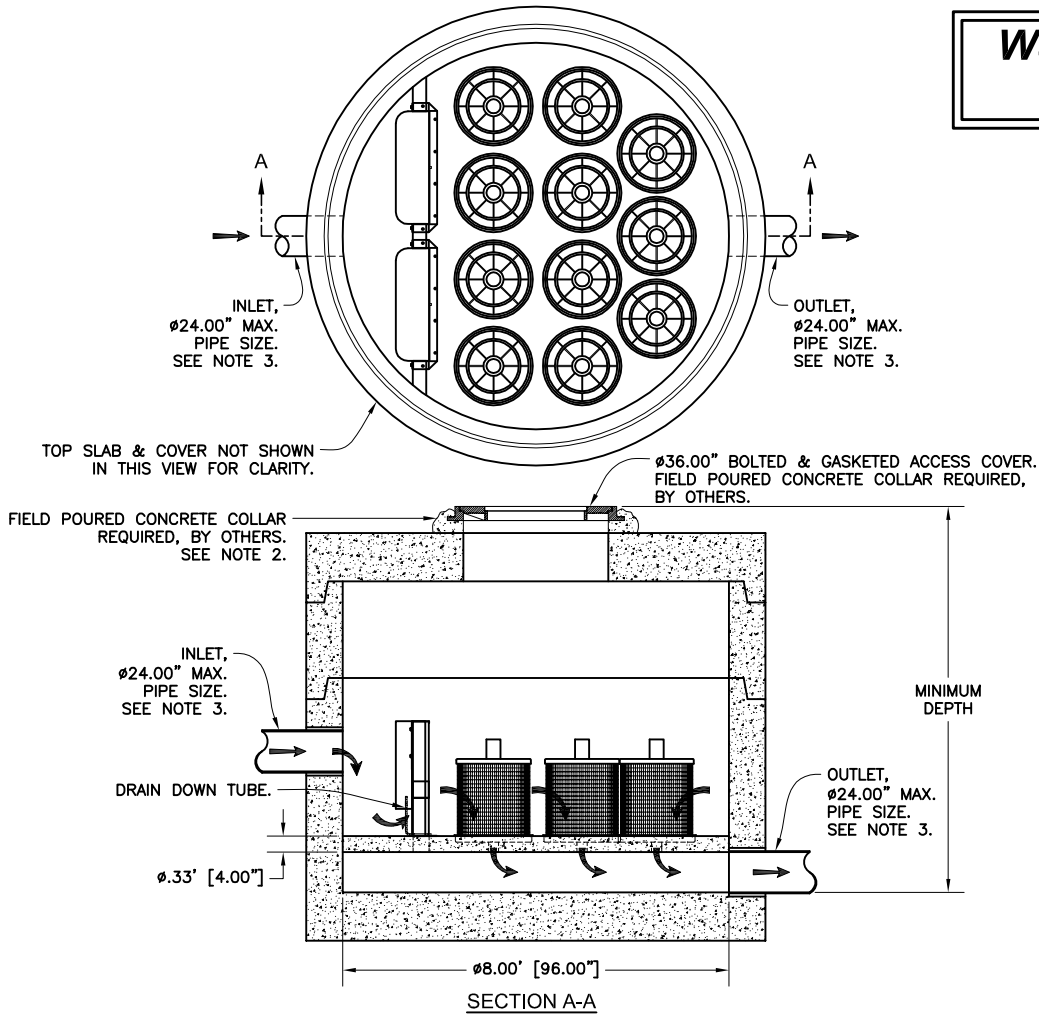


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DRAWING NO. PF-MH-96-WA	REV NR	ECO ECO-0132	DATE ISM 4/27/15	SHEET 1 OF 2
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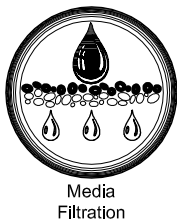


Minimum Depth

PIPE SIZE	Ø6.00"	Ø8.00"	Ø10.00"	Ø12.00"	Ø15.00"	Ø18.00"	Ø21.00"	Ø24.00"
CARTRIDGE TYPE	MINIMUM DEPTH RIM TO OUTLET	MINIMUM DEPTH RIM TO OUTLET	MINIMUM DEPTH RIM TO OUTLET	MINIMUM DEPTH RIM TO OUTLET	MINIMUM DEPTH RIM TO OUTLET	MINIMUM DEPTH RIM TO OUTLET	MINIMUM DEPTH RIM TO OUTLET	MINIMUM DEPTH RIM TO OUTLET
12"	4.00' [48.00"]	4.25' [51.00"]	4.25' [51.00"]	4.50' [54.00"]	5.00' [60.00"]	5.25' [63.00"]	5.50' [66.00"]	5.75' [69.00"]
18"	4.75' [57.00"]	5.00' [60.00"]	5.00' [60.00"]	5.25' [63.00"]	5.75' [69.00"]	6.00' [72.00"]	6.25' [75.00"]	6.50' [78.00"]
12" + 12"	5.75' [69.00"]	5.75' [69.00"]	6.25' [75.00"]	6.25' [75.00"]	6.50' [78.00"]	6.75' [81.00"]	7.00' [84.00"]	7.25' [87.00"]
12" + 18"	6.25' [75.00"]	6.25' [75.00"]	6.75' [81.00"]	6.75' [81.00"]	7.00' [84.00"]	7.25' [87.00"]	7.50' [90.00"]	7.75' [93.00"]

**Ø96.00" PERK FILTER MANHOLE
TREATMENT FLOW RATES, TOTAL FLOW CAPACITIES & MAXIMUM HEAD LOSS**

CARTRIDGE STACK QUANTITY	CARTRIDGE STACK CONFIGURATION							
	12"		18"		12" & 12"		12" & 18"	
	TREATMENT FLOW RATE (GPM / CFS)	TOTAL FLOW CAPACITY (CFS)	TREATMENT FLOW RATE (GPM / CFS)	TOTAL FLOW CAPACITY (CFS)	TREATMENT FLOW RATE (GPM / CFS)	TOTAL FLOW CAPACITY (CFS)	TREATMENT FLOW RATE (GPM / CFS)	TOTAL FLOW CAPACITY (CFS)
1	6.8 / 0.015	4.94	10.2 / 0.022	6.10	13.6 / 0.03	6.90	17 / 0.037	7.24
2	13.6 / 0.03	4.94	20.4 / 0.045	6.10	27.2 / 0.06	6.90	34 / 0.075	7.24
3	20.4 / 0.045	4.94	30.6 / 0.068	6.10	40.8 / 0.09	6.90	51 / 0.113	7.24
4	27.2 / 0.06	4.94	40.8 / 0.09	6.10	54.4 / 0.121	6.90	68 / 0.151	7.24
5	34 / 0.075	4.94	51 / 0.113	6.10	68 / 0.151	6.90	85 / 0.189	7.24
6	40.8 / 0.09	4.94	61.2 / 0.136	6.10	81.6 / 0.181	6.90	102 / 0.227	7.24
7	47.6 / 0.106	4.94	71.4 / 0.159	6.10	95.2 / 0.212	6.90	119 / 0.265	7.24
8	54.4 / 0.121	4.94	81.6 / 0.181	6.10	108.8 / 0.242	6.90	136 / 0.303	7.24
9	61.2 / 0.136	4.94	91.8 / 0.204	6.10	122.4 / 0.272	6.90	153 / 0.34	7.24
10	68 / 0.151	4.94	102 / 0.227	6.10	136 / 0.303	6.90	170 / .378	7.24
11	74.8 / 0.166	4.94	112.2 / 0.25	6.10	149.6 / 0.333	6.90	187 / 0.416	7.24
MAXIMUM HEAD LOSS	1.7 FEET		2.3 FEET		2.9 FEET		3.5 FEET	



Perk Filter™
 Ø96.00" Manhole
 Washington State GULD
 One to Eleven Cartridges / Stacks

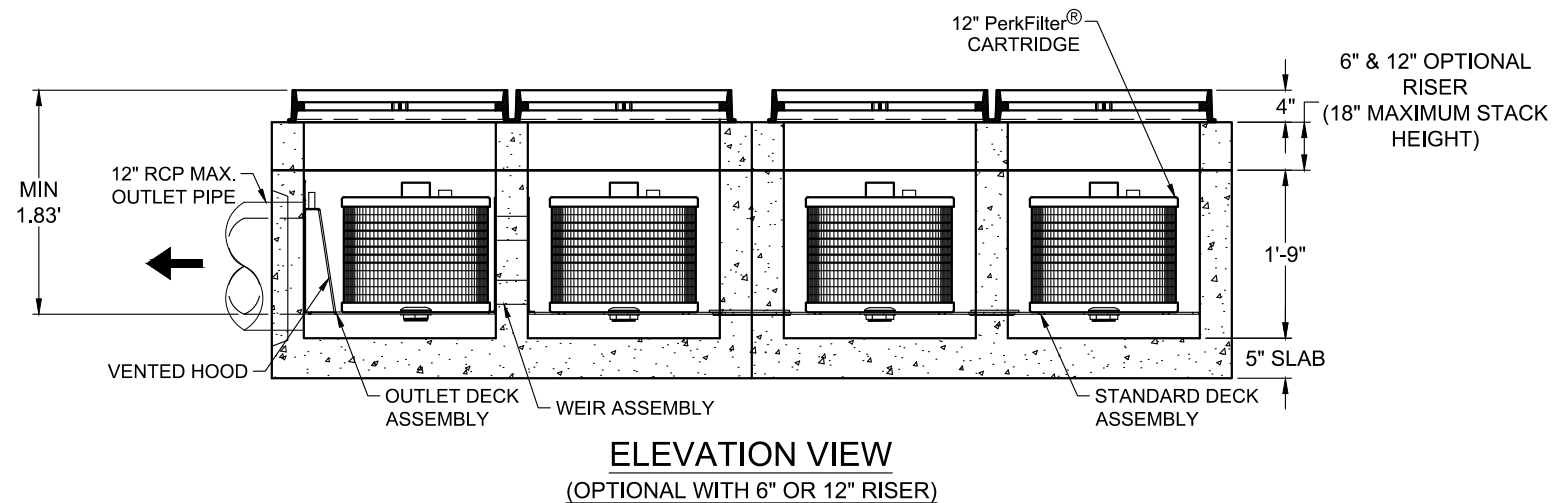
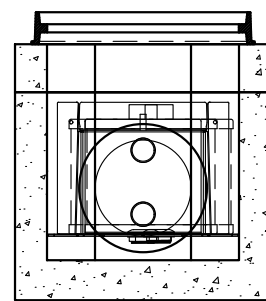
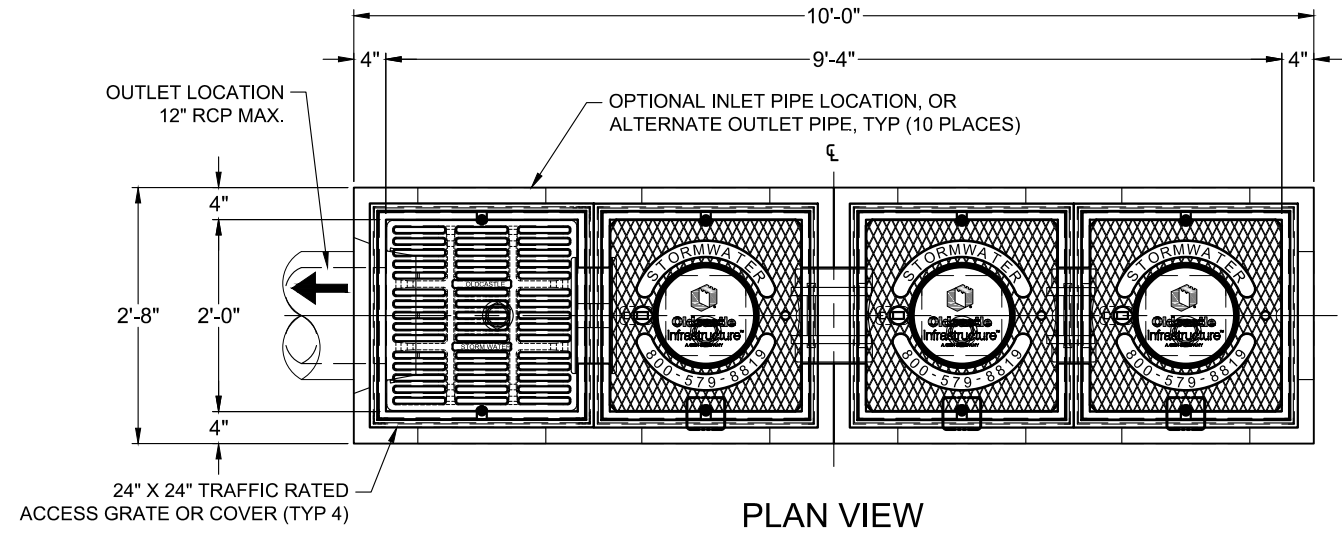
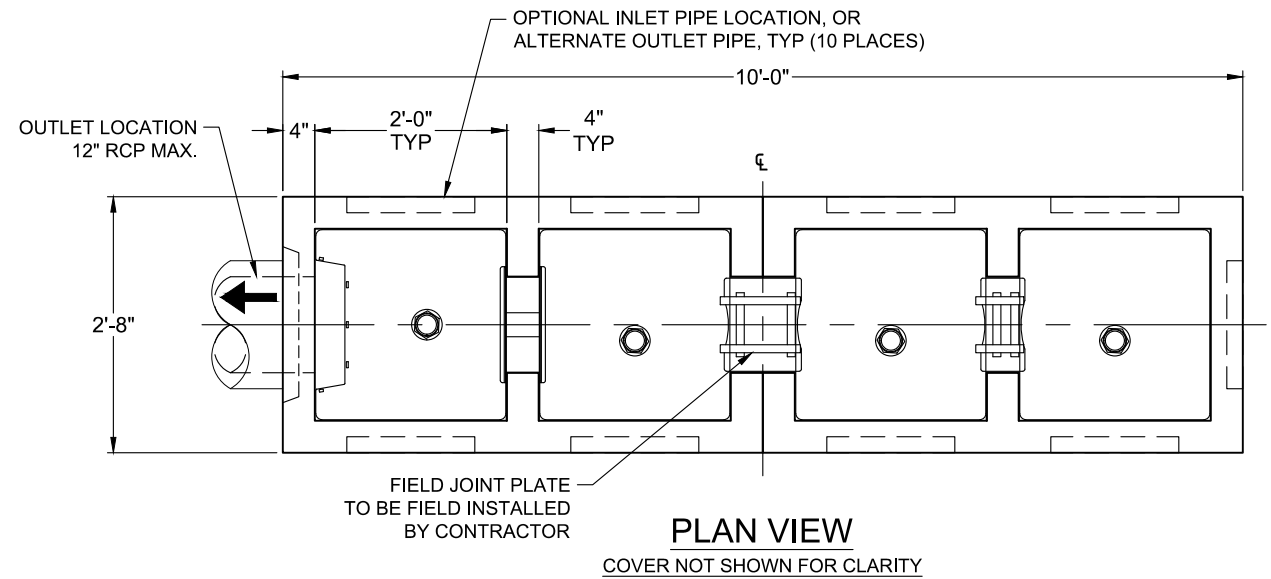


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DRAWING NO. PF-MH-96-WA	REV NR	ECO ECO-0132 ISM 4/27/15	DATE ISM 4/27/15	SHEET 2 OF 2
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SITE SPECIFIC DATA				
Structure ID	ID			
Treatment Flow Rate (cfs)	-			
Peak Flow Rate (cfs)	1.3 cfs			
Rim Elevation	X.XX'			
Pipe Data	Pipe Location	Pipe Size	Pipe Type	Invert Elevation
Outlet	XXX	XX"	XXX	X.XX'
Inlet	XXX	XX"	XXX	X.XX'
Notes: -				
PERFORMANCE SPECIFICATIONS				
Treatment Flow Capacities:*				
NJDEP 80% Removal, 75 micron	0.108 cfs			
WA Ecology GULD - Basic & Phosphorus	0.060 cfs			
*Contact Oldcastle for alternative treatment flow capacities.				



NOTES:

- DESIGN LOADINGS:
 - AASHTO HS-20-44 W/ IMPACT.
 - STANDARD DESIGN FILL: MAX TOP OF STRUCTURE.
 - ASSUMED WATER TABLE: BELOW STRUCTURE.
 - DRY LATERAL EARTH PRESSURE (EFP) = 45 PCF.
 - LATERAL LIVE LOAD SURCHARGE = 80 PSF (APPLIED TO 8' BELOW GRADE).
 - NO LATERAL SURCHARGE FROM ADJACENT BUILDINGS, WALLS, PIERS, OR FOUNDATIONS.
- CONCRETE 28 DAY COMPRESSIVE STRENGTH SHALL BE 5,000 PSI MINIMUM.
- STEEL REINFORCEMENT: REBAR, ASTM A-615 OR A-706, GRADE 60.
- CEMENT: ASTM C-150 SPECIFICATION.
- REQUIRED ALLOWABLE SOIL BEARING PRESSURE = 2,500 PSF. CONTRACTOR RESPONSIBLE TO ENSURE ADEQUATE BEARING SURFACE IS PROVIDED (I.E. COMPACTED AND LEVEL PER PROJECT SPECIFICATIONS).
- REFERENCE STANDARD:
 - ASTM C 890
 - ASTM C 913
 - ACI 318-14
- OUTLET HOLES WILL BE FACTORY CORED/CAST PER PLANS/CUSTOMER REQUIREMENTS. OUTLET LOCATIONS CAN BE CHANGED.
- MAXIMUM PICK WEIGHT (COMBINED WEIGHT OF BASE, CARTRIDGE & ACCESS COVER) = TBD.
- FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT OLDCASTLE INFRASTRUCTURE.

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PerkFilter® Concrete Catch Basin 12" Cartridge					
CUSTOMER					
PROJECT NAME					
DATE	MFG	DRAWN	ENGINEER	CHECKED	SALES ORDER
--/--/22	-	-	-	-	-
SHEET NAME				REVISION	SHEET
Specifier Drawing				-	-
PFCB-29-1x12				REV DATE	1 OF 1



Date: 3/1/2023
 LDC Project No: C22-173
 Project Name: Creekside

List #2 Summary Matrix				
BMP #	BMP Name	BMP Criteria	Feasible or Infeasible	Comment
Lawn and Landscaped Areas:				
T5.13	Post-Construction Soil Quality and Depth	Establish minimum soil quality and depth to provide increased stormwater and pollutant removal function.	Feasible	All disturbed landscape areas will be amended in accordance with BMP T5.13.
Roofs:				
T5.30	Full Dispersion	Development must protect at least 65% of the site in a forest or native condition, and a 100' vegetated flowpath must be provided for discharged flows.	Infeasible	The site does not meet the required 65% protected native vegetation since existing onsite wetlands do not count. Additionally, adequate flowpaths could not be achieved on the site due to spatial constraints and steep slopes present.
T5.10A	Downspout Full Infiltration Systems	If outwash soils are present, field testing must indicate a native soil saturated hydraulic conductivity greater than 0.30 in/hr, and at least 1' of vertical separation must be available between the facility and confining layer(s) or groundwater. Adequate setbacks from proposed structures must also be observed.	Infeasible	Limited infiltration systems are only feasible at the northwestern portion of the project site, which is located on the high side of the property. As a result, infiltration is not a recommended BMP. Geotechnical Evaluation prepared by Nelson Geotechnical Associates, Inc. dated 10/5/2022.
T7.30	Bioretention	Bioretention facilities must be oriented such that there is a safe overflow pathway to the municipal separate storm sewer system or private storm sewer system.	Infeasible	Limited infiltration systems are only feasible at the northwestern portion of the project site, which is located on the high side of the property. As a result, infiltration is not a recommended BMP. Geotechnical Evaluation prepared by Nelson Geotechnical Associates, Inc. dated 10/5/2022.
T5.10B	Downspout Dispersion Systems	A minimum 25' vegetated flowpath must be provided for dispersed flows.	Infeasible	Adequate flowpaths could not be achieved on the site due to spatial constraints and steep slopes present.
T5.10C	Perforated Stub-out Connections	Provide a length of perforated pipe within a gravel filled trench to accommodate infiltration, while observing setback criteria.	Infeasible	Limited infiltration systems are only feasible at the northwestern portion of the project site, which is located on the high side of the property. As a result, infiltration is not a recommended BMP. Geotechnical Evaluation prepared by Nelson Geotechnical Associates, Inc. dated 10/5/2022.
Other Hard Surfaces:				
T5.30	Full Dispersion	Development must protect at least 65% of the site in a forest or native condition, and a 100' vegetated flowpath must be provided for discharged flows.	Infeasible	The site does not meet the required 65% protected native vegetation since existing onsite wetlands do not count. Additionally, adequate flowpaths could not be achieved on the site due to spatial constraints and steep slopes present.
T5.15	Permeable Pavement	If outwash soils are present, field testing must indicate a native soil saturated hydraulic conductivity greater than 0.30 in/hr. Pavement slopes must not exceed 10 percent.	Infeasible	Limited infiltration systems are only feasible at the northwestern portion of the project site, which is located on the high side of the property. As a result, infiltration is not a recommended BMP. Geotechnical Evaluation prepared by Nelson Geotechnical Associates, Inc. dated 10/5/2022.
T5.14B	Bioretention	Bioretention facilities must be oriented such that there is a safe overflow pathway to the municipal separate storm sewer system or private storm sewer system.	Infeasible	Limited infiltration systems are only feasible at the northwestern portion of the project site, which is located on the high side of the property. As a result, infiltration is not a recommended BMP. Geotechnical Evaluation prepared by Nelson Geotechnical Associates, Inc. dated 10/5/2022.
T5.12	Sheet Flow Dispersion	Provide a "transition zone" and minimum 25' vegetated flowpath to attenuate flows from driveways/hard surfaces.	Infeasible	Adequate flowpaths could not be achieved on the site due to spatial constraints and steep slopes present.

SECTION 5.0: OPERATIONS AND MAINTENANCE MANUAL

The proposed storm drainage system consists of a detention vaults, dispersion trench, buried pipes, catch basins, and Perfilter water quality treatment units. These facilities will require periodic maintenance and inspection. Maintenance of the landscaping/grass within the Creekside project boundaries will be the responsibility of the homeowners. This is consistent with the maintenance requirements for other landscaping elements in ROW described in Marysville Municipal Code 12.12 SIDEWALKS – MAINTENANCE BY ABUTTING OWNERS. The City would take responsibility for any other operation and maintenance tasks, including annual inspections. Inspection and maintenance procedures are contained on the following pages and have been taken from the 2019 DOE Manual.

No. 8 – Detention Tanks and Vaults			
Component	Potential Defect	Condition When Maintenance is Needed	Maintenance Action and Expected Results
Storage Area	Plugged Air Vents	<ul style="list-style-type: none"> One-half of the cross section of a vent is blocked at any point or the vent is damaged. 	<ul style="list-style-type: none"> Vents open and functioning.
	Debris and Sediment	<ul style="list-style-type: none"> Accumulated sediment depth exceeds 10% of the diameter of the storage area for 1/2 length of storage vault or any point depth exceeds 15% of diameter. Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank. 	<ul style="list-style-type: none"> All sediment, debris, and organic matter removed from storage area.
	Joints Between Tank Section	<ul style="list-style-type: none"> Any openings or voids at section joint allowing material to seep into or water to leak out of facility. This may need an engineering analysis to assess the structural stability. 	<ul style="list-style-type: none"> All joints between tank sections are sealed.
	Tank Bent Out of Shape	<ul style="list-style-type: none"> Any part of tank is bent out of shape more than 10% of its design shape. This may need an engineering analysis to assess the structural stability. 	<ul style="list-style-type: none"> Tank section is repaired or replaced to design.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	<ul style="list-style-type: none"> Cracks wider than 1/2-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls. 	<ul style="list-style-type: none"> Vault replaced or repaired to design specifications and is structurally sound. No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe.

No. 8 – Detention Tanks and Vaults			
Component	Potential Defect	Condition When Maintenance is Needed	Maintenance Action and Expected Results
Access Hole	Cover Not in Place	<ul style="list-style-type: none"> Cover is missing or only partially in place. Any open manhole requires maintenance. 	<ul style="list-style-type: none"> Cover is in place.
	Locking Mechanism Not Working	<ul style="list-style-type: none"> Locking mechanism cannot be opened or lock bolts cannot be removed by one maintenance person with proper hand tools. 	<ul style="list-style-type: none"> Mechanism or lock bolts open with proper hand tools.
	Cover Difficult to Remove	<ul style="list-style-type: none"> One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools. Intent is to keep cover from sealing off access to maintenance. 	<ul style="list-style-type: none"> Cover can be removed and reinstalled by one maintenance person with proper hand tools.
		<ul style="list-style-type: none"> Ladder is unsafe due to missing rungs, cracked/broken rungs, and misalignment, rungs not securely attached to structure wall, rust, or cracks. 	<ul style="list-style-type: none"> Ladder meets design standards and allows maintenance person safe access.

CAUTION: A detention tank or vault is considered an enclosed space where harmful chemicals and gasses can accumulate. Therefore, the inspection and maintenance of these facilities should be conducted by individuals trained and certified to work in confined spaces under hazardous conditions.

Maintenance Standards

No. 6 – Energy Dissipaters			
Component	Potential Defect	Condition When Maintenance is Needed	Maintenance Action and Expected Results
Rock Pad	Missing or Moved Rock	<ul style="list-style-type: none"> Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil where pad was originally installed 	<ul style="list-style-type: none"> Rock pad replaced to design standards
	Erosion	<ul style="list-style-type: none"> Soil erosion in or adjacent to rock pad 	<ul style="list-style-type: none"> Rock pad replaced to design standards
Rock Gabion Structures	Wire basket matrix deteriorated or broken	<ul style="list-style-type: none"> Deterioration determined to be near to breaking Broken wire results in hole large enough to allow rocks to protrude out of basket 	<ul style="list-style-type: none"> Rewire area of concern or replace basket and/or rocks as necessary
	Wire basket misaligned	<ul style="list-style-type: none"> Baskets have shifted and no longer providing full energy dissipations or may be prone to tipping or collapse 	<ul style="list-style-type: none"> Realign or relocate as necessary to meet design intent
Dispersion Trench	Perforated Pipe Plugged with Sediment	<ul style="list-style-type: none"> Accumulated sediment that exceeds 20% of the design depth or over 1/3 of perforations in pipe are plugged 	<ul style="list-style-type: none"> Pipe cleaned/flushed so that it matches design
	Not Discharging Water Properly	<ul style="list-style-type: none"> Water in receiving area is causing or has potential of causing landslide problems. Water is observed or reported to be flowing out of top of basin during any storm less than the design storm. 	<ul style="list-style-type: none"> Trench redesigned or rebuilt to standards
	Receiving Area Over-Saturated “Distributor” Catch Basin Overflows	<ul style="list-style-type: none"> Water in receiving area is causing or has potential of causing landslide problems. Water is observed or reported to be flowing out of top of basin during any storm less than the design storm. 	<ul style="list-style-type: none"> Facility rebuilt or redesigned to standards.
	Receiving Area Over-Saturated	<ul style="list-style-type: none"> Water in receiving area is causing or has potential of causing landslide problems. 	<ul style="list-style-type: none"> No danger of landslides.

Maintenance Standards

No. 2 – Conveyance Storm Pipes			
Component	Potential Defect	Condition When Maintenance is Needed	Maintenance Action and Expected Results
General	Obstructions, Including Roots	<ul style="list-style-type: none"> • Root enters or deforms pipe, reducing flow. 	<ul style="list-style-type: none"> • Use mechanical methods to remove root if possible. Use of chemicals to remove roots shall be done in accordance with applicable regulations. If necessary, remove the vegetation over the pipe.
		<ul style="list-style-type: none"> • Pipe Dented or Broken 	<ul style="list-style-type: none"> • Inlet/outlet piping damaged or broken and in need of repair.
		<ul style="list-style-type: none"> • Pipe Rusted or Deteriorated 	<ul style="list-style-type: none"> • Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.
		<ul style="list-style-type: none"> • Sediment & Debris 	<ul style="list-style-type: none"> • Sediment depth is greater than 20% of pipe diameter.
		<ul style="list-style-type: none"> • Debris barrier or Trash Rack Missing 	<ul style="list-style-type: none"> • A debris barrier or trash rack that had been installed on the end of a drainage pipe is missing
		<ul style="list-style-type: none"> • Joint/Seal Problems 	<ul style="list-style-type: none"> • The joint between pipe sections is separated and/or the seal at the joint is cracked or broken.

Common Maintenance Considerations

The most common equipment for cleaning catch basins is a heavy-duty, combination power-washing and vacuum truck, also known as a vactor truck. It provides high-pressure washing for the walls and the bottom of catch basins and a high-power vacuum for removing water that is mixed with sediment, oil, grease, gasoline, vegetation debris, and trash. Generally this is the best and most effective way to clean catch basins.

Refer to the table below titled No. 1 – Catch Basins for maintenance standards.

Maintenance Standards

No. 1 – Catch Basins			
Component	Potential Defect	Condition When Maintenance is Needed	Maintenance Action and Expected Results
General	Sediment & Debris	<ul style="list-style-type: none"> Sediment, trash, and/or other debris material is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%. 	<ul style="list-style-type: none"> No sediment or debris is located immediately in front of catch basin or on grate opening.
		<ul style="list-style-type: none"> Sediment, trash, and/or other debris material (located in the catch basin) exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe. Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height or pipe end blockage exceeds 33%. 	<ul style="list-style-type: none"> No sediment or debris is in the catch basin.
		<ul style="list-style-type: none"> Sediment, trash, and/or other debris material located in any inlet or outlet pipe is blocking more than 1/3 of its height. 	<ul style="list-style-type: none"> Inlet and outlet pipes are free of sediment and debris.

No. 1 – Catch Basins			
Component	Potential Defect	Condition When Maintenance is Needed	Maintenance Action and Expected Results
		<ul style="list-style-type: none"> • Dead animals or vegetation that impair catch basin function or that could generate odors that could cause complaints or dangerous gases (e.g., methane). 	<ul style="list-style-type: none"> • No dead animals or vegetation are present within the catch basin.
	Contaminants and Pollution	<ul style="list-style-type: none"> • Any evidence of oil, gasoline, contaminants or other pollutants • Note: Coordinate removal/cleanup with local and/or state water quality response agency. 	<ul style="list-style-type: none"> • Contaminants or pollutants are removed.
Structure	Structure Damage to Frame and/or Top Slab	<ul style="list-style-type: none"> • Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch (Intent is to make sure no material is seeping into the catch basin) • Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached 	<ul style="list-style-type: none"> • Top slab is free of holes and cracks. No water and/or soil is seeping into the catch basin • Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	<ul style="list-style-type: none"> • Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks, or qualified maintenance or inspection personnel determine that the vault is not structurally sound. • Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks. 	<ul style="list-style-type: none"> • Catch basin is replaced or repaired to design standards. • Pipe is regouted and secure at basin wall.

No. 1 – Catch Basins			
Component	Potential Defect	Condition When Maintenance is Needed	Maintenance Action and Expected Results
	Settlement/ Misalignment	<ul style="list-style-type: none"> • Settlement or misalignment of the catch basin causes a safety, function, or design problem. 	<ul style="list-style-type: none"> • Catch basin is replaced or repaired to design standards.
Access Hole Cover	Cover Not in Place	<ul style="list-style-type: none"> • Cover is missing or only partially in place. Any open catch basin requires maintenance. 	<ul style="list-style-type: none"> • Catch basin cover is fully in place
	Locking Mechanism Not Working	<ul style="list-style-type: none"> • Locking mechanism cannot be opened or lock bolts cannot be removed by one maintenance person with proper hand tools. 	<ul style="list-style-type: none"> • Mechanism or lock bolts open with proper hand tools.
	Cover Difficult to Remove	<ul style="list-style-type: none"> • One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools. Intent is keep cover from sealing off access to maintenance. 	<ul style="list-style-type: none"> • Cover can be removed and reinstalled by one maintenance person with proper hand tools.
	Metal grate damaged or missing (if applicable)	<ul style="list-style-type: none"> • Grate missing or broken member(s) of the grate. 	<ul style="list-style-type: none"> • Grate is in place and meets design standards.
Ladder	Ladder Rungs Unsafe	<ul style="list-style-type: none"> • Ladder is unsafe due to missing rungs, cracked/broken rungs, rungs not securely attached to basin wall, misalignment, rust, cracks, or sharp edges. 	<ul style="list-style-type: none"> • Ladder meets design standards and allows maintenance person safe access.

CAUTION: A catch basin may be considered an enclosed space where harmful chemicals and gasses can accumulate. Therefore, the inspection and maintenance of these structures should be conducted by individuals trained and certified to work in confined spaces under hazardous conditions.

SECTION 6.0: SPECIAL REPORTS AND STUDIES

The following reports have been conducted with past submittals or with reference to this project:

- Geotechnical Evaluation, Nelson Geotechnical Associates, Inc., dated October 5, 2022
- Critical Areas Report, Soundview Consultants, dated March 3, 2023