

EXHIBIT K

STORM DRAINAGE REPORT

Kitsap Transit North Base Heavy-Duty Maintenance Facility

Preliminary Drainage Report

Prepared for

Kitsap Transit
60 Washington Ave
Suite 200
Bremerton, WA 98337

Prepared by



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Jesse Jarrell, PE



December 2024

Job No: C23-159

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APPENDICES

#	Title
1	Project Overview
3	Resource Review
4	Hydrology and WWHM Modeling
5	Conveyance Analysis

SECTION 1: PROJECT OVERVIEW

The Kitsap Transit North Base project proposes the development of a 15,400 SF maintenance facility, a 2,900 SF shared space, new vehicular pavements for driveway and parking areas, utility installation, stormwater management systems and landscaping. The current property is partially developed with an operational building to remain, parking lot, and lawn owned by Kitsap Transit. The project site consists of parcel #102601-1-004-2007 and lies within the North-East quarter of Section 10, Township 26 N, Range 1 E within the City of Poulsbo. The property is addressed 21711 Vetter Road Northeast, Poulsbo, Washington 98370.

EXISTING SITE

The existing site consists of parcel #102601-1-004-2007. The site currently contains an operational building, parking lot, and lawn. The undeveloped portions of the site are mostly pasture with a small amount of light brush and forest. A new roadway was constructed south and southeast of the project site as part of the Ruth Haines Roadway Project connecting Vetter Road NW and Viking Avenue NW; the project also included stormwater improvements along with the roadway construction. Consequently, a portion of the onsite south area has been acquired as public Right-of-Way. There is a bypass line conveying upstream runoff from the north parcel through the northeast ditch running along the east border of the site, connecting to the existing storm system to the south. The bypass line will remain post-development to convey upstream runoff. According to the preliminary geotechnical engineering report, dated October 23, 2023, by GeoEngineers, Inc, the site soils are consistent with glacial till with a design infiltration rate of 0.1 in/hr. The existing topography of the project site descends from the north, east, and west towards the south portion of the site. The subject property is zoned Light Industrial.

DOWNSTREAM ANALYSIS

Stormwater from the site generally flows towards the center of the site where it is collected by an existing catch basin. An upstream bioretention pond overflow also outfalls towards this culvert. Site runoff flows south in the through existing bypass conveyance constructed with the adjacent Ruth Haines Road project. Flows are then routed to an existing storm detention pond constructed with a Park and Ride facility, which discharges to a stream and associated wetland flows to Dogfish Creek, ultimately outflowing into the Puget Sound.

PROPOSED DEVELOPMENT

The Kitsap Transit North Base project proposes the development of a 15,400 SF maintenance facility, a 2,900 SF shared space, new vehicular pavements for driveway and parking areas, utility installation, stormwater management systems, and landscaping. The project site will access Vetter Road NW and Viking

Ave NW via the north and south driveway accesses. Runoff associated with the project is contained within a single Threshold Discharge Area (TDA). As such, the project is proposing an underground detention vault in the southeast parking lot to provide flow control mitigation prior to release to the existing storm line. Total disturbance associated with proposed project improvements is estimated at 134,550 SF, or 3.09 acres, including 107,986 SF, or 2.48 acres, of new/replaced hard surface areas. All existing vegetation will be cleared within the clearing limits, and any conflicting structures will be demolished as part of the development. See section 4.0 for further discussion regarding the stormwater management proposed.

PROPOSED FLOW CONTROL

The proposed project adheres to the requirements of the 2019 Department of Ecology (DOE) Stormwater Management Manual for Western Washington (SWMMWW) in addition to City of Poulsbo Code and Engineering Standards. Due to more than 10,000 sf of new/replaced hardscape being proposed for the project, Minimum Requirements 1-9 apply to the project. Minimum Requirement #7 (flow control) will be met via a detention facility.

In accordance with the 2019 DOE SWMMWW, List #2 BMPs will be utilized to the extent feasible to fulfill minimum requirement #5 Onsite Stormwater Management. See Section 4 for additional description and calculations concerning the proposed stormwater measures.

PROPOSED WATER QUALITY

As proposed new/replaced pollution-generating impervious surfaces (PGIS) exceed the 5,000 sf PGIS threshold per Minimum Requirement #6, water quality treatment will be required. The project is required to provide "Enhanced" Level for water treatment given the nature of the proposed maintenance facility. Water quality treatment for all captured runoffs will be provided by means of a Contech BioPod Biofiltration System upstream of the detention vault. See Section 4 for additional description and calculations concerning the proposed stormwater measures.

EROSION/SEDIMENTATION CONTROL

Erosion control measures that will be utilized during construction will be provided in the SWPPP and TESC plan sheets.

MINIMUM REQUIREMENTS

This project is proposing 107,986 sf (2.48 AC) of new/replaced hardscape. Per the 2019 DOE SWMMWW, Minimum Requirements 1-9 apply to the proposed development activities.

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) will be 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. The maintenance facility shall self-contain all contaminants and pollutants.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls:

The proposed improvements to the site include one onsite discharge location that lies within a single TDA. The site historically flows from north to south overland. In the developed condition, all onsite stormwaters will be collected via catch basins, where it will be conveyed to the detention vault and ultimately conveyed to the existing conveyance system and detention system constructed as part of the Ruth Haines Roadway project. All developed runoff will maintain historical flow paths by discharging to a stream and associated wetland flows into Dogfish Creek, and ultimately making its way to the Puget Sound.

Minimum Requirement #5: Onsite Stormwater Management:

LID techniques per list #2 requirements were considered for stormwater management in accordance with this minimum requirement.

According to the Preliminary Geotechnical Engineering Report, dated October 23rd, 2023, by GeoEngineers, site soils are Glacial Till as observed in all ten test pits. Infiltration evaluation for site stormwater management states that infiltration is not ideal due to shallow depths of observed glacial till. See section 4 for further discussion on List #2 LID BMP feasibility.

Minimum Requirement #6: Runoff Treatment:

As the proposed new/replaced PGIS of 79,413 SF (1.82 AC) exceeds the 5,000 SF PGIS threshold per Minimum Requirement #6, water quality treatment will be required. The project is required to provide "Enhanced" Level of Water Quality treatment given the nature of the maintenance facility. Water quality treatment for all captured runoff will be provided by means of an Oldcastle Infrastructure BioPod Bioretention System upstream of the detention vault. See Section 4 for additional description and calculations concerning the proposed stormwater measures.

Minimum Requirement #7: Flow Control:

Flow control is required for this project, as proposed new/replaced impervious surfaces of 107,986 SF exceeds the 10,000 SF threshold per the 2019 DOE SWMMWW. The project proposes a detention vault in the southeast corner of the parking lot to meet flow control requirements. Section 4 for additional discussion and associated calculations for proposed stormwater mitigation measures.

Minimum Requirement #8: Wetlands Protection:

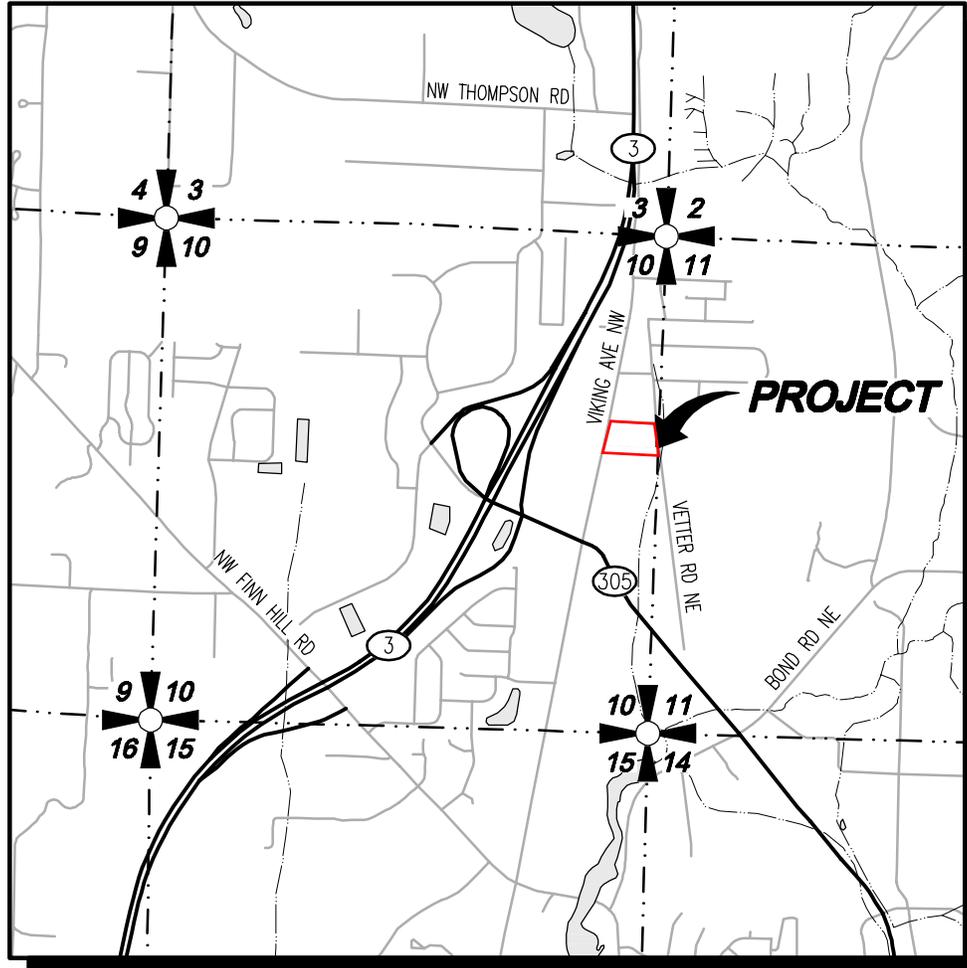
This produces associated runoff flows that enters an offsite wetland within the quarter-mile downstream flow path. Stormwater runoff flows and drainage patterns being discharged into this wetland will not be altered due to the proposed developments of this project.

Minimum Requirement #9: Operation and Maintenance:

See Operations and Maintenance in Section 6 of this report.

Appendix 1: Project Overview

1. Figure 1 – Vicinity Map
2. Figure 2 - Flowchart
3. Figure 2 – Existing Conditions Map
4. Figure 3 – Developed Conditions Map



VICINITY MAP

SCALE: 1" = 2000'

Drawing: P:\Civil\2022\C22-143 Ruth Haines Roadway Design\Drawings\Exhibits\C22143E-VI.dwg Plotted: May 18, 2022 - 7:59am

LDC

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Engineering
Planning

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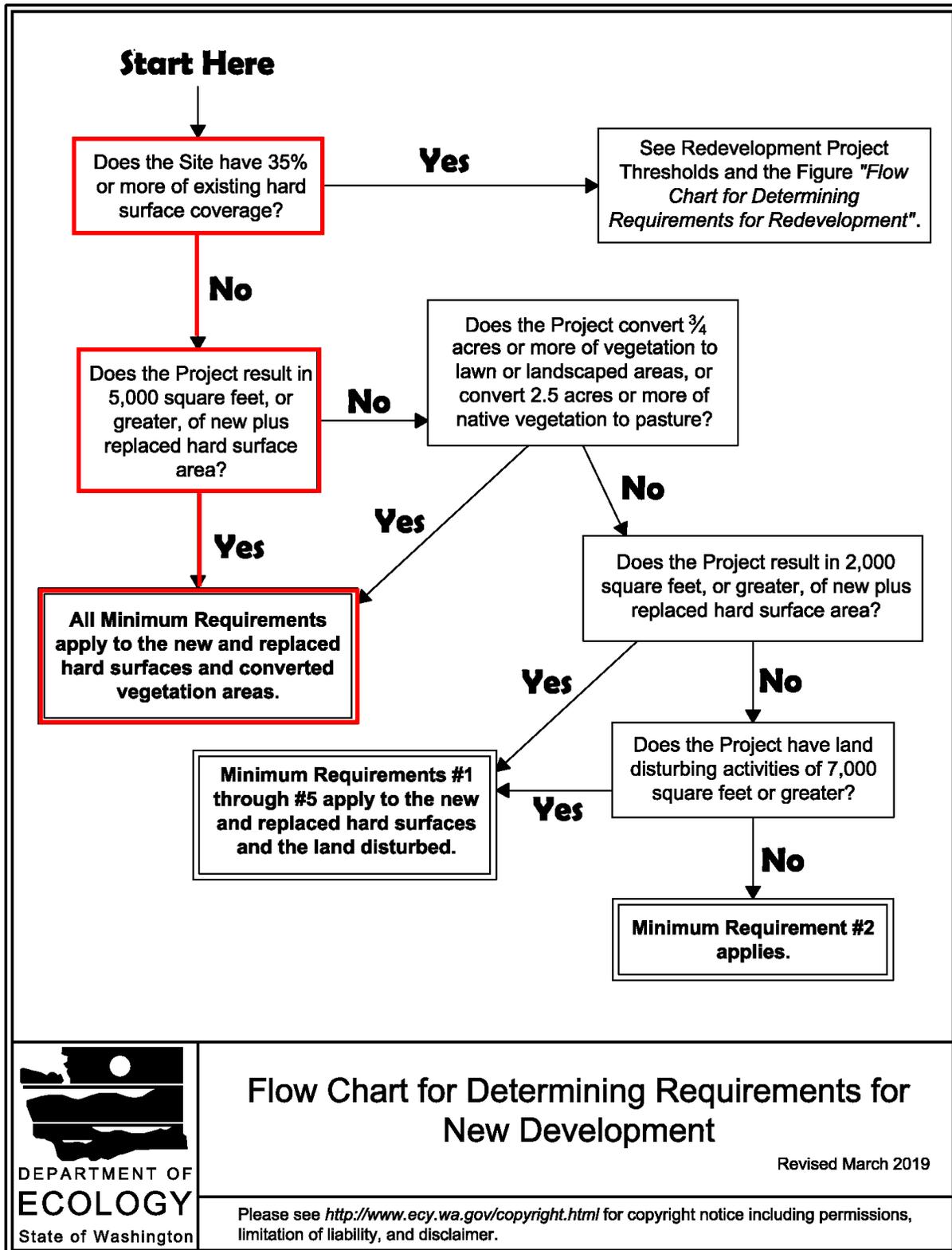
F 425.482.2893

KITSAP TRANSIT

RUTH HAINES

VICINITY MAP

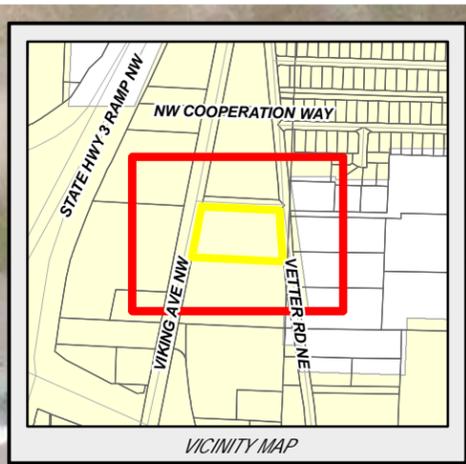
Figure I-3.1: Flow Chart for Determining Requirements for New Development



Flow Chart for Determining Requirements for New Development

Revised March 2019

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LEGEND

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

0 100 200
Scale in Feet



PUBLIC R/W FROM RUTH HAINES ROADWAY PROJECT

KITSAP TRANSIT
NORTH BASE
MAINTENANCE FACILITY
EXISTING CONDITIONS

MAD 1983 HARN
STATEPLANE WASHINGTON
NORTH FIPS 4601 FEET

REVISION:
JOB NUMBER: C23-159
DRAWING NAME: C23-159-2.0
DESIGNER: CTIWEYANG
DRAWING BY: CTIWEYANG
DATE: 4/18/2024
SCALE: AS SHOWN
JURISDICTION: POULSBORO

FIGURE: 2.0

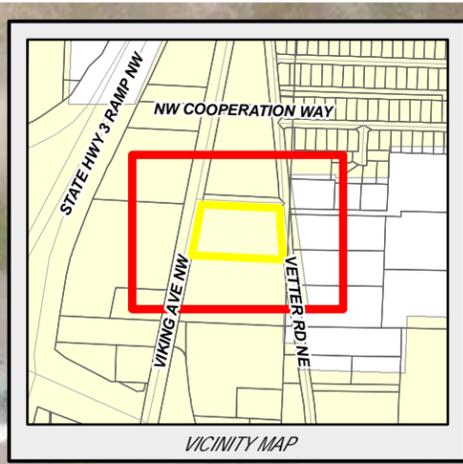
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SOURCE INFORMATION	
SOURCE AGENCY	DESCRIPTION
KITSAP COUNTY GIS	PARCEL BOUNDARY



LEGEND

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

0 100 200
Scale in Feet

VIKING AVE NW

VETTER RD NE

PUBLIC R/W FROM RUTH HAINES ROADWAY PROJECT

SOURCE INFORMATION	
SOURCE AGENCY	DESCRIPTION
KITSAP COUNTY GIS	PARCEL BOUNDARY

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Kent
1851 Central Pl S, #101
Kent, WA 98030

KITSAP TRANSIT
NORTH BASE
MAINTENANCE FACILITY
PROPOSED DEVELOPMENT MAP

NAD 1983 HARN STATEPLANE WASHINGTON NORTH FIPS 4601 FEET	
REVISION:	
JOB NUMBER: C23-159	
DRAWING NAME: C23-159-3.0	
DESIGNER: CTIWEIYANG	
DRAWING BY: CTIWEIYANG	
DATE: 4/18/2024	
SCALE: AS SHOWN	
JURISDICTION: POULSBO	

FIGURE:
3.0

SECTION 2: 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 DOE SWMMWW. 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 sheet ER-01 of the construction plans for locations and associated details.

Element #2 – Establish Construction Access: Existing paved roadway areas providing access to the southerly adjacent transit facility from Viking Ave NW and Vetter Road NW will be utilized for construction access. Gravel construction entrance(s), if necessary, may be constructed from the edge of existing access roads to provide access to the project site.

Element #3 – Control Flow Rates: Flow rates will be controlled during construction through check dams, interceptor dike and swales, and a temporary detention pond until the site is stabilized and permanent detention facilities have been constructed.

Element #4 – Install Sediment Controls: Storm drain inlet protection, silt fencing, and silt dams at existing/proposed culvert intakes will be utilized to contain sediments within the clearing limits. See sheet ER-01 of the construction plans for locations and details.

Element #5 – Stabilize Soils: Any exposed soils will be stabilized with plastic covering, mulching and/or temporary and permanent seeding.

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

Element #7 – Protect Drain Inlets: All storm drain inlets shall be protected throughout all stages of construction. See sheet ER-01 of the construction plans for locations and details.

Element #8 – Stabilize Channels and Outlets: Temporary channels/concentrated outlets are not proposed as part of this project, as construction-period runoff is expected to be minimal.

Element #9 – Control Pollutants: Pollutants shall be controlled as specified in the provided SWPPP document.

Element #10 – Control De-Watering: De-watering activities are not anticipated as part of this project. If necessary, disposal options for de-watering water are as specified in the SWPPP document.

Element #11 – Maintain BMPs: Maintenance of the BMPs is specified within the Construction Sequence and provided SWPPP documents.

Element #12: Manage the Project: Seasonal work limitations, project sequencing/record-keeping procedures, and maintenance of the BMPs is specified within the Construction Sequence and SWPPP documents.

Element #13: Protect LID BMPs: Clearing limits, along with associated sediment controls, shall be implemented as indicated on the erosion control plans to limit sedimentation and avoid unnecessary soil compaction that would adversely affect existing bioretention facilities.

SECTION 3: DOWNSTREAM ANALYSIS REPORT

Task 1. Study Area Definition and Maps

Kitsap County Bare Earth LiDAR, Kitsap County GIS data, topographic survey, and 2012 aerial photography were the best topographical references available for the area containing the site. The limits of the downstream analysis extend roughly 0.25 miles beyond the subject property's natural discharge location (See Figure 3, Downstream Analysis Map).

Task 2. Resource Review

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

- **Drainage Basin**

This site is located within the Dogfish Creek watershed. Discharge from the proposed development will discharge through an unnamed wetland to Dogfish Creek. Dogfish Creek is tributary to the Puget Sound.

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

According to FEMA floodplain mapping, the subject property is not within a floodplain. Reference the FEMA Firmette in Appendix 3.

- **Critical Areas**

According to the Kitsap County Critical Areas Map there is a wetland downstream of the project site. This agrees with the GIS data gathered and used for preliminary site analysis. As this project proposes to provide appropriate water quality and flow control measures no adverse effects on this wetland are expected. See Appendix 3 for Kitsap County Critical Areas map.

- **Drainage Complaints**

There are no known drainage complaints near the project site.

- **NRCS Soil Survey**

According to the NRCS Soil Survey, the site soils are consistent with Norma fine sandy loam and Poulsbo gravelly sandy loam. According to Geotechnical Investigation performed by GeoEngineers dated October 23rd, 2023, the project site contains glacial till soils covered by silty sands and fill soils. Infiltration is not ideal for this site but can be used with a conservative infiltration rate and onsite soil verification during construction.

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

Washington State Department of Ecology's Water Quality Assessment for Washington contains two Category 5 listings for Dogfish Creek which is the first assessed waterbody downstream from the site. Dogfish Creek has category 5 listings for Dissolved Oxygen and Temperature, this creek eventually flows into the Puget Sound. The listings for Dogfish creek can be found in Appendix 3 of this report. No additional BMPs will be warranted due to these findings.

Task 3. Field Inspection/Downstream Analysis (See Figure 3, Appendix 3)

On April 7th, 2022, a Downstream Analysis was performed at the site. The weather consisted of 68°F, Sunny. The following observations were verified during the visit.

The subject property consists of approximately 3.09 acres and is currently partially developed with an operational facility and parking.

Onsite Basins:

The site consists of one onsite basin, with one natural existing discharge path in its partially developed state. Flow in the existing conditions is considered to convey overland towards the local depression in the center of the site before exiting via existing storm drainpipe to the south. In the developed condition, hard surface flows will be collected and conveyed to a onsite detention facility before entering the existing conveyance system to the south towards the historical flow path. The entire site lies within the Dogfish Creek. See Figure 3, "Downstream Analysis Map" for map exhibits of the discharge locations. The flow path is described below.

Flow Path:

Surface water flows south through the developed subject property storm network until out falling along the southern property line. Images 1-3 track runoff through the onsite existing storm network. Upon exiting the site all flows convey south via existing wetlands and the Type-F waterbody named Dogfish Creek. Images 4-5 track runoff as it leaves the site and crosses the ¼ mile boundary of analysis. Dogfish Creek eventually enters the Puget Sound

Task 4. Drainage System Description and Problem Descriptions

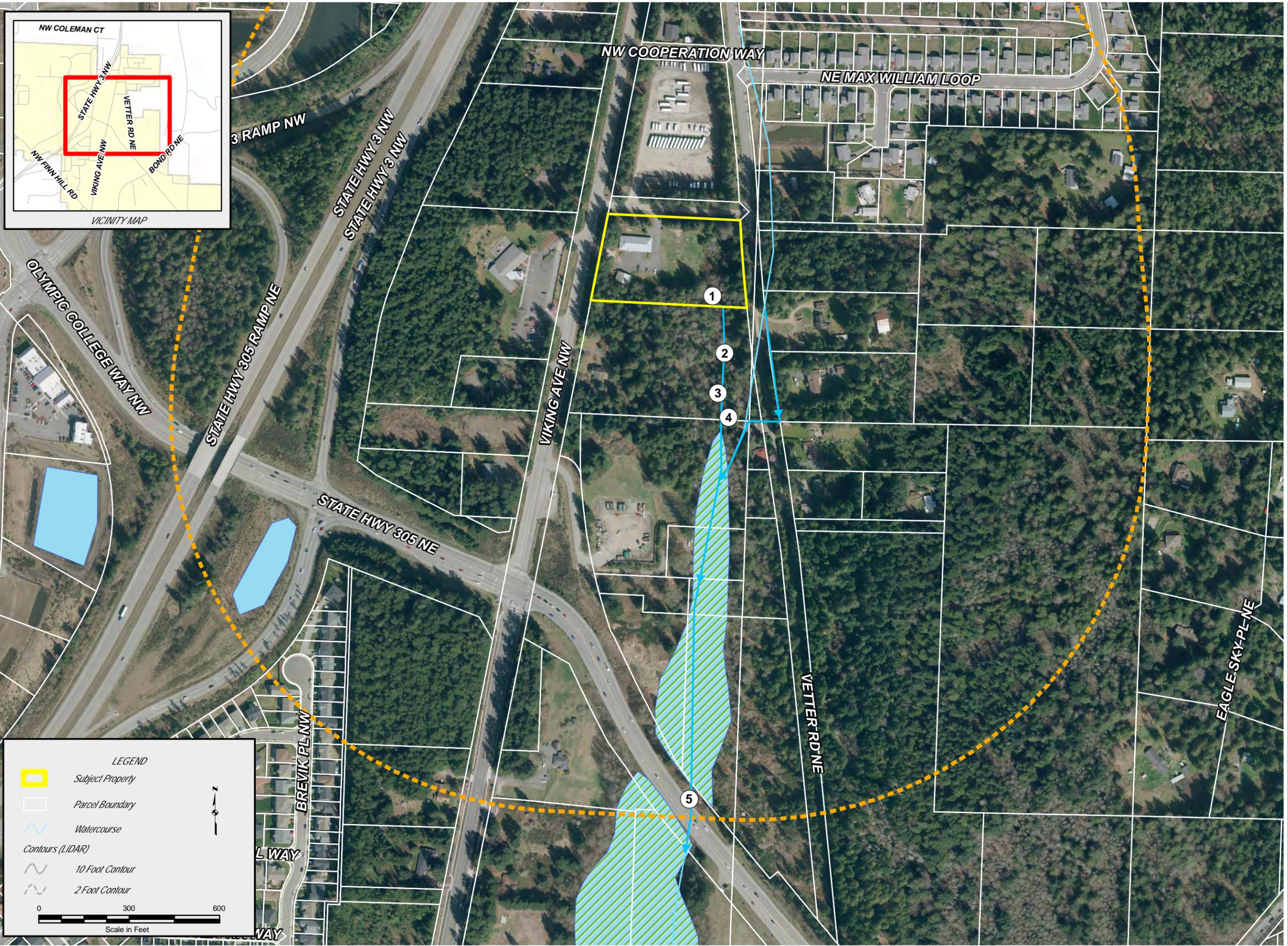
Based on the information and all the resources available including visual inspection of the downstream flow path, there is no evidence of existing or anticipated downstream drainage problems. All flows are adequately carried into/through existing drainage structures/conveyances.

Task 5. Mitigation of Existing or Potential Drainage Problems

No evidence of existing or potential problems with upstream or downstream drainage conveyances/infrastructure was found. Mitigation is not required.

Appendix 3: Resource Review

1. Figure 4 - Downstream Analysis Map
2. Site Visit Pictures
3. Kitsap County Critical Areas Map
4. FEMA Floodplain Map – Panel #53035C0094F
5. USDA Soils Map
6. USDA Soils Description
7. 303d Listings



LEGEND

- Subject Property
- Parcel Boundary
- ~ Watercourse
- Contours (LiDAR)
- ~ 10 Foot Contour
- ~ 2 Foot Contour

0 300 600
Scale in Feet

N
↑

NW COLEMAN CT
STATE HWY 3 NW
VETTER RD NE
BOND RD NE
VIKING AVE NW
NW FINN HILL RD
VICINITY MAP

SOURCE INFORMATION	
SOURCE AGENCY	DESCRIPTION
KITSAP COUNTY GIS	PARCEL BOUNDARY

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KITSAP TRANSIT
 NORTH BASE MAINTENANCE FACILITY
 DOWNSTREAM ANALYSIS

NAD 1983 HARN
 STATEPLANE WASHINGTON
 NORTH FIPS 4601 FEET

REVISION:
JOB NUMBER: C23-159
DRAWING NAME: C23-159-4.0
DESIGNER: SBRUNK
DRAWING BY: SBRUNK
DATE: 10/1/2024
SCALE: AS SHOWN
JURISDICTION: POULSBO

FIGURE:
4.0

Site Visit Pictures



Image 1: Facing South from north or project corridor. Outfall from upstream bioswale and inlet located within corridor shown.



Image 2: Facing north from the manhole downstream of the inlet pictured in Image 1.

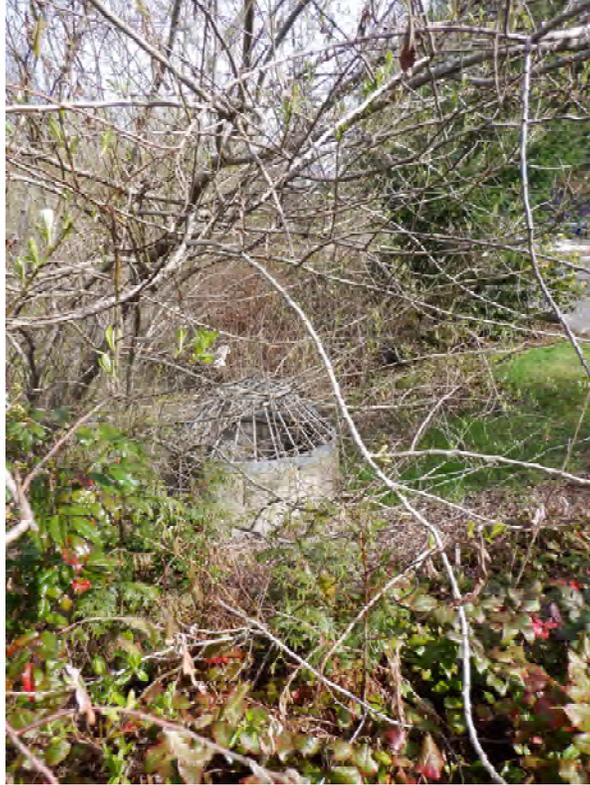


Image 3: North facing view of the southern most onsite structure. Acts as collection for outfall and emergency overflow for bioretention ponds.



Image 4: South facing view of the offsite wetland which all site flows outlet to. Specific outlet pipe could not be located due to inaccessibility of wetland.



Image 5: North facing view of the wetland flows pass through from the State Hwy 305 NE crossing.
Wetland could not be accessed due to land ownership and terrain.

Critical Areas

KITSAP COUNTY

Washington

Geologically Hazardous Areas

High

High Geological Hazard Areas described:

Areas of HIGH EROSION HAZARD:

- Channel Migration Zones, as mapped by the Washington Department of Ecology;
- Coastal erosion with a sediment source rating value of 0.6 to 1.0, per the Prioritization Analysis of Sediment Sources in Kitsap County

Areas of HIGH LANDSLIDE HAZARD:

- Shallow landslide areas with Factor of Safety (FS) of 0.5 to 1.5. FS is a method (Harp, 2006) for slope stability based on the angle of the slope from LIDAR elevation data and strength parameters.
- Areas with slopes greater to or equal to 30 percent in grade and deemed by a qualified geologist or geotechnical engineer to meet the criteria of U, UOS, or URS.
- All deep-seated landslides areas.

Areas of high seismic hazard are those areas with faults that have evidence of rupture at the ground surface.

Moderate

Moderate Geological Hazard Areas described:

Areas of MODERATE EROSION HAZARD AREA:

- Areas identified as geologically hazardous for soil erosion (soil type and slope grade) by NRCS Kitsap County Soil Survey;
- Slopes 15 percent or greater, not classified as I, U, UOS, or URS, with soils classified by the U.S. Department of Agriculture NRCS as "highly erodible" or "potentially highly erodible";
- Coastal erosion with a sediment source rating value of 0.3 to 0.6 per the Prioritization Analysis of Sediment Sources in Kitsap County

Areas of MODERATE LANDSLIDE AREA:

- Shallow landslide areas with FS of 1.5 to 2.5
- Slopes of 15 percent or greater and not classified as I, U, UOS, or URS, with soils classified by the U.S. Department of Agriculture NRCS as "highly erodible" or "potentially highly erodible"; or slopes of 15 percent or greater with springs or groundwater seepage
- Slopes in all areas equal to or greater than 40 percent.

Areas of MODERATE SEISMIC HAZARD:

- Areas susceptible to seismically induced soil liquefaction, such as hydric soils as identified by the NRCS, and areas that have been filled to make a site more suitable for development. This may include former wetlands that have been covered with fill.
- Areas identified as Seismic Site Class D, E, and F.
- Faults without recognized evidence of rupture at the ground surface.

Waterbodies

Bay, estuary, Puget Sound

Lake, Pond, Reservoir, Gravel pit or quarry filled with water

Watercourses

(defined in WAC 222-16-030)

Fish Habitat Water Type Code

- (S) Shoreline of the State
- (F) Fish Habitat
- (N) Non-fish Habitat
- (U) Unknown, unmodeled hydrographic feature.

Potential Wetlands

Marsh, wetland, swamp, bog

Wetland data from Department of Natural Resources, National Wetland Inventory and Kitsap County Surveys

Hydric Soils

Soils in the DNRSCS survey area. Hydric soils include: Bellingham silty clay loam, McKenna gravelly loam, Mukiteo peat, Norma fine sandy loam, Semiamoo muck, Shalcar muck, Shelton-McKenna complex, 0-10 percent flood and Talcora silt loam

FEMA Flood Zone

High Risk - Coastal Area Zones

Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves.

High Risk Areas Zones A, AE

Zone A: Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage.

Zone AE: The base floodplain where base flood elevations are provided.

Unincorporated Urban Growth Area

Incorporated City

Tax Parcels (Full Ownership)

Salt Water Tidelands

Street Center Lines

State Highway

Major Road

Collector / Arterial

Railroad Lines

Ferry Routes

Ferry Terminals

JEFFERSON COUNTY

MASON COUNTY

PIERCE COUNTY

This map was created from existing map sources, not from field surveys. Determination of fitness for use lies with the user, as does the responsibility for understanding the accuracy and limitations of this map and data.

The information on this map may have been collected from various sources and can change over time without notice.

While great care was taken in making this map, there is no guarantee or warranty of its accuracy as to labeling, placement or location of any geographic features present. This map is intended for informational purposes only and is not a substitute for a field survey.

Kitsap County and its officials and employees assume no responsibility or legal liability for the accuracy, completeness, reliability, or timeliness of any information on this map.

Critical Areas described by Kitsap County Critical Areas Ordinance
Kitsap County Code Title 19

Map Published Date: April 27, 2017

THIS MAP IS FOR INFORMATIONAL AND ILLUSTRATIVE PURPOSES ONLY AND MY DIFFER FROM THE OFFICIAL CRITICAL AREAS MAPS FOR THE INCORPORATED CITIES WITHIN KITSAP COUNTY

This map depicts Critical Areas, as defined in Title 19 Kitsap County Code (Critical Areas Ordinance), and is for informational and illustrative purposes only (WAC 365-190-080).

This map includes:

- Wetlands (Chapter 19.200 KCC)
- Fish and Wildlife Habitat Conservation Areas (Chapter 19.300 KCC) - Streams, lakes, waterbodies ONLY
- Geologically Hazardous Areas (Chapter 19.400 KCC)
- Frequently Flooded Areas (Chapter 19.500 KCC)

This map does NOT include:

- Critical Aquifer Recharge Areas (Chapter 19.600 KCC). Please see separate Critical Aquifer Recharge Areas map. This critical area applies primarily to commercial, industrial, and mining uses.
- Fish and Wildlife Habitat Conservation Areas (Chapter 19.300 KCC), other than streams and lakes.

Please see the Priority Habitats and Species maps and database provided by the Washington Department of Fish and Wildlife (<http://wdfw.wa.gov/conservation/pdfs/>) for the most recent information on Class 1 and Class 2 Fish and Wildlife Habitat Conservation Areas.

Scale of Miles



Kitsap County Department of Community Development

614 Division Street, MS-36 Port Orchard, Washington 98366

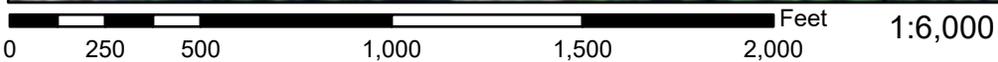
(360) 337-5777 <https://pdp.kitsapgov.com/icc/Pages/default.aspx>
Product of Kitsap County Geographic Information System



National Flood Hazard Layer FIRMette



122°39'20"W 47°45'50"N



122°38'43"W 47°45'26"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

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

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		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 Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
OTHER FEATURES		Levee, Dike, or Floodwall
		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
MAP PANELS		17.5 Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		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

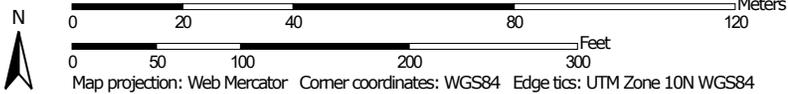
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 4/1/2022 at 2:16 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new 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.

Soil Map—Kitsap County Area, Washington



Map Scale: 1:1,360 if printed on A landscape (11" x 8.5") 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: Kitsap County Area, Washington
 Survey Area Data: Version 17, Aug 31, 2021

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

Date(s) aerial images were photographed: Nov 21, 2021—Nov 29, 2021

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
37	Norma fine sandy loam	2.0	20.1%
39	Poulsbo gravelly sandy loam, 0 to 6 percent slopes	7.8	79.9%
Totals for Area of Interest		9.8	100.0%

Kitsap County Area, Washington

39—Poulsbo gravelly sandy loam, 0 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2y5vm

Elevation: 0 to 490 feet

Mean annual precipitation: 35 inches

Mean annual air temperature: 50 degrees F

Frost-free period: 210 days

Farmland classification: Prime farmland if irrigated

Map Unit Composition

Poulsbo and similar soils: 95 percent

Minor components: 5 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Poulsbo

Setting

Landform: Terraces, moraines

Parent material: Basal till with volcanic ash in the upper part

Typical profile

H1 - 0 to 2 inches: gravelly ashy sandy loam

H2 - 2 to 24 inches: gravelly ashy sandy loam

H3 - 24 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 0 to 6 percent

Depth to restrictive feature: 20 to 40 inches to densic material

Drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)

Depth to water table: About 12 to 30 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4s

Hydrologic Soil Group: B/D

Ecological site: F002XA004WA - Puget Lowlands Forest

Forage suitability group: Limited Depth Soils (G002XN302WA)

Other vegetative classification: Limited Depth Soils (G002XN302WA)

Hydric soil rating: No

Minor Components

Norma

Percent of map unit: 5 percent

Landform: Depressions

Other vegetative classification: Wet Soils (G002XN102WA)

Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Kitsap County Area, Washington

Survey Area Data: Version 17, Aug 31, 2021

Kitsap County Area, Washington

37—Norma fine sandy loam

Map Unit Setting

National map unit symbol: 2y5vl

Elevation: 0 to 1,000 feet

Mean annual precipitation: 35 to 60 inches

Mean annual air temperature: 48 to 52 degrees F

Frost-free period: 150 to 200 days

Farmland classification: Prime farmland if drained

Map Unit Composition

Norma and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Norma

Setting

Landform: Depressions

Parent material: Alluvium with some volcanic ash in the upper part

Typical profile

H1 - 0 to 8 inches: ashy fine sandy loam

H2 - 8 to 22 inches: fine sandy loam

H3 - 22 to 60 inches: stratified loamy sand to clay loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Poorly drained

Capacity of the most limiting layer to transmit water

(Ksat): Moderately high to high (0.57 to 1.98 in/hr)

Depth to water table: About 0 to 12 inches

Frequency of flooding: None

Frequency of ponding: Frequent

Available water supply, 0 to 60 inches: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 5w

Hydrologic Soil Group: B/D

Ecological site: F002XA007WA - Puget Lowlands Wet Forest

Forage suitability group: Wet Soils (G002XN102WA)

Other vegetative classification: Wet Soils (G002XN102WA)

Hydric soil rating: Yes

Minor Components

Mckenna

Percent of map unit: 5 percent

Landform: Depressions

Other vegetative classification: Wet Soils (G002XN102WA)

Hydric soil rating: Yes

Shalcar

Percent of map unit: 5 percent

Landform: Depressions

Other vegetative classification: Wet Soils (G002XN102WA)

Hydric soil rating: Yes

Bellingham, undrained

Percent of map unit: 5 percent

Landform: Depressions

Other vegetative classification: Wet Soils (G002XN102WA)

Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Kitsap County Area, Washington

Survey Area Data: Version 17, Aug 31, 2021

303d Listings

LISTING ID	CATEGORY 201	WATERBODY NAME	PARAMETER NAME
23529	5	DOGFISH CREEK	Dissolved Oxygen
73436	5	DOGFISH CREEK	Temperature

SECTION 4: Site Hydrology

4.1 Predeveloped Site Hydrology

As the existing onsite structures within the project boundaries do not total 35% or greater impervious land cover, the project is considered a new development. The pre-developed conditions are applied to all onsite landcover to be converted for development. All proposed project development is in a single TDA for both the predeveloped and developed conditions. For visual representation of the following existing conditions see Figure 5, "Predeveloped Hydrology Map".

In the predeveloped condition, the site is characterized by a single onsite basin which contains all areas which will be disturbed.

Predeveloped Onsite Basin:

The Onsite Basin totals 3.09 acres in the predeveloped condition and has been modeled in WWHM2012 as follows. See Appendix 4 for full WWHM2012 model results.

Table 4-1.1 – Predeveloped Basin Areas: Onsite Basin

Onsite Basin	
Land Cover	Area
Roof, Flat	0.09 AC
Forest, Flat	1.56 AC
Forest, Mod	0.93 AC
Forest, Steep	0.51 AC
Total	3.09 AC

4.2 Developed Site Hydrology

Proposed project improvements consist of stormwater infrastructure, new parking area, building area, and landscaping. The newly developed impervious surfaces will be collected and routed through the proposed detention facilities for detention and water quality treatment structure. The existing operational facility will remain post-development and runoff from this roof area will be connected into the proposed onsite conveyance system and routed to the proposed detention vault. The previous land cover has been modeled as pasture. Per Section 7.1 of the Low Impact Development Technical Guidance Manual for Puget Sound (LID Manual), referenced in Appendix III-C of the 2019 DOE SWMMWW, landscaped areas utilizing amended soils per BMP T5.13 may be modeled as pasture. All converted landscaped areas will be underlain

with BMP T5.13 soil mixtures in the developed condition and, as such, these areas have been modeled as pasture in WWHM2012.

In the developed condition, the site is characterized by a single onsite basin. Detailed breakdowns of developed areas and land coverage designations, as modeled in WWHM2012, are included in the subsections below. For visual representation of the following developed conditions see Figure 6, "Developed Hydrology Map".

Onsite Basin:

The Onsite Basin totals 3.09 AC in the developed condition and is comprised of all developed surfaces which are collected and mitigated onsite. Runoff within this basin will be routed into the detention facility for flow control mitigation. See Appendix 4 for a detailed WWHM2012 modeling summary. In the developed condition, the Onsite Basin has been modeled using WWHM2012 with the following areas:

Table 4-2.1 – Developed Condition Areas: Onsite Basin

Onsite Basin	
Land Cover	Area
Roads, Flat	1.82 AC
Sidewalks, Flat	0.14 AC
Roof, Flat	0.51 AC
Pasture, Flat	0.61 AC
Total	3.09 AC

4.3 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 SWMMWW was applied to the site to determine LID BMP feasibility. This section of the 2019 DOE SWMMWW directs projects triggering minimum requirements #1-9 to List #2 in section 1-2.5.5 as feasible. A summary of the BMPs as outlined in List #2 are listed below:

Lawn and Landscaped Areas:

1. Post-Construction Soil Quality and Depth: ***Feasible*** and will be applied to all landscaped areas in the developed condition via BMP T5.13.

Roofs:

1. BMP T5.30 Full Dispersion: ***Infeasible*** due to inability to provide sufficient vegetated flow path and proposed improvement area exceeding 10% of the total site area.
2. BMP T5.10A: Downspout Full Infiltration: ***Infeasible*** due to shallow depth to intact glacial till limiting infiltration capabilities.
3. BMP T7.30 Bioretention: ***Infeasible*** due to shallow depth to intact glacial till limiting infiltration capabilities.
4. BMP T5.10B Downspout Dispersion Systems: ***Infeasible*** due to spatial constraints limiting the ability to provide sufficient vegetated flow path.
5. BMP T5.10C Perforated Stub-Out Connections: ***Feasible*** and will be utilized for all stub-out connections.

Other Hard Surfaces:

1. BMP T5.30 Full Dispersion: ***Infeasible*** due to the inability to provide sufficient vegetated flow path and proposed improvements in excess of 10% of the total site area.
2. BMP T5.15 Permeable Pavement: ***Infeasible*** due to spatial constraints and shallow depth to intact glacial till limiting infiltration capabilities.
3. BMP T7.30 Bioretention: ***Infeasible*** due to spatial constraints and shallow depth to intact glacial till limiting infiltration capabilities.
4. Sheet Flow Dispersion and Concentrated Flow Dispersion: ***Infeasible*** due to spatial constraints limiting the ability to provide sufficient vegetated flow path.

4.4 Flow Control

Flow control is required for all new/replaced and tributary surfaces will be provided by means of the detention facility. The detention system will provide complete flow control of the developed site prior to conveyance into the existing underground storm system which travels through the adjacent park and ride development to the south.

Concrete Detention Vault

The proposed detention facility used for mitigating developed condition flows was designed in compliance with the 2019 DOE SWMMWW requirements 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 postdevelopment 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 postdevelopment 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

Modeled Footprint:	140' x 60' x 7.0'
Storage Volume Modeled:	1.115 AC-FT
Storage Volume Provided:	1.115 AC-FT
Riser Height:	6.0'
Live Storage Begins Elevation:	170.30'
Top of Live Storage Elevation:	176.30'
Orifice #1 Diameter (in):	1.3125"
Orifice #2 Diameter (in):	2.3125"
Orifice #3 Diameter (in):	1.46875"
Orifice #1 Height (ft):	0.00'
Orifice #2 Height (ft):	4.75'
Orifice #3 Height (ft):	5.46'

The following table provides a summary of flow rates and water surface elevations in the detention pond during various storm events.

Storm Event	Predeveloped Rate (cfs)	Unmitigated Rate (cfs)	Mitigated Rates (cfs)
2-Year	0.1562	1.1383	0.0856
10-Year	0.3501	1.6814	0.1623
50-Year	0.6074	2.2115	0.2641
100-Year	0.7467	2.4540	0.3197

Refer to Appendix 4 for WWHM detention sizing calculations.

4.5 Water Quality Treatment

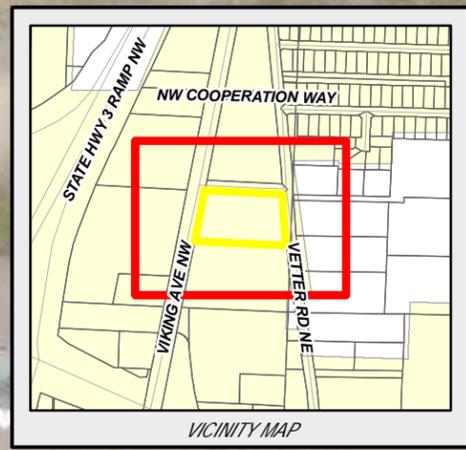
The proposed 8x12 BioPod Biofilter System (BioPod) will treat all runoff from all project developed surfaces. The BioPod system will be placed upstream of the detention facility and will treat all runoff in accordance with the "Enhanced" Water Quality Treatment up to 95% of the total runoff volume as determined by WWHM2012. The BioPod is "on-line" and has been sized to bypass the 100-year unmitigated peak flows internally. A summary of the treatment facility is provided below. See Appendix 4 for a full copy of WWHM2012 water quality calculations.

8'x12' BioPod Biofilter System

<i>Proposed Unit:</i>	<i>8'x12' BioPod Biofilter System</i>
<i>Tributary Area:</i>	<i>3.09 AC</i>
<i>Tributary PGIS Area:</i>	<i>1.82 AC</i>
<i>Off-line Water Quality Design Flow Rate:</i>	<i>0.2639 CFS</i>
<i>BioPod Treatment Capacity:</i>	<i>0.270 CFS</i>
<i>Peak Flow Rate (100-yr Unmitigated):</i>	<i>2.4779 CFS</i>
<i>BioPod Bypass Capacity:</i>	<i>6.5 CFS</i>

Appendix 4: Hydrology and WWHM Modeling

1. Figure 5 – Predeveloped Hydrology Map
2. Figure 6 – Developed Hydrology Map
3. WWHM2012 – Detention Vault Modeling Output
4. 8x12 BioPod Biofiltration System Detail



LEGEND

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

0 100 200
Scale in Feet

VIKING AVE NW

VETTER RD NE

PUBLIC R/W FROM RUTH HAINES ROADWAY PROJECT

Predeveloped Site Areas		
Land Cover	Area (SF)	Area (AC)
Roof, flat	4,000	0.09
Forest, flat	67,886	1.56
Forest, mod	40,471	0.93
Forest, steep	22,194	0.51
Total =	134,550	3.09

SOURCE INFORMATION

SOURCE AGENCY	DESCRIPTION
KITSAP COUNTY GIS	PARCEL BOUNDARY

LDC | Surveying
Engineering
Planning

Woodinville
20210 142nd Avenue NE
Woodinville, WA 98072
T: 425.386.1869 www.LDCcorp.com F: 425.482.2893

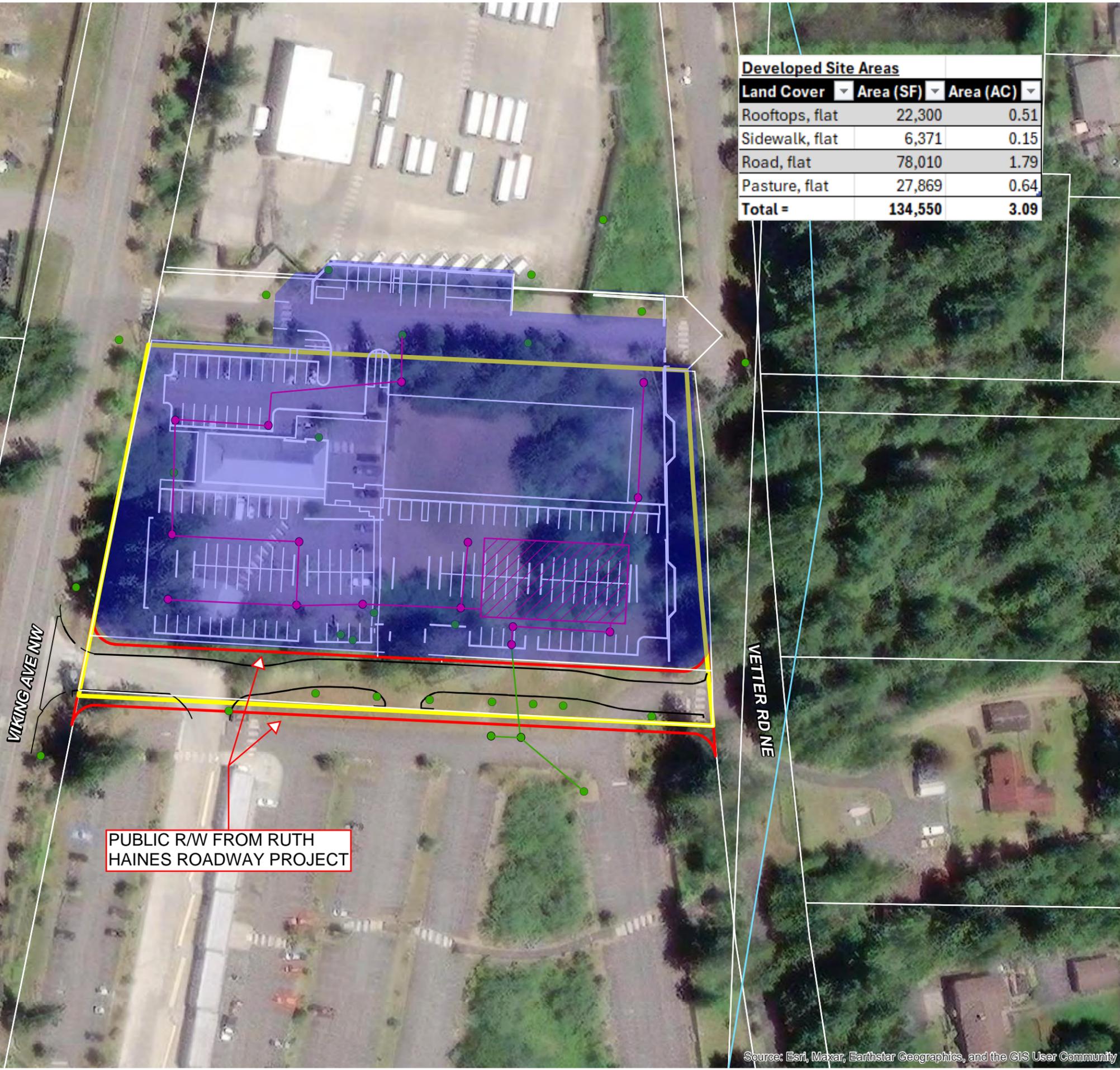
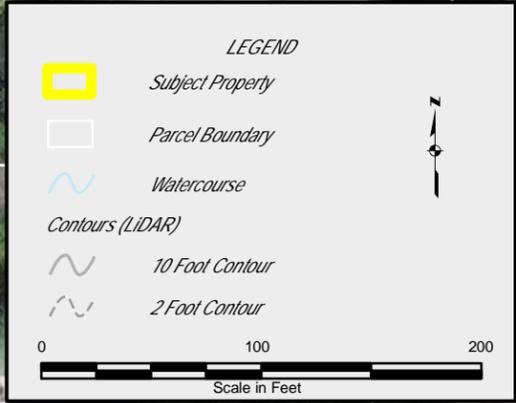
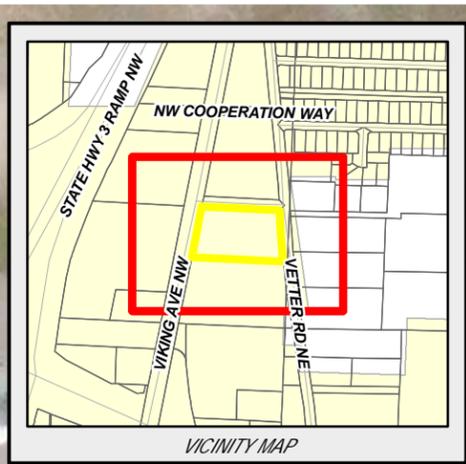
Kent
1851 Central Pl S, #101
Kent, WA 98030

KITSAP TRANSIT
NORTH BASE
MAINTENANCE FACILITY
PREDEVELOPED HYDROLOGY MAP

MAD 1983 HARN
STATEPLANE WASHINGTON
NORTH FIPS 4601 FEET

REVISION:
JOB NUMBER: C23-159
DRAWING NAME: C23-159-5.0
DESIGNER: CTIWEYANG
DRAWING BY: CTIWEYANG
DATE: 4/18/2024
SCALE: AS SHOWN
JURISDICTION: POULSBORO

FIGURE:
5.0



PUBLIC R/W FROM RUTH HAINES ROADWAY PROJECT

Developed Site Areas		
Land Cover	Area (SF)	Area (AC)
Rooftops, flat	22,300	0.51
Sidewalk, flat	6,371	0.15
Road, flat	78,010	1.79
Pasture, flat	27,869	0.64
Total =	134,550	3.09

KITSAP TRANSIT
NORTH BASE
MAINTENANCE FACILITY
DEVELOPED HYDROLOGY MAP

MAD 1983 HARN
STATEPLANE WASHINGTON
NORTH FIPS 4601 FEET

REVISION:
JOB NUMBER: C23-159
DRAWING NAME: C23-159-6.0
DESIGNER: CTIWEYANG
DRAWING BY: CTIWEYANG
DATE: 4/18/2024
SCALE: AS SHOWN
JURISDICTION: POULSBO

FIGURE:
6.0

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Planning

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Kent
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Kent, WA 98030

SOURCE INFORMATION

SOURCE AGENCY	DESCRIPTION
KITSAP COUNTY GIS	PARCEL BOUNDARY

Detention Vault WWHM2012 Modeling Summary

Contributing Basins

Basin 1 Mitigated ✖

Subbasin Name: Designate as Bypass for PDC:

Flows To : **Surface** **Interflow** **Groundwater**

Show Only Selected

Area in Basin			
Available Pervious	Acres	Available Impervious	Acres
<input type="checkbox"/> A/B, Forest, Flat	0	<input checked="" type="checkbox"/> ROADS/FLAT	1.82
<input type="checkbox"/> A/B, Forest, Mod	0	<input type="checkbox"/> ROADS/MOD	0
<input type="checkbox"/> A/B, Forest, Steep	0	<input type="checkbox"/> ROADS/STEEP	0
<input type="checkbox"/> A/B, Pasture, Flat	0	<input checked="" type="checkbox"/> ROOF TOPS/FLAT	0.51
<input type="checkbox"/> A/B, Pasture, Mod	0	<input type="checkbox"/> DRIVEWAYS/FLAT	0
<input type="checkbox"/> A/B, Pasture, Steep	0	<input type="checkbox"/> DRIVEWAYS/MOD	0
<input type="checkbox"/> A/B, Lawn, Flat	0	<input type="checkbox"/> DRIVEWAYS/STEEP	0
<input type="checkbox"/> A/B, Lawn, Mod	0	<input checked="" type="checkbox"/> SIDEWALKS/FLAT	0.15
<input type="checkbox"/> A/B, Lawn, Steep	0	<input type="checkbox"/> SIDEWALKS/MOD	0
<input checked="" type="checkbox"/> C, Forest, Flat	0	<input type="checkbox"/> SIDEWALKS/STEEP	0
<input checked="" type="checkbox"/> C, Forest, Mod	0	<input type="checkbox"/> PARKING/FLAT	0
<input checked="" type="checkbox"/> C, Forest, Steep	0	<input type="checkbox"/> PARKING/MOD	0
<input checked="" type="checkbox"/> C, Pasture, Flat	0.61	<input type="checkbox"/> PARKING/STEEP	0
<input type="checkbox"/> C, Pasture, Mod	0	<input type="checkbox"/> POND	0
<input type="checkbox"/> C, Pasture, Steep	0	<input type="checkbox"/> Porous Pavement	0
<input type="checkbox"/> C, Lawn, Flat	0		
<input type="checkbox"/> C, Lawn, Mod	0		
<input type="checkbox"/> C, Lawn, Steep	0		
<input type="checkbox"/> SAT, Forest, Flat	0		
<input type="checkbox"/> SAT, Forest, Mod	0		
<input type="checkbox"/> SAT, Forest, Steep	0		

Pervious Total Acres

Impervious Total Acres

Basin Total Acres

Deselect Zero **Select By:**

Detention System

WWHM2012
PROJECT REPORT

Project Name: C23-159 Vault Model
Site Name: North Base Heavy-Duty Maintenance Facility
Site Address: 21710 Vetter Rd NE
City : Poulsbo
Report Date: 12/02/2024
Gage : Seatac
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.17
Version Date: 2023/01/27
Version : 4.2.19

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Predeveloped
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Forest, Flat	1.56
C, Forest, Mod	.87
C, Forest, Steep	.57

Pervious Total 3

<u>Impervious Land Use</u>	<u>acre</u>
ROOF TOPS FLAT	0.09

Impervious Total 0.09

Basin Total 3.09

Element Flows To:
Surface

Interflow

Groundwater

MITIGATED LAND USE

Name : Developed
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Pasture, Flat	.61
Pervious Total	0.61
<u>Impervious Land Use</u>	<u>acre</u>
ROADS FLAT	1.82
ROOF TOPS FLAT	0.51
SIDEWALKS FLAT	0.15
Impervious Total	2.48
Basin Total	3.09

Element Flows To:

Surface	Interflow	Groundwater
Vault	Vault	

Name : Vault
Width : 60 ft.
Length : 140 ft.
Depth: 7 ft.
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 1.3125 in. **Elevation:** 0 ft.
Orifice 2 Diameter: 2.3125 in. **Elevation:** 4.75 ft.
Orifice 3 Diameter: 1.46875 in. **Elevation:** 5.46 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	0.192	0.000	0.000	0.000
0.0778	0.192	0.015	0.013	0.000
0.1556	0.192	0.030	0.018	0.000
0.2333	0.192	0.045	0.022	0.000

0.3111	0.192	0.060	0.026	0.000
0.3889	0.192	0.075	0.029	0.000
0.4667	0.192	0.090	0.031	0.000
0.5444	0.192	0.105	0.034	0.000
0.6222	0.192	0.120	0.036	0.000
0.7000	0.192	0.135	0.039	0.000
0.7778	0.192	0.150	0.041	0.000
0.8556	0.192	0.165	0.043	0.000
0.9333	0.192	0.180	0.045	0.000
1.0111	0.192	0.195	0.047	0.000
1.0889	0.192	0.210	0.048	0.000
1.1667	0.192	0.225	0.050	0.000
1.2444	0.192	0.240	0.052	0.000
1.3222	0.192	0.255	0.053	0.000
1.4000	0.192	0.270	0.055	0.000
1.4778	0.192	0.285	0.056	0.000
1.5556	0.192	0.300	0.058	0.000
1.6333	0.192	0.315	0.059	0.000
1.7111	0.192	0.330	0.061	0.000
1.7889	0.192	0.345	0.062	0.000
1.8667	0.192	0.360	0.063	0.000
1.9444	0.192	0.375	0.065	0.000
2.0222	0.192	0.390	0.066	0.000
2.1000	0.192	0.405	0.067	0.000
2.1778	0.192	0.420	0.069	0.000
2.2556	0.192	0.435	0.070	0.000
2.3333	0.192	0.450	0.071	0.000
2.4111	0.192	0.465	0.072	0.000
2.4889	0.192	0.480	0.073	0.000
2.5667	0.192	0.494	0.074	0.000
2.6444	0.192	0.509	0.076	0.000
2.7222	0.192	0.524	0.077	0.000
2.8000	0.192	0.539	0.078	0.000
2.8778	0.192	0.554	0.079	0.000
2.9556	0.192	0.569	0.080	0.000
3.0333	0.192	0.584	0.081	0.000
3.1111	0.192	0.599	0.082	0.000
3.1889	0.192	0.614	0.083	0.000
3.2667	0.192	0.629	0.084	0.000
3.3444	0.192	0.644	0.085	0.000
3.4222	0.192	0.659	0.086	0.000
3.5000	0.192	0.674	0.087	0.000
3.5778	0.192	0.689	0.088	0.000
3.6556	0.192	0.704	0.089	0.000
3.7333	0.192	0.719	0.090	0.000
3.8111	0.192	0.734	0.091	0.000
3.8889	0.192	0.749	0.092	0.000
3.9667	0.192	0.764	0.093	0.000
4.0444	0.192	0.779	0.094	0.000
4.1222	0.192	0.794	0.094	0.000
4.2000	0.192	0.809	0.095	0.000
4.2778	0.192	0.824	0.096	0.000
4.3556	0.192	0.839	0.097	0.000
4.4333	0.192	0.854	0.098	0.000
4.5111	0.192	0.869	0.099	0.000
4.5889	0.192	0.884	0.100	0.000
4.6667	0.192	0.899	0.101	0.000

4.7444	0.192	0.914	0.101	0.000
4.8222	0.192	0.929	0.141	0.000
4.9000	0.192	0.944	0.159	0.000
4.9778	0.192	0.959	0.173	0.000
5.0556	0.192	0.974	0.185	0.000
5.1333	0.192	0.989	0.195	0.000
5.2111	0.192	1.004	0.205	0.000
5.2889	0.192	1.019	0.214	0.000
5.3667	0.192	1.034	0.222	0.000
5.4444	0.192	1.049	0.230	0.000
5.5222	0.192	1.064	0.252	0.000
5.6000	0.192	1.079	0.266	0.000
5.6778	0.192	1.094	0.278	0.000
5.7556	0.192	1.109	0.289	0.000
5.8333	0.192	1.124	0.299	0.000
5.9111	0.192	1.139	0.309	0.000
5.9889	0.192	1.154	0.318	0.000
6.0667	0.192	1.169	0.601	0.000
6.1444	0.192	1.184	1.204	0.000
6.2222	0.192	1.199	1.980	0.000
6.3000	0.192	1.214	2.852	0.000
6.3778	0.192	1.229	3.745	0.000
6.4556	0.192	1.244	4.582	0.000
6.5333	0.192	1.259	5.298	0.000
6.6111	0.192	1.274	5.849	0.000
6.6889	0.192	1.289	6.236	0.000
6.7667	0.192	1.304	6.599	0.000
6.8444	0.192	1.319	6.913	0.000
6.9222	0.192	1.334	7.213	0.000
7.0000	0.192	1.349	7.500	0.000
7.0778	0.192	1.364	7.777	0.000
7.1556	0.000	0.000	8.044	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1

Total Pervious Area:3

Total Impervious Area:0.09

Mitigated Landuse Totals for POC #1

Total Pervious Area:0.61

Total Impervious Area:2.48

Flow Frequency Return Periods for Predeveloped. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.156231
5 year	0.261468
10 year	0.350074

25 year	0.48635
50 year	0.607362
100 year	0.746684

Flow Frequency Return Periods for Mitigated. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.085571
5 year	0.127805
10 year	0.163261
25 year	0.21795
50 year	0.266822
100 year	0.323529

Stream Protection Duration

Annual Peaks for Predeveloped and Mitigated. POC #1

<u>Year</u>	<u>Predeveloped</u>	<u>Mitigated</u>
1949	0.225	0.067
1950	0.235	0.082
1951	0.278	0.219
1952	0.111	0.059
1953	0.088	0.070
1954	0.113	0.078
1955	0.188	0.080
1956	0.165	0.087
1957	0.172	0.076
1958	0.136	0.079
1959	0.114	0.072
1960	0.240	0.180
1961	0.126	0.080
1962	0.083	0.056
1963	0.119	0.077
1964	0.154	0.073
1965	0.130	0.085
1966	0.102	0.071
1967	0.258	0.081
1968	0.151	0.072
1969	0.142	0.069
1970	0.131	0.070
1971	0.156	0.081
1972	0.220	0.096
1973	0.110	0.081
1974	0.151	0.080
1975	0.202	0.078
1976	0.145	0.079
1977	0.066	0.068
1978	0.120	0.079
1979	0.066	0.058
1980	0.369	0.188
1981	0.111	0.070
1982	0.267	0.098
1983	0.158	0.081
1984	0.108	0.064
1985	0.062	0.069
1986	0.236	0.093
1987	0.231	0.101
1988	0.098	0.066

1989	0.067	0.066
1990	0.642	0.148
1991	0.326	0.168
1992	0.136	0.079
1993	0.112	0.068
1994	0.058	0.056
1995	0.150	0.083
1996	0.357	0.222
1997	0.269	0.245
1998	0.128	0.070
1999	0.398	0.101
2000	0.120	0.084
2001	0.050	0.061
2002	0.168	0.096
2003	0.240	0.071
2004	0.264	0.254
2005	0.175	0.080
2006	0.169	0.081
2007	1.086	0.462
2008	0.499	0.256
2009	0.239	0.092

Stream Protection Duration

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	1.0862	0.4624
2	0.6419	0.2559
3	0.4986	0.2544
4	0.3979	0.2445
5	0.3688	0.2223
6	0.3568	0.2195
7	0.3262	0.1881
8	0.2776	0.1796
9	0.2689	0.1681
10	0.2668	0.1482
11	0.2642	0.1010
12	0.2578	0.1006
13	0.2401	0.0981
14	0.2400	0.0965
15	0.2392	0.0962
16	0.2358	0.0933
17	0.2347	0.0925
18	0.2307	0.0871
19	0.2253	0.0852
20	0.2199	0.0836
21	0.2019	0.0830
22	0.1878	0.0818
23	0.1754	0.0812
24	0.1718	0.0811
25	0.1690	0.0810
26	0.1680	0.0808
27	0.1649	0.0807
28	0.1583	0.0803
29	0.1562	0.0802
30	0.1538	0.0797
31	0.1510	0.0795

32	0.1507	0.0795
33	0.1497	0.0793
34	0.1451	0.0790
35	0.1415	0.0788
36	0.1363	0.0781
37	0.1356	0.0780
38	0.1313	0.0765
39	0.1304	0.0760
40	0.1276	0.0730
41	0.1259	0.0719
42	0.1197	0.0718
43	0.1197	0.0714
44	0.1188	0.0713
45	0.1140	0.0705
46	0.1135	0.0704
47	0.1125	0.0703
48	0.1112	0.0697
49	0.1105	0.0694
50	0.1097	0.0690
51	0.1076	0.0680
52	0.1023	0.0678
53	0.0983	0.0669
54	0.0883	0.0663
55	0.0833	0.0658
56	0.0671	0.0643
57	0.0664	0.0607
58	0.0657	0.0592
59	0.0623	0.0584
60	0.0577	0.0563
61	0.0495	0.0561

Stream Protection Duration

POC #1

The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0781	11717	11276	96	Pass
0.0835	10091	7266	72	Pass
0.0888	8609	5116	59	Pass
0.0942	7247	3065	42	Pass
0.0995	6280	1678	26	Pass
0.1048	5510	964	17	Pass
0.1102	4703	931	19	Pass
0.1155	4162	905	21	Pass
0.1209	3685	886	24	Pass
0.1262	3200	854	26	Pass
0.1316	2849	830	29	Pass
0.1369	2530	808	31	Pass
0.1423	2167	779	35	Pass
0.1476	1895	740	39	Pass
0.1530	1680	692	41	Pass
0.1583	1451	642	44	Pass
0.1637	1282	578	45	Pass
0.1690	1125	532	47	Pass

0.1743	996	483	48	Pass
0.1797	904	442	48	Pass
0.1850	819	398	48	Pass
0.1904	744	365	49	Pass
0.1957	667	327	49	Pass
0.2011	578	282	48	Pass
0.2064	506	241	47	Pass
0.2118	432	210	48	Pass
0.2171	353	170	48	Pass
0.2225	298	138	46	Pass
0.2278	254	117	46	Pass
0.2331	205	102	49	Pass
0.2385	170	94	55	Pass
0.2438	138	84	60	Pass
0.2492	115	74	64	Pass
0.2545	99	53	53	Pass
0.2599	77	46	59	Pass
0.2652	66	43	65	Pass
0.2706	51	42	82	Pass
0.2759	46	40	86	Pass
0.2813	43	37	86	Pass
0.2866	41	34	82	Pass
0.2920	38	31	81	Pass
0.2973	30	25	83	Pass
0.3026	27	22	81	Pass
0.3080	23	19	82	Pass
0.3133	20	14	70	Pass
0.3187	17	8	47	Pass
0.3240	15	7	46	Pass
0.3294	11	7	63	Pass
0.3347	11	6	54	Pass
0.3401	10	6	60	Pass
0.3454	9	6	66	Pass
0.3508	9	6	66	Pass
0.3561	9	6	66	Pass
0.3614	8	6	75	Pass
0.3668	8	6	75	Pass
0.3721	7	5	71	Pass
0.3775	7	5	71	Pass
0.3828	7	5	71	Pass
0.3882	7	5	71	Pass
0.3935	7	4	57	Pass
0.3989	6	4	66	Pass
0.4042	6	4	66	Pass
0.4096	5	4	80	Pass
0.4149	5	3	60	Pass
0.4203	5	3	60	Pass
0.4256	5	3	60	Pass
0.4309	5	3	60	Pass
0.4363	5	3	60	Pass
0.4416	5	3	60	Pass
0.4470	5	3	60	Pass
0.4523	5	2	40	Pass
0.4577	5	2	40	Pass
0.4630	5	0	0	Pass
0.4684	5	0	0	Pass
0.4737	5	0	0	Pass

0.4791	5	0	0	Pass
0.4844	5	0	0	Pass
0.4898	4	0	0	Pass
0.4951	4	0	0	Pass
0.5004	3	0	0	Pass
0.5058	3	0	0	Pass
0.5111	2	0	0	Pass
0.5165	2	0	0	Pass
0.5218	2	0	0	Pass
0.5272	2	0	0	Pass
0.5325	2	0	0	Pass
0.5379	2	0	0	Pass
0.5432	2	0	0	Pass
0.5486	2	0	0	Pass
0.5539	2	0	0	Pass
0.5592	2	0	0	Pass
0.5646	2	0	0	Pass
0.5699	2	0	0	Pass
0.5753	2	0	0	Pass
0.5806	2	0	0	Pass
0.5860	2	0	0	Pass
0.5913	2	0	0	Pass
0.5967	2	0	0	Pass
0.6020	2	0	0	Pass
0.6074	2	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.3722 acre-feet
On-line facility target flow: 0.4683 cfs.
Adjusted for 15 min: 0.4683 cfs.
Off-line facility target flow: 0.2639 cfs.
Adjusted for 15 min: 0.2639 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	(ac-ft)	(ac-ft)		Credit
Vault POC	N	466.85			N
0.00					
Total Volume Infiltrated		466.85	0.00	0.00	
0.00	0.00	0%	No Treat.	Credit	
Compliance with LID Standard 8					
Duration Analysis Result = Failed					

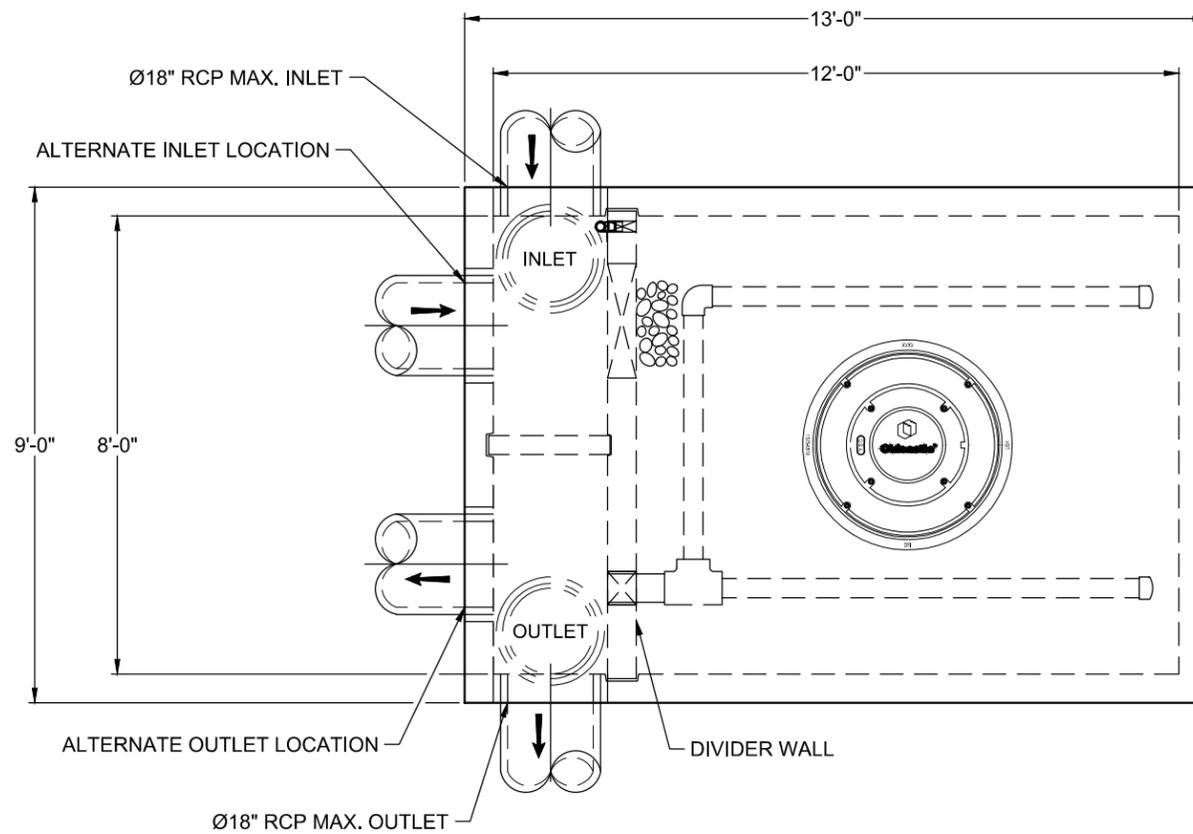
Perlnd and Implnd Changes

No changes have been made.

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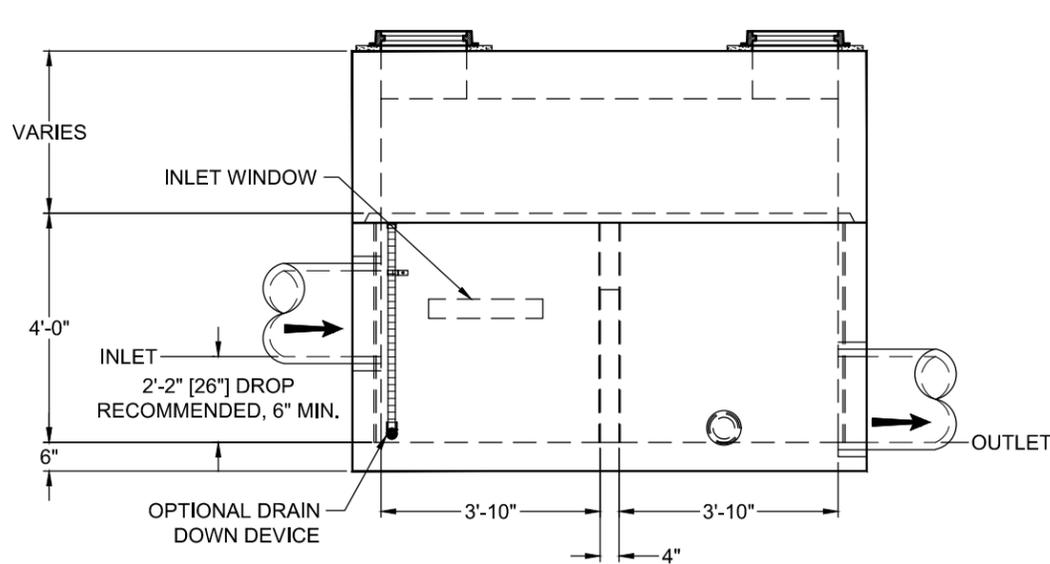
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SITE SPECIFIC DATA				
Structure ID	ID			
Treatment Flow Rate (cfs)	-			
Peak Flow Rate (cfs)	-			
Rim Elevation	-			
Top of Vault Elevation	-			
Pipe Data	Pipe Location	Pipe Size	Pipe Type	Invert Elevation
Inlet	-	-	-	-
Outlet	-	-	-	-
Notes:				
PERFORMANCE SPECIFICATIONS				
Treatment Flow Capacities:*				
NJDEP 80% Removal, 75 micron	0.304 cfs			
WA Ecology GULD - Basic, Enhanced & Phosphorus	0.270 cfs			
Bypass Capacity	6.5 cfs			
*Contact Oldcastle for alternative treatment flow capacities.				

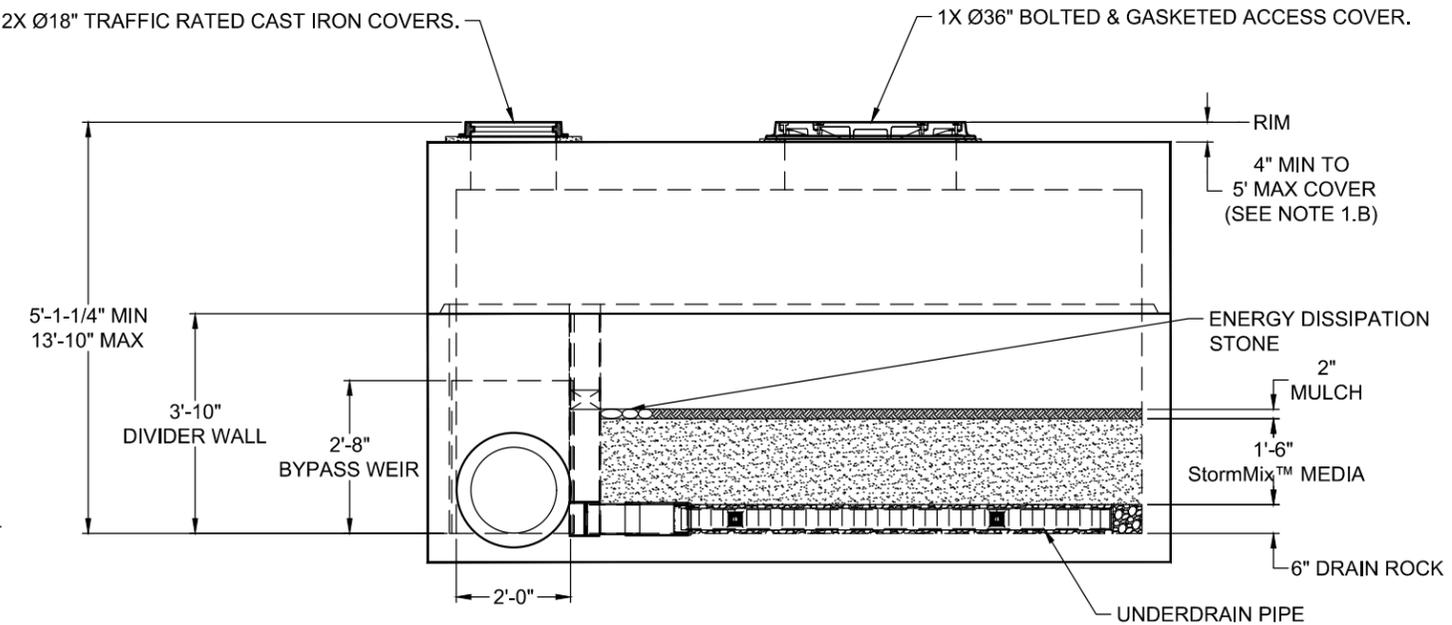


PLAN VIEW

2X Ø18" TRAFFIC RATED CAST IRON COVERS.
1X Ø36" BOLTED & GASKETED ACCESS COVER.



LEFT END VIEW



ELEVATION VIEW

NOTES:

- DESIGN LOADINGS:
 - AASHTO HS-20-44 (WITH IMPACT)
 - DESIGN SOIL COVER: 5'-0" MAXIMUM
 - ASSUMED WATER TABLE: BELOW BASE OF PRECAST (ENGINEER-OF-RECORD TO CONFIRM SITE WATER TABLE ELEVATION)
 - LATERAL EARTH PRESSURE: 45 PCF (DRAINED)
 - LATERAL LIVE LOAD SURCHARGE: 80 PSF (APPLIED TO 8'-0" BELOW GRADE)
 - NO LATERAL SURCHARGE FROM ADJACENT BUILDINGS, WALLS, PIERS, OR FOUNDATIONS.
- CONCRETE 28-DAY MINIMUM COMPRESSIVE STRENGTH: 5,000 PSI MINIMUM.
- REINFORCING: REBAR, ASTM A615/A706, GRADE 60
- CEMENT: ASTM C150
- REQUIRED ALLOWABLE SOIL BEARING CAPACITY: 2,500 PSF
- REFERENCE STANDARD:
 - ASTM C890
 - ASTM C913
 - ACI 318-14
- THIS STRUCTURE IS DESIGNED TO THE PARAMETERS NOTED HEREIN. ENGINEER-OF-RECORD SHALL VERIFY THAT NOTED PARAMETERS MEET OR EXCEED PROJECT REQUIREMENTS. IF DESIGN PARAMETERS ARE INCORRECT, REVIEWING ENGINEER/AUTHORITY SHALL NOTIFY OLDCASTLE INFRASTRUCTURE UPON REVIEW.
- INLET AND OUTLET HOLES WILL BE FACTORY CORED/CAST PER PLAN AND CUSTOMER REQUIREMENTS. INLET AND OUTLET LOCATIONS CAN BE MIRRORRED.
- CONTRACTOR RESPONSIBLE TO VERIFY ALL SIZES, LOCATIONS, AND ELEVATIONS OF OPENINGS.
- CONTRACTOR RESPONSIBLE TO ENSURE ADEQUATE BEARING SURFACE IS PROVIDED (I.E. COMPACTED AND LEVEL PER PROJECT SPECIFICATIONS).
- SECTION HEIGHTS, SLAB/WALL THICKNESSES, AND KEYWAYS ARE SUBJECT TO CHANGE AS REQUIRED FOR SITE REQUIREMENTS AND/OR DUE TO PRODUCT AVAILABILITY AND PRODUCTION FACILITY CONSTRAINTS.
- MAXIMUM PICK WEIGHTS*:
 - TOP: XX,XXX LBS
 - BASE: XX,XXX LBS* (* COMBINED WEIGHT OF BASE INCLUDES BYPASS WEIR, DIVIDER WALL, ROCK & MEDIA)
- INTERNALS SHALL CONSIST OF UNDERDRAIN PIPE, ROCK, STORMMIX™ MEDIA, MULCH, DIVIDER WALL, BYPASS WEIR AND OPTIONAL DRAIN DOWN.



Ph: 800.579.8819 | www.oldcastleinfrastructure.com/stormwater
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BioPod™ Biofilter System (STANDARD)
8' x 12' Underground with Internal Bypass

CUSTOMER	-	
PROJECT NAME	-	
SHEET NAME	REVISION	SHEET
Specifier Drawing BPU-812IB	REV DATE	1 OF 1



SECTION 5: CONVEYANCE ANALYSIS AND DESIGN

Conveyance Capacity Analysis

The proposed collection and conveyance systems are comprised of catch basins and pipe networks. Conveyance analysis has been performed for the proposed pipe network. A full conveyance analysis using the Rational method will be provided at a later submittal.

5.1 Downstream Discharge Line

The conveyance capacity analysis for the pipe downstream of the detention vault facility was performed as a Manning's Equation evaluation of the discharge pipe with the smallest diameter, shallowest slope, and largest flow capacity requirement. The pipe was analyzed against the peak 100-year mitigated flow. Analysis confirms an adequate design. See Section 4 and Appendix 4 for WWHM flow results used to determine 100-yr flow. The following is a summary of the Manning's analysis performed on the Detention Facility discharge line:

Pipe Diameter:	12"
Pipe Slope:	0.50%
100-year Peak Discharge Rate:	0.3235 CFS (WWHM2012 801 Series)
Flow Depth:	0.24' (2.88")
Evaluation:	System Adequate

Appendix 5: Conveyance Analysis

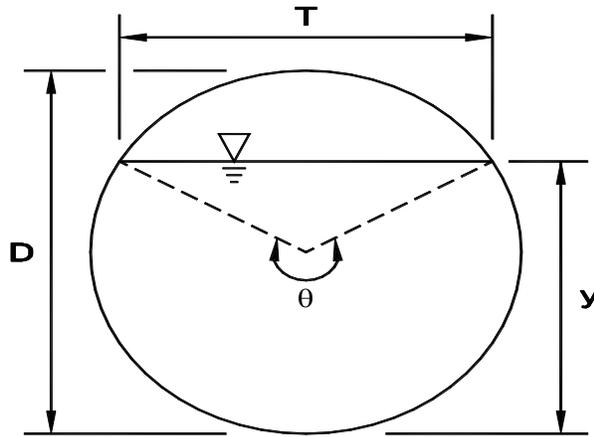
1. Manning's Analysis: Downstream Discharge

Open Channel Flow Calculator For Circular Pipes	<i>Land Development Consultants, Inc.</i>	
	14201 NE 200th St. Ste. 100 Woodinville, WA 98072	Tel: (425) 806-1869 Fax: (425) 482-2893

Project Name: Kitsap Transit North Base
Description: Downstream Discharge Line

Project No.: C23-159
Date: 6/18/2024
Calc. By: CTJR

Pipe Diameter (D) = 12 in
Pipe Slope (S) = 0.50 %
Flow Depth (y) = 0.24 ft
Flowrate (Q) = 0.32 cfs
Mannings Coeff. (n) = 0.013
Theta Angle (θ) = 2.06 rad
Wetted Area (A) = 0.15 ft²
Wet. Perimeter (P) = 1.03 ft
Hydraulic Radius (R) = 0.14 ft
Top Width (T) = 0.86 ft
Flow Velocity = 2.21 fps



Formulas:

Theta Angle (θ): If $y \geq r$: $\theta = 2\pi - 2a \cos\left(\frac{y-r}{r}\right)$ where: r = Pipe Radius

If $y \leq r$: $\theta = 2a \cos\left(\frac{r-y}{r}\right)$ where: r = Pipe Radius

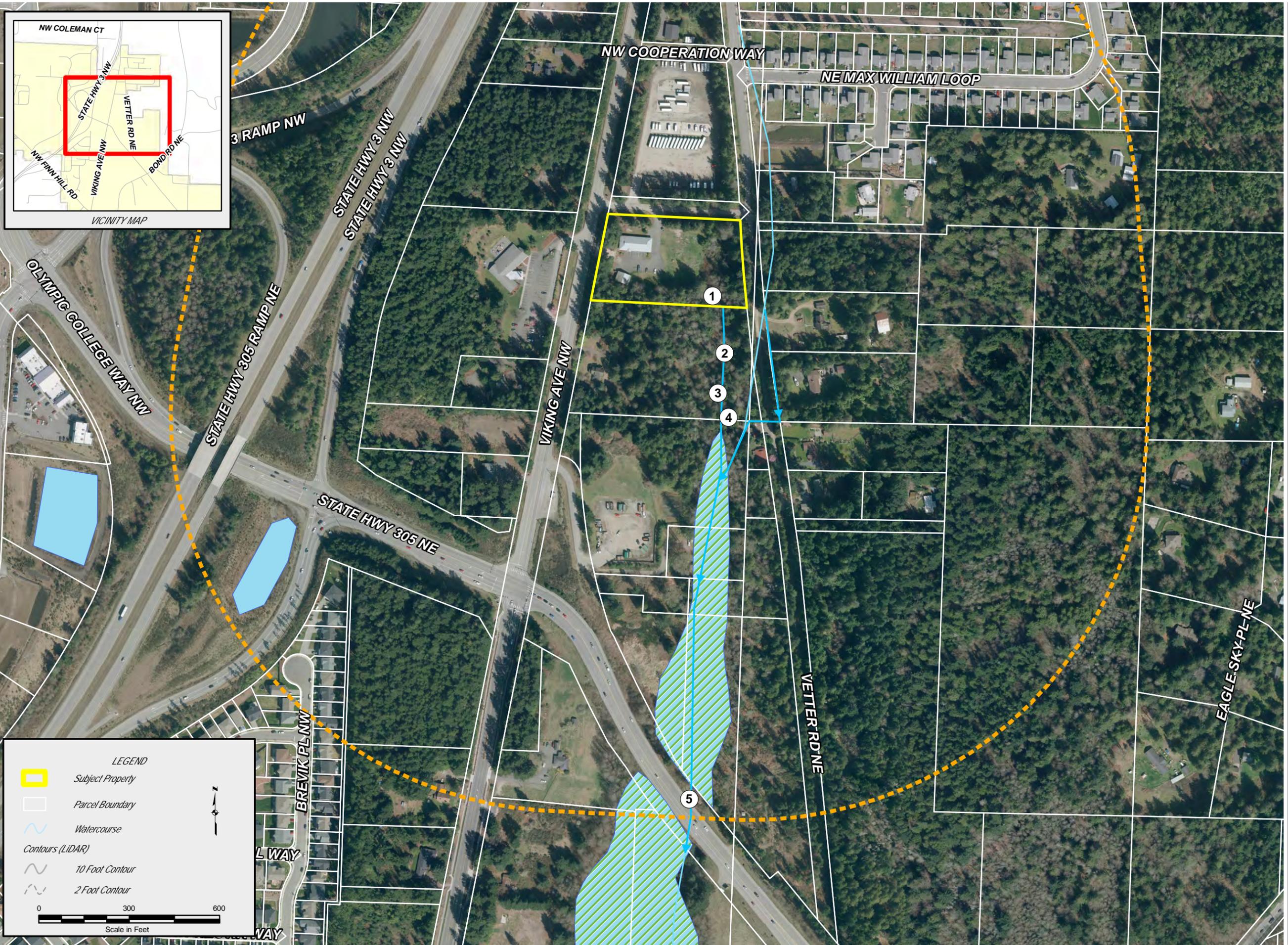
Wetted Area (A): $A = \frac{1}{8}(\theta - \sin \theta)d^2$

Wetted Perimeter (P): $P = \frac{1}{2}\theta d$

Hydraulic Radius (R): $R = \frac{A}{P}$

Top Width (T): $T = \sin\left(\frac{\theta}{2}\right)d$

Downstream Map.mxd | MOD: 10/17/2024 | sbrunk



LEGEND

- Subject Property
- Parcel Boundary
- ~ Watercourse
- Contours (LiDAR)
- ~ 10 Foot Contour
- ~ 2 Foot Contour

0 300 600
Scale in Feet

N
↑

NW COLEMAN CT
STATE HWY 3 NW
VETTER RD NE
BOND RD NE
VIKING AVE NW
NW FINN HILL RD
VICINITY MAP

SOURCE INFORMATION	
SOURCE AGENCY	DESCRIPTION
KITSAP COUNTY GIS	PARCEL BOUNDARY

LDC
 Surveying
 Engineering
 Planning

Woodinville
 20210 142nd Avenue NE
 Woodinville, WA 98072
 T: 425.386.1889

Kent
 1851 Central Pl S, #101
 Kent, WA 98030
 www.LDCcorp.com
 F: 425.482.2893

KITSAP TRANSIT
 NORTH BASE MAINTENANCE FACILITY
 DOWNSTREAM ANALYSIS

NAD 1983 HARN
 STATEPLANE WASHINGTON
 NORTH FIPS 4601 FEET

REVISION:
JOB NUMBER: C23-159
DRAWING NAME: C23-159-4.0
DESIGNER: SBRUNK
DRAWING BY: SBRUNK
DATE: 10/1/2024
SCALE: AS SHOWN
JURISDICTION: POULSBO

FIGURE:
4.0

SECTION 6: OPERATIONS AND MAINTENANCE MANUAL

The proposed storm drainage system consists of buried pipes, catch basins, an Oldcastle Infrastructure BioPod Biofiltration System, and a buried detention facility. These facilities will require periodic maintenance and inspection. Inspection and maintenance procedures will be provided during the full construction design.

SECTION 7: SPECIAL REPORTS AND STUDIES

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

- Preliminary Geotechnical Engineering Report, GeoEngineers., dated April 23, 2023